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Banks' Risk Taking Behavior and the Optimization Monetary Policy

Risna Triandhari[1], Sugiharso Safuan[2], M. Syamsudin[3], Halim Alamsyah[4]

Abstract:

This study analyzes the behavior of risk taking on economic agents such as banks, households, and firms as a repond of monetary policy and macroprudential choices in Indonesia. The behavior of economic agents modeled in a DSGE models.

In the model, the credit risk is modeled endogenously. Credit risk is a function of household and firm leverage ratio, bank leverage ratio, property market and general economy condition. Moreover, there are two types of bank in assessing the risks of credit.

The results show that, endogenous credit risk, has an impact on the deepen procyclicality in credit. Furthermore, this research model contributes to a deeper understanding of the prudential policy framework. In the event of risk taking, analysis optimal policy responses using the loss function of central banks.

The policy of lower interest rates should be combined with a loan to value ratio policy and increase CAR to generate the smallest losses

Keywords: *risk taking behaviour, DSGE model, monetary policy.*

JEL: *E43, E52, C60.*

[1]*Doctoral Student, Graduate Program in Economics, Department of Economics, Faculty of Economics and Business, Universitas Indonesia, E-mail : risna.triandhari@ui.ac.id*
[2]*Corresponding author, Department of Economics, Faculty of Economics and Business, Universitas Indonesia, E-mail: sugiharso@ui.ac.id*
[3]*Department of Mathematics, Bandung Institute of Technology.*
[4]*Indonesia Deposit Insurance Corporation*

1. Introduction

The Global Crisis raises the debate between the link of short-term interest rates and bank risk-taking, also known as monetary policy's 'risk-taking' channel – the notion that interest rate policy not just affect the quantity of bank credits, yet also the quality. Borrio and Zhu (2008), Adrian Shin (2009) suggested that monetary policy affect bank risk-taking behavior. For this reason, it is important to do the analysis of behaviour agents economy such as banks, households, and firms on risk-taking in the transmission mechanism of monetary policy. Research on risk-taking behavior is increasing [5], but there are two elements that remain. Firstly, the element that provide a basic understanding of the pragmatic macroeconomic framework that models the behavior of banks to provide credit, which is related to credit risk. Secondly, the element of micro-data that indicates the period of the risk-taking behavior.

This study use dynamic stochastic general equilibrium (DSGE) model to capture the behaviour of agents economy, which holds the character of risk taking behavior that models the nature of the bank influenced by leverage ratio, property market conditions and general economic conditions. The main feature of our framework is to model risk-taking behavior by an endogenous credit risk[6]. The fundamental result of the model expresses some evidence.

First, an indication of balance sheet that show the ratio of bank debt on the balance sheet of households, which increased in value from 2002 to 2013. Second, a behavior model that explains risk-taking through the credit risk and the demeanor of banks in assessing credit risk are proposed. Precisely, the discovery in this paper is the endogenous credit risk and bank model that focuses on the future exacerbates procyclicality of credit condition. In risk taking behavior, optimal monetary policy is an outcome from central bank interest rate and macroprudential policy combination. The result show that BI rate policy joint with macroprudential policy generate the smallest loss.

This paper is structured as follows. Section 2 analyze the role of the banking sector in Indonesia's economy and the period of risk taking behaviour. Section 3 presents our model. In Section 4, usage of model and policy implication. Finally, section 5 concludes the results and findings in this paper.

2. The Risk Taking Behaviour in Indonesia

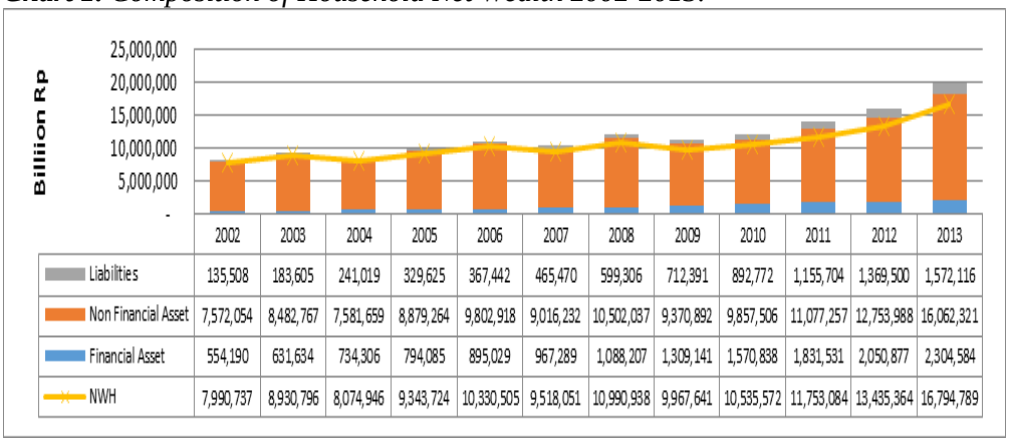
[5]*Altunbas et al. (2010), Jimenez et al. (2009) Gambacorta (2009).*

[6]*Credit risk used in this paper is risk weighted assets (RWA). RWA is a measure of the amount of banks assets, adjusted for risk. RWA are important element of risk based capital ratios. Indeed, bank can increase their capital adequacy ratio in two ways : (i) by increasing the amount of regulatory capital held, which boosts the numerator of the ratio, or (ii) by decreasing risk-weighted assets, which is the denominator of the regulatory ratio (Sonali and Amadou 2012).*

This section explains the period when risk taking in Indonesia occurred. The data used to structure are from micro data of households and companies in Indonesia, which are compiled in the form of balance sheet.

