
Optimal Monetary and Macroprudential Policies Under Risk Taking Environment

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Abstract:

The purpose of this study is to identify the existence of risk taking behavior in economic agents and optimal monetary and macro prudential policy options in Indonesia. Using the household and firm balance sheet data during the period 2002q1-2013q4, our approach found that risk taking behavior occurs both in households and firms in Indonesia.

We develop a model whose economic agents consist of households, firms, banks and central banks by treating the bank credit risk as an endogenous variable. The performance of the model suggests that the monetary shock response drives an increase in credit growth. The same pattern occurs in the shock of increasing asset prices and increasing world GDP.

Furthermore, this study model contributes to a deeper understanding of the prudential policy framework. In the even of risk taking, either shock by exogenous asset price or world economy shock, monetary policy alone nor macroprudential alone may not be optimal policy responses.

Keywords: risk taking behavior, DSGE model, monetary policy, macroprudential policy

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1. Introduction

The 2008 financial crisis raised the question "whether the low interest rate policy of the central bank encourages risk taking behavior in banks?". The question became a debate between academics and policymakers. Monetary policy in recent years is said to contribute instability in the financial system by maintaining low interest rates (Bianchi and Rebucci, 2017; Baaxaa *et al.*, 2013; Miller and Choi, 2014; Thalassinos and Dafnos, 2015). The determination of interest rates from the central bank have impact to the risk perceptions of business performers (banking and people). Low interest rates and excessive liquidity make banks more willing to take risks (excessive risk taking). This triggers an increase in asset prices and raises leverage.

Risk taking behavior is a tendency for banks to conduct activities or actions that clearly increase their risk exposure. There is a general opinion that increasingly risky investments will get higher returns. In performing its activities, the bank may choose its risk appetite on risk averse (preferring non-risk activities) and risk lover (preferring risky activity). Furthermore, what factors influence the bank's risk-taking behavior. Gersl *et al.*, (2011) examined risk-taking behavior by banks, the result was a causal relationship between risk taking behavior and bank competition variables, interest rates, capital, profits and liquidity.

Borio and Zhu (2008) found a significant relationship between low interest rates and bank behavior in taking risks. This path is called risk taking channel. Risk taking occurs because of the behavior of the procyclical⁵ financial sector. This raises an opinion on the importance of risk taking channel analysis in monetary policy transmission mechanism. Risk taking channel affects credit offerings by banks through its decision to offer credit based on bank behavior in the face of credit risk. Low interest rates encourage banks and other investors to assess risks to be lower (underestimate risk).

Research on risk-taking behavior is increasing⁶, but there are two elements that remain. The first element provides a basic understanding of the realistic macroeconomic model that determines the behavior of banks to provide credit and related to credit risk, and second is the micro data that indicates the period of the risk taking behavior.

In this study, the first step is to build micro data on household and firms in Indonesia to identify the period in which risk taking behavior occurred. Micro data are arranged in the form of aggregate household and firm balance sheet. The second step, is to

⁵*Procyclicality defined as the interaction between the financial system and the real economy are mutually reinforcing. Such interaction tends to strengthen the amplitude of the business cycle, thereby increasing the risk of financial system stability (Utaril, et al., 2011)*

⁶*Altunbas et al., (2010), Jimenez et al., (2009) Gambacorta (2009).*

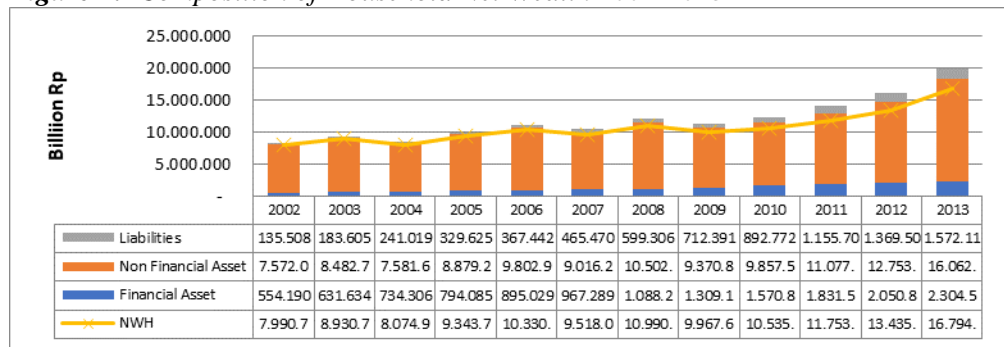
build a dynamic stochastic general equilibrium (DSGE) model⁷ that can be used to simulate the periods occurred risk taking. The main characteristic of the model is risk taking behavior model characteristic by the behavior of the bank which is influenced by leverage ratio, property market condition and general economic condition. As is the case in many countries, the credit market is determined by the market supply (Andres and Arce, 2012). The credit behavior of the demand side will be more easy (facilitate) if banks are more willing to give credit.