Household net wealth was relatively stable in the early 2002s even as households continued to save. One of the factors affecting the increase in the value of non financial assets is the increase in property prices. Household net wealth grew steadily from Rp 7.990.337 in 2002 to about Rp 16.794.789 in 2013 (Chart 1). The total value of assets in 2013, increased 24,06 per cent from the previous year. Financial asset grew by 13,73 percent while non financial asset[7] increase by 25,94 per cent. Household liabilities from bank increased by a moderate 15 per cent in 2013. Moreover, mortgage loans grew by 26,06 per cent.

Chart 1. *Composition of Household Net Wealth 2002-2013.*



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Liabilities	135,508	183,605	241,019	329,625	367,442	465,470	599,306	712,391	892,772	1,155,704	1,369,500	1,572,116
Non Financial Asset	7,572,054	8,482,767	7,581,659	8,879,264	9,802,918	9,016,232	10,502,037	9,370,892	9,857,506	11,077,257	12,753,988	16,062,321
Financial Asset	554,190	631,634	734,306	794,085	895,029	967,289	1,088,207	1,309,141	1,570,838	1,831,531	2,050,877	2,304,584
NWH	7,990,737	8,930,796	8,074,946	9,343,724	10,330,505	9,518,051	10,990,938	9,967,641	10,535,572	11,753,084	13,435,364	16,794,789

Source: *Authors Calculation.*

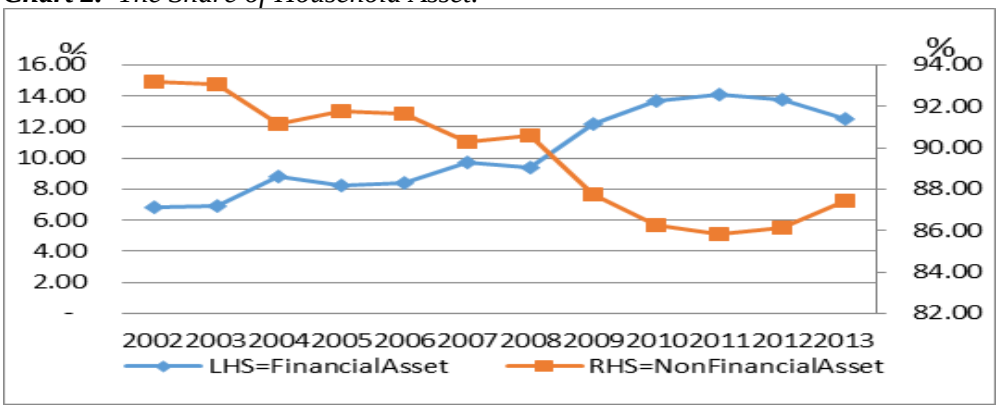
Despite the growth of non financial assets faster than the financial asset, non financial assets as a share of total assets decreased from 93,18 per cent in 2002 to 87,45 per cent in 2013. Conversely, the share of financial asset increased steadily from 6,82 per cent in 2002 to 12,50 per cent in 2013 (chart 2). The change in the relative shares of financial and non-financial assets is largely driven by changes in their relative prices. Until recently, the performance of the property market could have prompted households to diversify their asset portfolios towards increasing their holdings of financial assets so as to reduce the investment risks from property assets.

The role of banks as financial institutions in Indonesia's economy has become increasingly vital in the economy in the last decade. The bank's debt to GDP ratio value is increasing every year. The increase in bank debt to GDP ratio can indicate increasing credit demand by the public to finance consumption and investment

[7]*Non financial assets consist of land, home and other fixed assets.*

activities. In the balance sheet of the household, the ratio of bank loans against total liability value has increased from 1 per cent in 2002 to 9 per cent in 2013 (Chart 2).

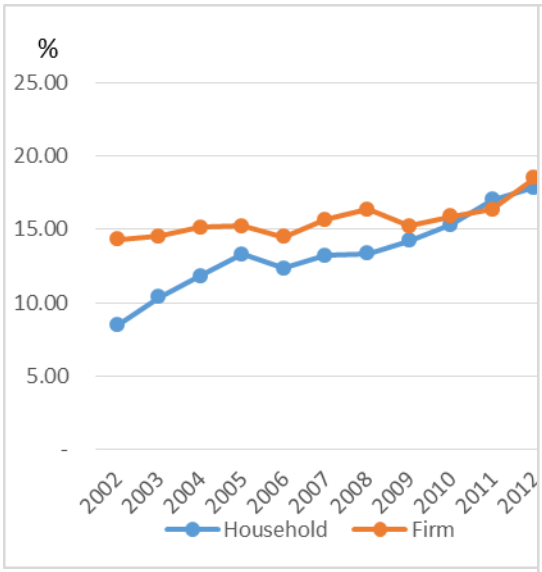
Chart 2. *The Share of Household Asset.*



Source: *Authors Calculation.*

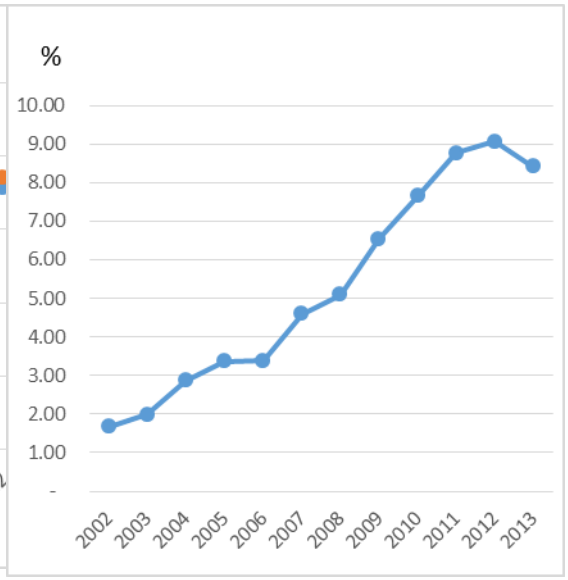
The rise in the ratio is in line with the rise in bank debt to GDP ratio. Household agents are increasingly becoming more daring to ask for loans to banks, driven by the ever increasing needs and their possession of collateral. Analysis of how households behave in performing loans could be seen from the comparison between the growth of disposable income and bank debt (mortgage and debt).

Chart 3. *The Growth of the bank Debt to GDP Ratio Year 2002-2013*



Source: *Bank Indonesia, treated.*

Chart 4. *The Growth of Ratio Bank Debt to Total Pasiva in Household Balance Sheet*

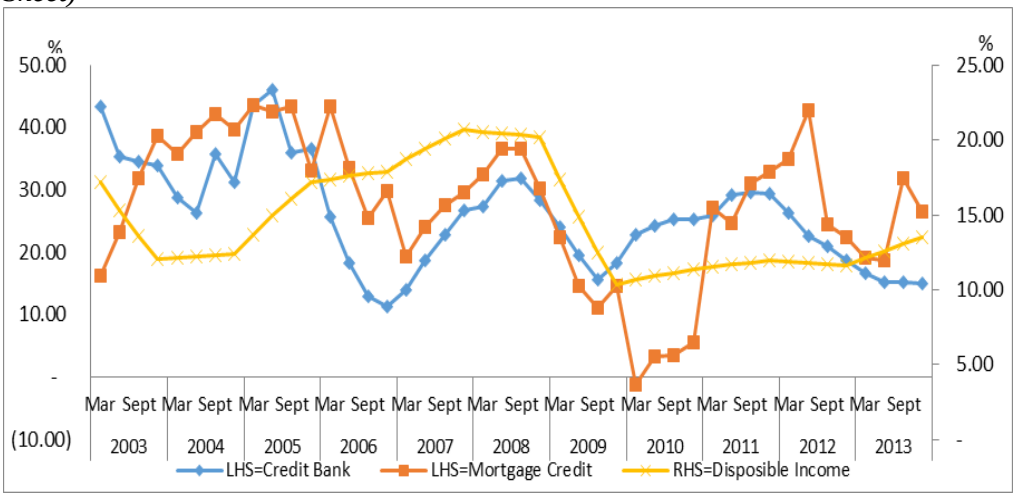


Source: *Authors Calculation.*

In 2003, the growth of disposable income declined but mortgage debt growth increased. The behavior of households who dared to ask for credit was driven by good economic growth and the increase in property price index (IHPR). A rise in IHPR means an increase in the value of collateral held by households. BI rate[8] declining trend also has an impact on lending rates. In this period, the household became more daring to ask for loans since interest rates for loans were lower than the previous period and the increasing value of collateral.

For banks, the increase in collateral value gives more confidence to give the household credit. This causes an increasingly risky behaviour by both households and banks. The decline in BI rate and the increase in the value of collateral can affect the behavior of banks in assessing credit risk (Utari *et al.*, 2011; Miller and Choi, 2014). To curb the growth rate of mortgage loans, the central bank sets the macroprudential policy Loan to Value (LTV) for property and vehicle loans that help manage growth and reduce price pressures in the sectors in which increase in demand is high.

Chart 5. *The Growth of Disposible Income and Credit Bank (Household Balance Sheet)*

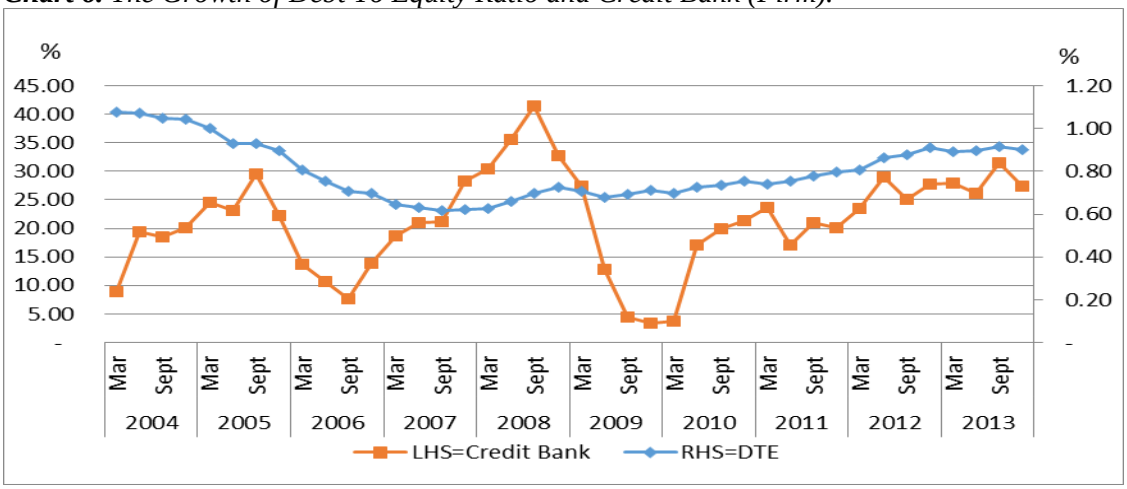


Source: *Authors Calculation.*

For the period of 2007 to mid-2008, the growth ratio of debt to equity (DER) increased, followed by the increase in the growth of bank debt. Corporate behavior in this period was driven by macroeconomic circumstances. Rising commodity prices affect the company's profit growth positively. Moreover, interest rates are lower in this period. These two conditions improved the financial condition of the company thereby increasing the ability of businesses to obtain financing from banks.