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 behavior. Section 3 presents our model. In Section 4, the use of the model and policy implications are presented. Finally, Section 5 concludes the results and the findings of this study.

2. The Risk Taking Behavior in Indonesia

This section explains the period when risk taking in Indonesia occurred. The data used are from micro data of households and firms 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. Increasing property prices significantly increased the value of non-financial assets. Household net wealth grew steadily from Rp 7.990.337 in 2002 to about Rp 16.794.789 in 2013 (Figure 1). The total value of assets in 2013, increased by 24,06 per cent from the previous year. Financial asset grew by 13,73 percent while non financial asset⁸ increase by 25,94 per cent. Household liabilities from bank increased by a moderate 15 per cent in 2013. More over, mortgage loans grew by 26,06 per cent.

Figure 1: Composition of Household Net Wealth 2002-2013



Source: Bank Indonesia (Indonesia Financial Statistics), Authors Processed

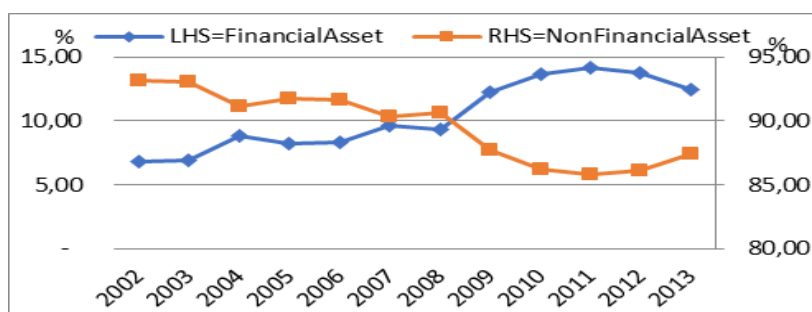
Although non-financial assets grew faster than financial assets, non-financial assets as a share of total assets decreased from 93.18 per cent in 2002 to 87.45 per cent in

⁷ The model based on Gerali et al., (2010) and Harmanta et al., (2012).

⁸ Non financial assets consist of land, home and other fixed assets.

2013. Conversely, the share of financial asset increased steadily from 6,82 per cent in 2002 to 12,50 per cent in 2013 (Figure 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.

Figure 2: *The Share of Household Asset*



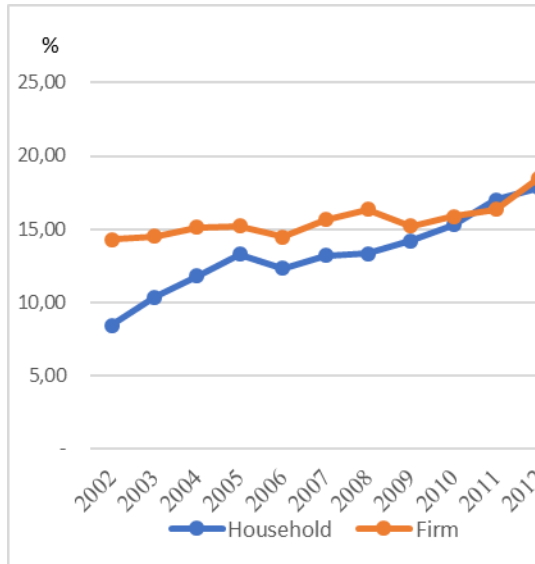
Source: Bank Indonesia (Indonesia Financial Statistics), Authors Processed.

Banks are playing an increasingly vital role as financial institutions in Indonesia's economy over 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 (society) to finance consumption and investment activities. In household balance sheet, the ratio of bank loans to total liability value has increased from 1 per cent in 2002 to 9 per cent in 2013 (Figure 5). This rise is in line with the rise in bank debt to GDP ratio. Household agents are increasingly daring in requesting bank loans, 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).

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. A declining BI rate (the central bank rate in Indonesia) also has an impact on lending rates. In this period, risk-taking behavior occurred: household became more daring in asking for loans because interest rates for loans were lower than the previous period and the value of collateral increasing. Increased collateral value gave banks more confidence in giving household credit. This causes an increasingly risky behavior 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). To curb the growth rate of mortgage loans, the central bank sets the macroprudential

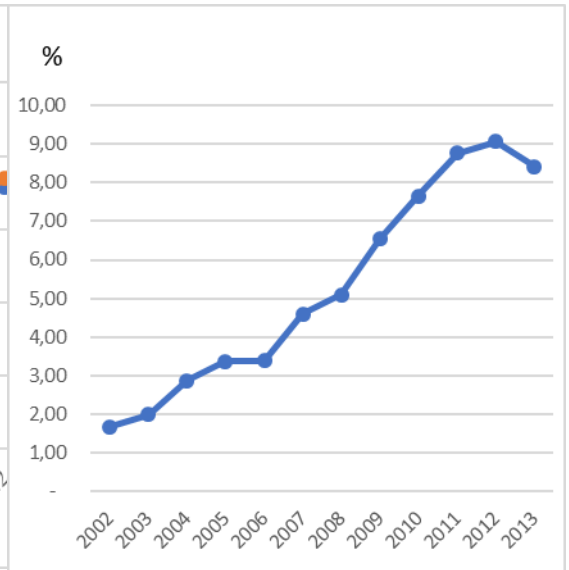
policy Loan to Value (LTV) for property and vehicle loans that help manage growth and reduce price pressures in sectors experiencing a significant increase in demand.

Figure 3: The Growth of The Ratio Bank Debt To GDP Household Balance Sheet Year 2002-2013



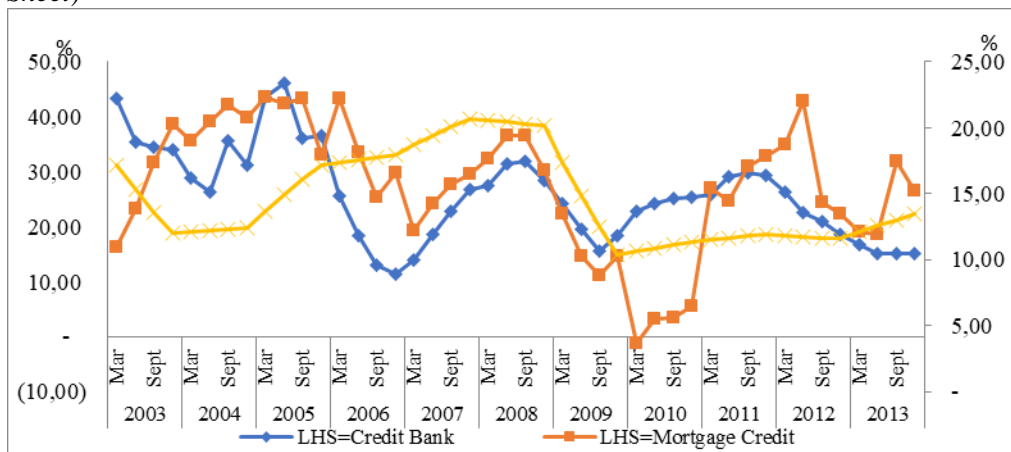
Source: Bank Indonesia (Indonesia Financial Statistics), processed

Figure 4: The Growth of Ratio To Total Pasiva in Year 2002-2013



Source: Bank Indonesia (Indonesia Financial Statistics), processed

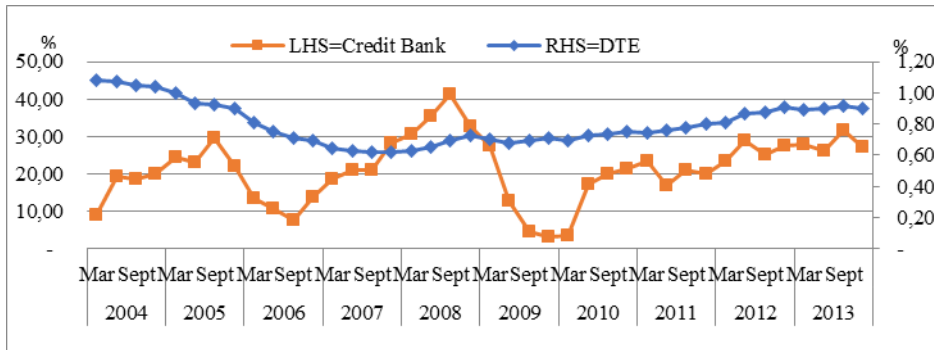
Figure 5: The Growth of Disposable Income and Credit Bank (Household Balance Sheet)