[8]*BI rate is central bank rate in Indonesia.*

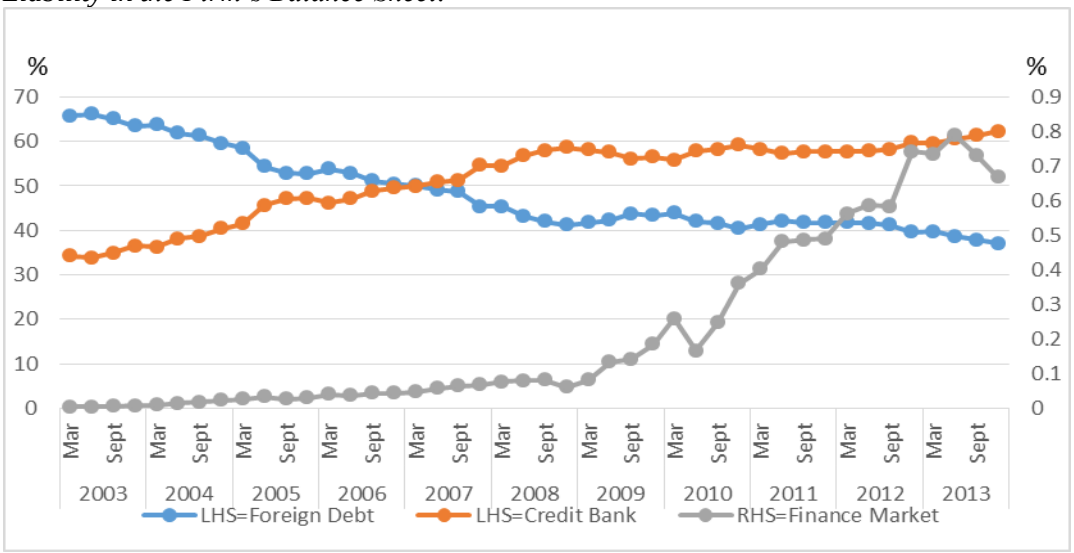
Chart 6. *The Growth of Debt To Equity Ratio and Credit Bank (Firm).*



Source: *Author's calculation.*

The largest portion of financing sources for corporations is still from banks rather than the financial markets. Chart 7 shows that the ratio of bank credit to liabilities on corporate balance sheets is greater than the ratio of securities to liabilities. The ratio of the value of securities to liabilities rose gradually, however, the ratio is still very small compared to bank credit.

Chart 7. *The Growth of Ratio Foreign Debt, Credit Bank and Bonds to Total Liability in the Firm's Balance Sheet.*



Source: *Author's calculation.*

3. A DSGE Model With Bank[9]

The risk-taking channel affects the supply of credit by banks via the bank's decision to extend credit based on the behavior of banks in handling risk. The model developed for this dissertation is based on the banking sector DSGE models which have been developed previously by Harmanta, *et al.* (2012). Harmanta's model was built based on the model of Gerali *et al.* (2010) who have entered the banking sector in the framework of New Keynesian DSGE. Further financial accelerator is added as done by Bernanke *et al.* (1999), which was later modified by Zhang (2009). Modifications are done in relation to credit risk.

Following Falagiarda Saia (2013), the assessment of banks against risk is reflected by calculating the risk weighting in risk-weighted assets. In the risk-weighted assets, the assets contained in the bank's balance sheet was given a contained risk weighting, therefore lending banks should be given a contained risk weighting. Calculation of risk is influenced by the ratio of risk of the current year compared to previous years, the ratio of the number of loans extended by banks (added by payment of interest) with a price guarantee (collateral), the ratio between the amount of loans extended by banks (added by payment of interest) with capital owned bank, the output gap (to capture the macroeconomic situation) and the ratio of the amount of credit granted to households and to companies. Furthermore, the risk weighting will affect the lending rates set by banks which in turn will affect the amount of credit granted by the bank.

Further more, it will be shown equations on economic agent of bank while other economic agents about the same as Harmanta (2012) dan Gerali et al (2010).
Bank's utility function is

$$\max_{\{Risk\_free_t, B_t, D_t\}} E_0 \sum_{s=0}^{\infty} (\beta_p)^s \frac{\lambda_{t+s}^P}{\lambda_t^P} \Big[\Gamma_{t+s} D_{t+s} - \Gamma_{t+s+1} D_{t+s+1} + (1 + r_{t+s}) RF_{t+s} - RF_{t+s+1} + \left(1 + R_{t+s}^b\right) B_{t+s} - B_{t+s+1} + D_{t+s+1} - \left(1 + R_{t+s}^d\right) D_{t+s} + \Delta K_{t+s+1}^b - \frac{\kappa_{Kb}}{2} \left(\frac{K_{t+s}^b}{\omega_{t+s}^{b,tot} B_{t+s}} - v_{b,t+s} \right)^2 K_{t+s}^b \Big] \tag{1}$$

$$\text{s.t.} RF_t + B_t = (1 - \Gamma_t) D_t + K_t^b \tag{2}$$

In this model, the calculation of credit risk endogenously follow Falagiarda Saia (2013). Risk weighting consists of deviation risk weight last year of steady state conditions, the ratio between loans granted at a price of collateral (assets), the ratio between the value of credit with the bank's capital, and economic conditions are represented by the output gap.