Source: Bank Indonesia (Indonesia Financial Statistics), BPS-statistics Indonesia, processed

From 2007 to mid 2008, the growth ratio of debt to equity (DER) increased, followed by an increase in the growth of bank debt. Corporate behavior in this period was driven by macroeconomic circumstances. Rising commodity prices positively affected companies' profit growth. Moreover, interest rates are lower in this period. These two conditions improved the financial state of companies, increasing their ability to obtain financing from banks.

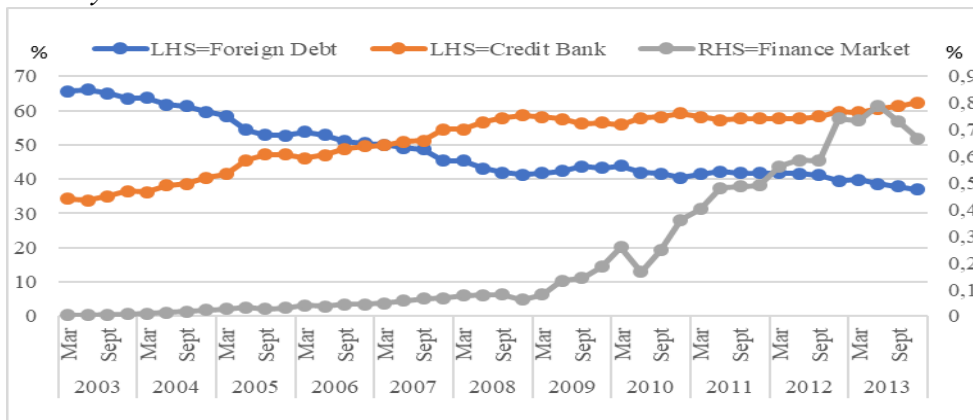
Figure 6: The Growth of Debt To Equity Ratio and Credit Bank (Firm)



Source: Bank Indonesia (Indonesia Financial Statistics), Author's calculation.

The largest portion of financing sources for corporations is still from banks rather than the financial markets. Figure 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.

Figure 7: The Growth of Ratio Foreign Debt, Credit Bank and Bonds To Total Liability in The Firm's Balance Sheet



Source: Bank Indonesia (Indonesia Financial Statistics) Author's calculation

3. A DSGE Model for the Banking Sector

The risk-taking channel affects the supply of credit by banks via the bank's decision to extend credit based on the risk-handling behavior. The model (a graphical illustration of the main model can be seen in Appendix 1) developed for this study 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 in risk-weighted assets. The 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 bank capital, 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.

Furthermore, the following equation can be seen in banking economic agent. The model of other economic agent, in general is similar to (2012) and Gerali *et al.*, (2010). Bank's utility function is:

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

$$\text{subject to } RF_t + B_t = (1 - \Gamma_t) D_t + K_t^b \quad (2)$$

In this model, the calculation of credit risk endogenously follow Falagiarda Saia (2013). Risk weighting consists of the deviation risk weight last year from the steady state conditions, the ratio between loans granted and the 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.

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

$$\left(\frac{Y_t}{Y}\right)^{\varphi_4 \omega^b} \left(\frac{b_t^C}{b_t^E}\right)^{\varphi_3 \omega^b} \exp\left(\varepsilon_t^{\omega^b}\right) \quad (3)$$

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

normal distribution.

The intuition of the equation above is that 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 inherent risk 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 capture 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:

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

4. Results

Before performing model simulations, the first step is to calibrate the parameters in the model. 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 response function to selected shock ⁹comparing the cases of exogenous credit risk. The results of the model with endogenous risk showed a consistent movement. The impact of cuts in the BI rate for endogenous model loans rose higher by 1.7 per cent and for exogenous model loans rose by 1.1 per cent. Loans to entrepreneurs for endogenous model rose by 3.3 per cent and for exogenous model rose 2.2 per cent. Bank Portfolios on credit increase, reducing the placement of their funds with the risk free rate, and causing output growth to rise by 1.1 percent. To return to equilibrium, the interest rate will rise gradually. The impact

⁹The selected shock is shock from financial sector that is asset price increase, external shock that is decreased in world GDP and monetary shock that is decreased in interest rate.

of expansionary monetary policy shock, the economy will return to equilibrium or steady state at quarter to 10-15. Direction of movement of credit due to falling interest rates, showed similar results with Falagiarda Saia (2013). In his research household loans increased when there was monetary policy expansion. Angeloni (2015) using a model somewhat different¹⁰ in the banking agent, also shows that an expansionary monetary policy also increases credit to producers and boosts output growth.