[9]*The Graphical ilustration of the main model can be seen in Appendix 1.*

$$\omega_{t+s}^{b} = \left(\omega_{t-1}^{b}\right)^{\phi_{\omega^b}} \left(\frac{\left(1+r_t^{bC}\right)b_t^C}{P_t^R R_t}\kappa_B^C\right)^{\varphi_1\omega^b} \left(\frac{\left(1+r_t^{bE}\right)b_t^E}{P_t^K K_t}\kappa_B^E\right)^{\varphi_2\omega^b} \left(\frac{\left(1+r_t^{bC}\right)b_t^C\left(1+r_t^{bE}\right)b_t^E}{K_t^b}\kappa_{K^b}\right)^{\varphi_3\omega^b} \left(\frac{Y_t}{Y}\right)^{\varphi_4\omega^b} \left(\frac{b_t^C}{b_t^E}\right)^{\varphi_5\omega^b} exp\left(\varepsilon_t^{\omega^b}\right) \quad (3)$$

where $\kappa_B^C = \frac{p^H H}{\left(1+r^{bC}\right)b^C}$, $\kappa_B^E = \frac{p^K K}{\left(1+r^{bE}\right)b^E}$, $\kappa_{K^b} = \left(\frac{K^b}{\left(1+r^{bC}\right)\left(1+r^{bE}\right)}\right)$ and $\varepsilon_t^{\omega^b}$ is i.i.d shock normal distribution.

The intuition of the equation above is the second and the third part is a proxy for household and entrepreneurs leverage positions, expressed as a ratio between the value of the credit and collateral value households and entrepreneurs: the higher this ratio, the higher the perceived risk associated with the loan. The fourth part is the risk inherent in the balance sheets of banks: the perceived risk is a function of the rise in the ratio between the amount of credit provided to households, entrepreneurs and equity bank. Follow Falagiarda Saia (2013), the sign of $\varphi_1\omega^b$, $\varphi_2\omega^b$ and $\varphi_3\omega^b$ means the risk is rising due to the leverage of households, entrepreneurs and the exposure of banks to increase. Lastly, the equations have a component relating to the macroeconomic situation to capure systematic risk.

There are two types bank behavior in assessing credit risk. The first type is banks more focus on the conditions of the past. The second type is banks more focus on the conditions of the future. In determining the risk weights, we need the necessary equations

$$\omega_t^{b,tot} = \theta^b\left(\omega_{t-1}^b\right) + (1-\theta^b)(\omega_t^b) \quad (4)$$

4. Results

To obtain results that are accordance with the conditions of Indonesia, then performed calibration for the parameters. The steady state value of the variables was obtained using 2007Q1-2014Q4 data. The first issue that needs to be addressed is with regards to the implications of the presence of such endogenous credit risk for the main model. For this purpose, we report the impulse responce function to selected shock, comparing the cases of exsogenous credit risk.

The results of the model with endogenous risk showed a consistent movement, if the endogenous loans rose higher by 1.7per cent and if the exogenous loans rose by 1.1per cent, loans to entrepreneurs for endogenous rose by 3.3per cent and if exogenous rose to 2.2per cent. If the risk is calculated endogenously, then the bank

can calculate risk from loans, thus affecting the perception of credit risk on the loans. Decreased perception of risk lowers the levels of bank credit risk, and will affect the interest rate of loans that affect the amount of credit supplied by banks. The impact of cuts in the BI rate is that household credit rose by 1.7 per cent and employers credit rose 3.3per cent. Portfolio of banks on credit increase, hence reducing the placement of their funds with the risk-free rate, causing output growth to rise by 1.1 percent. To return to equilibrium the interest rate will rise gradually. So, the effect of an expansionary monetary policy back towards balance in the quarter 10-15. Direction of movement of credit due to falling interest rates, showed similar results with Falagiarda Saia (2013). In his research when there is a monetary policy expansion, then the loans to households increased. Angeloni (2015) using a model that is somewhat different in the banking agent, also shows that an expansionary monetary policy also increases credit to producers and boost output growth.

Shocks that increase the price of assets, according to results from running the model, suggests that endogenous risk models increase credit provision to households and entrepreneurs. If the risk is exogenous, then the increase in house prices will be 2.8 per cent credit to households and 4.5 per cent to business loans. Firms' credit will increase because the risk of decreasing is more than the risk of idiosyncratic shock decreasing more than idiosyncratic export shock. It will further increase investment, output, and inflation.

Shocks of GDP growth abroad, the increasing world economic growth will give effect to the external sector by encouraging increase in exports and in turn boosting the firm's output. In addition, the increase in exports led to supply of foreign currency in the foreign exchange market in the country increased, resulting in the appreciation of the rupiah. As a result, imports of consumer goods also increased.

The resulting impulse response of the endogenous risk model shows that the impact of external shocks pushes output to rise, the volume of credit to increase, and the rupiah to appreciate. While using exogenous risk model (risk-taking) then the output, the volume of credit, and inflation have the same movement, but have differences in the magnitude of its increment. Loans to households rose by 0.8 percent in exogenous models, and credit to businesses rose by 1.7 percent, while the endogenous model of credit expansion to households rose by 1 percent and credit to businesses rose by 2 percent. The increase in credit to more entrepreneurs, manufacturers increase production to meet the needs of export and domestic consumption. Increased production will increase the use of capital goods. The increase in the loan portfolio of banks will reduce the risk-free investments by 1.8per cent.

There are two types of banks in assessing credit risk. Type 1 are the banks that are focused on historical performance. Type 2 are the banks that look into future potential (equation 4). The method used to determine the parameter value of

equation 37 is calibration in order to obtain a bank that behaves brave in giving credit. For this purpose, we need to set the parameter θ^b is at 0,35. The parameter of equation 37 shows the behaviour of banks that focus on the future more encouraging risk taking behaviour. The level of competition affecting bank risk taking behaviour (Jimenez 2010). The decline in BI rate, will cause the bank to respond by lowering interest rates on deposits and loans. The decrease in loan interest rates causes households and entrepreneurs to be more interested in asking for credit. Expansionary policy causes a rise in GDP growth. For banks that are more focused on the future potential, it affects the assessment of the credit risk. For this type of banks, more optimistic economic situations with the central bank keep interest rates low hence creating a good economy. This will cause the bank to raise its credit and further reduce the placement of their funds with the risk-free rate.

An increase in the price of collateral increases the value of the collateral of households and entrepreneurs. Thus the banks are more willing to give credit because their assessment of the credit risk decreased. Banks that are more inclined towards credit risk is more focused on the future and are more daring in giving credit. The banks tend to be more optimistic about growth in the value of collateral and would like to get a larger profit. With the increase in loans, the bank will gain more profit.

An increase in world economic growth would have an influence to the Indonesian economy through exports. Indonesian exports will be increased to meet demand from countries whose economic growth is rising. The increase in exports will boost the productivity of economic sectors that have high export demand. Therefore, the bank became more confident in giving credit to the sector that currently has high exports. Credit risk in sectors with high export levels fell because the growth prospects of the sector are high. Banks that focus on the future is more daring to give this particular sector credit.

5. Optimal Monetary Policy

Decline of the BI rate, on the circumstances there is risk taking, will further increase credit to households and entrepreneurs than the circumstances where there are no risk taking. To control it the risk of the occurrence of high credit growth, then combined with policy macroprudensial LTV. The imposition of LTV impact on the reduction in lending by banks. In addition to an additional policy increased CAR Requirement would reduce channeling credit to the community because of the increase in the bank's portfolio at the risk free asset.

An unanticipated shock such as an increase in the prices of assets, leads to a better economic growth, increased credit, the NPL that tends to go down, and the onset of a rise in inflation. High credit growth with the high price of asset when left may cause a price bubble and the occurrence of financial imbalance, and can eventually cause the occurrence of financial instability and financial crisis. This would interfere with

monetary stability. The world economic improvement can be seen from the growth of China's economy. As we mentioned in the previous section, Indonesia export market share to China was further increased every year and never higher than Japan. So that the output of china's growth affect Indonesia, especially on export commodity goods. The increase in the GDP of china coupled with an increase in world commodity prices, give a positive impact to the economy of Indonesia.

Increase in exports will increase output, so it will increase the consumption of domestic goods and imports. A positive impact against Indonesia means an increasing GDP. The increase in export income implies that it will raise the purchasing power of the community, and will encourage the increase of prices of assets. High asset prices increase the wealth of the borrower, giving the borrower more courage to ask for credit.

For the selection of the optimal monetary policy, the destination loss function of the central bank is utilized. Loss function is minimized variace of output and variance of price.

$$L_t = E_t \sum_{t=0}^{\infty} \beta \left((\pi - \pi^T)^2 + (y - \bar{y})^2\right) \quad (5)$$

Table 1. *The amount of loss function.*

Policy Simulation	BI Rate	BI Rate + LTV HH	BI Rate + LTV HH+ CAR
Decreasing BI Rate	8,45	7,23	6,34
Increasing Price of Assset	14,65	10,54	7,45
Increasing Output World	9,54	8.78	8,71

Source: *Authors calculation.*

Based on the above table, the smallest loss is the BI rate policy combined with, macroprudential policy (LTV and CAR). The combination of these policies to maintain the stability of the price level and lower output fluctuations.

6. Conclussion

The purpose of this study was to analyze the behavior of risk taking by banks to provide credit and risk taking behavior mechanisms. To that end, the first step to build the aggregate balance sheet of households and firms. The results show the bank's role as a financial intermediary in Indonesia is increasing, periods occur in risk taking boosted by the rise in housing prices. The second step is to build a DSGE model with banking sector, endogenize credit risk and modeled behavior of banks in assessing credit risk. This model is used to perform simulations based on the evidence obtained from the balance sheet. The results from this study is that endogenous credit risk, encourage bank became bolder give credit. Moreover, banks

with behavior that emphasizes the future in assessing the credit, it encourages risk taking in the economy. This indicates that endogenous credit risks will magnify the effects of the credit procyclicality.

Furthermore, in the event of risk taking in the economies, the study will do optimal policy simulations. When there is a macroeconomic shock and external shock, the monetary policy combined with macroprudential policy generate financial stability and minimal loss of function.

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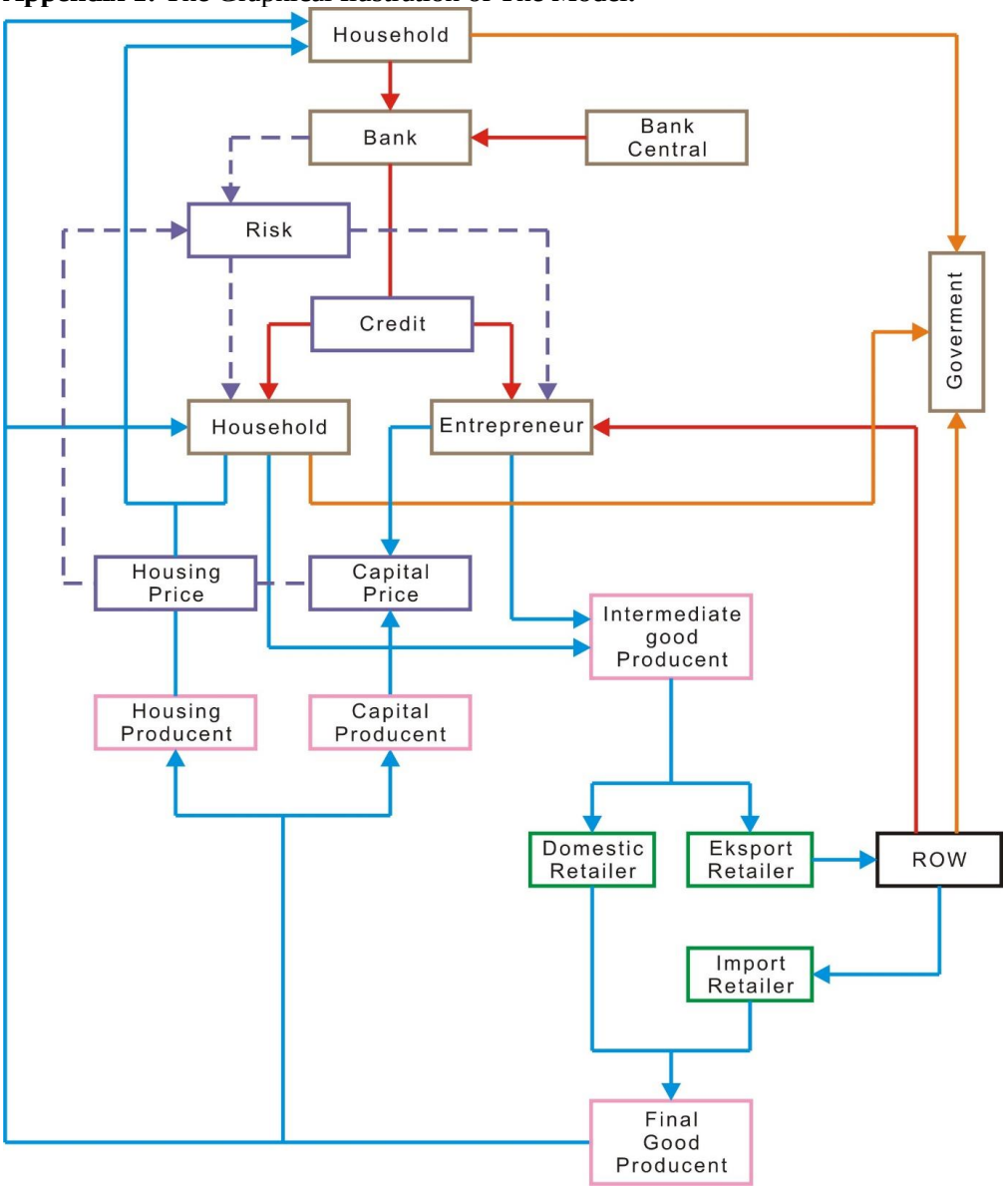
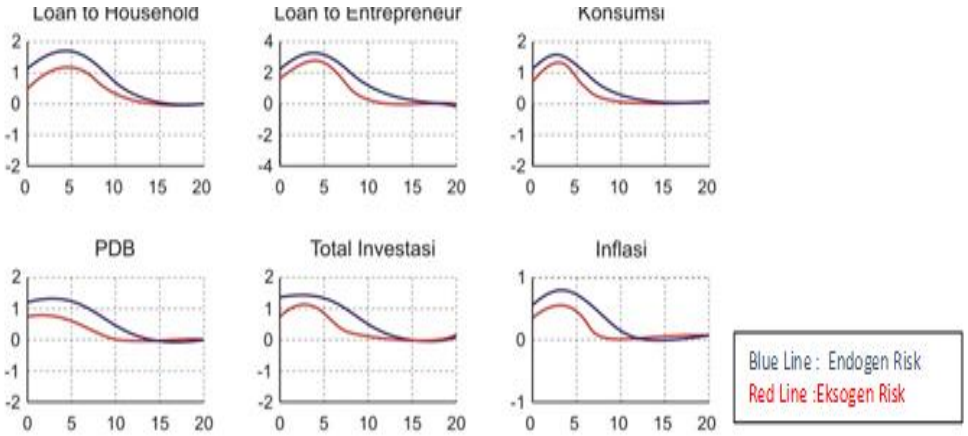
Appendix 1: The Graphical Ilustration of The Model**.**



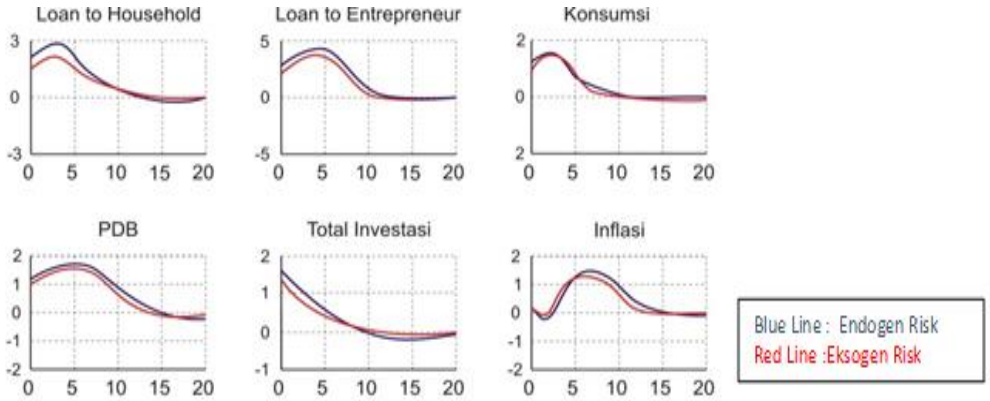
The Blue line is consumption good activity.
The Red line is financial intermediaries activity.
The orange line is tax activity.

Appendix 2: Model Exsogen and Endogenize credit risk

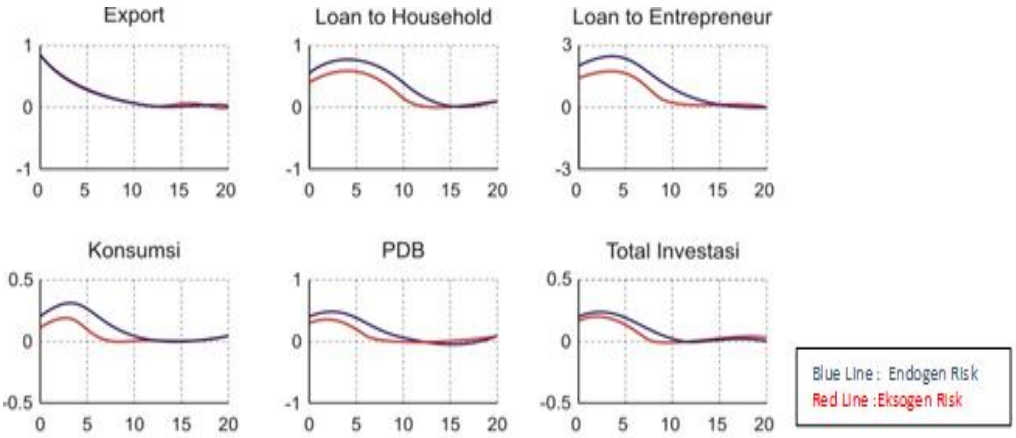
The Effect of Decreasing BI Rate (Endogenize Risk Model)



The Effect of Increasing Price of Asset (Endogenize Risk Model)

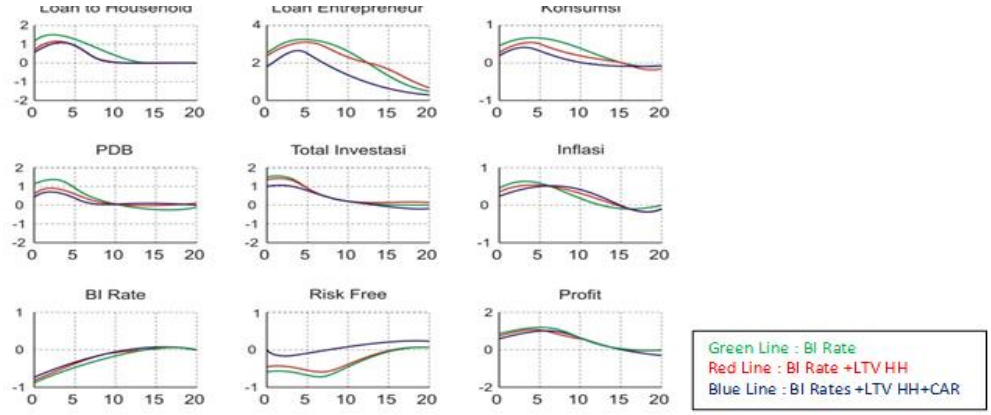


The Effect of Increasing World GDP (Endogenize Risk Model)

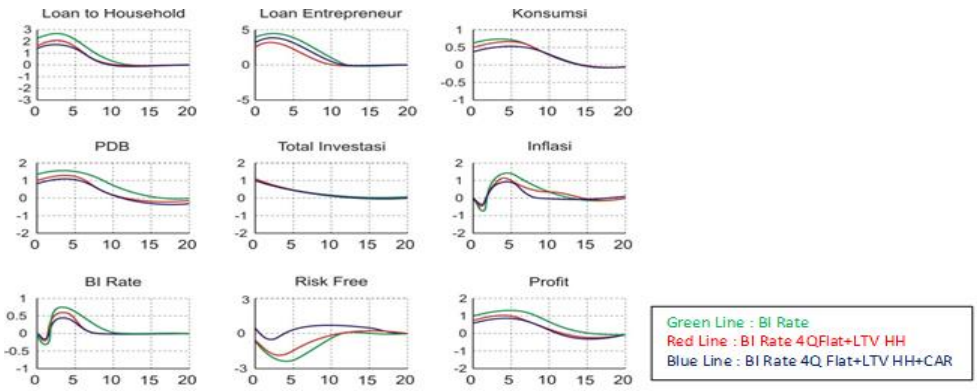


Result of Policy Simulation

Increasing BI Rate



Inreasing Collateral Price



Increasing World GDP