Shock increase in asset prices have an impact on the value of household assets and entrepreneur. This has an impact on the restrictions on loans for households. The results of model simulations show, credit to households rose by 2% and employers credit rose by 3% to exogenous models. While the endogenous model, higher credit growth, household credit increased by 2.8 percent and business credit increased by 4.5 percent. 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, 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 entrepreneur rose by 2 percent. With 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 1.8 per 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 4 is calibration in order to obtain a bank that behaves riskily in giving credit. For this purpose, we need to set the parameter θ^b is at 0,35. The parameter of equation 4 shows the behavior of banks that focus on the future more encouraging risk taking behavior. The level of competition affecting bank risk taking behavior (Jimenez 2010). A decline in BI rate will cause bank to respond by lowering interest

¹⁰In the Faia Angeloni, the difference between the economic agent of the bank lies in (1) only the producer can borrow money to the bank, (2) the bank is split into a loan unit and a uni deposit. Thus, it has a different maximization function.

rates on deposits and loans. Decreasing 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 has decreased. Banks that are more inclined towards credit risk are 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 an 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. Banks became more confident in giving credit to the sector that currently has high exports. Credit risk in the economic sector with high export growth will decline. Because, the growth prospects of that sector is high. Essentially, banks that focus on the future are more willing to give this particular sector credit.

5. Optimal Monetary Policy¹¹

An unanticipated shock such as an increase in the prices of assets, leads to a better economic growth, increased credit, the non performing loan (NPL) that tends to go down, and the rising inflation. High credit growth followed by high asset prices can lead to price bubbles and financial imbalance. Finally it can lead to financial instability and financial crisis. This can disrupt 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 in export commodity goods. China's increase in the GDP coupled with an increase in world commodity prices, has 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

¹¹An illustration of impulse response function can be found in Appendix 2).

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 objective function the central bank is used. Loss function is minimized variance of output and variance of price.

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

Table 1: The amount of loss function

Type of policy	Policy	The amount of Loss	
		Increase in asset prices	Increase in World GDP
Monetary Policy	BI Rate	14.65	9.54
Macroprudential Policy	LTV	15.01	11.41
	CAR	14.05	9.42
	LTV+CAR	8.56	9.02
Monetary Policy and Macroprudential Policy	BI Rate+ LTV	10.54	8.81
	BI Rate+CAR	7.52	8.73
	BI Rate+LTV+CAR	7.45	8.71

Source: Authors calculation

Based on the above table, in the event of an asset price shock, using only BI rate and macroprudential policy (CAR and LTV only) alone is not enough to control risk taking behavior. When applied the combined macroprudential policy (LTV+CAR) produces a gain efficiency, because the LTV and CAR policies affect consumer and bank behavior so that it has an impact on the two balance sheets : the household and the bank. However the implementation of LTV +CAR is not yet optimal. To get the optimal policy in controlling risk taking behavior is to use a combination of monetary and macroprudential policy. Combined monetary and macroprudential policies, in macroeconomic affect the demand side and supply side so as to obtain the smaleest welfare loss.

When there is an external shock that is decline in world GDP, the pattern is similar to asset price shocks. Monetary and macroprudential policy alone is not enough to control risk taking behavior, to obtain optimal policy by applying monetary and macroprudential policies. Given that BI rate dan LTV is under bank central's authority while CAR is financial service authority of Indonesia's authority, optimal policy response needs to coordinate between bank central (BI) and financial service authority of Indonesia (Otoritas Jasa Keuangan-OJK)

6. Conclusion

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 asset prices (housing and capital).

The second step is to build a DSGE model with banking sector, modelling endogenous credit risk and the 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 to take more risks in extending credit. Moreover, banks with behavior that emphasizes forward looking (the behavior to manage credit risk) 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.

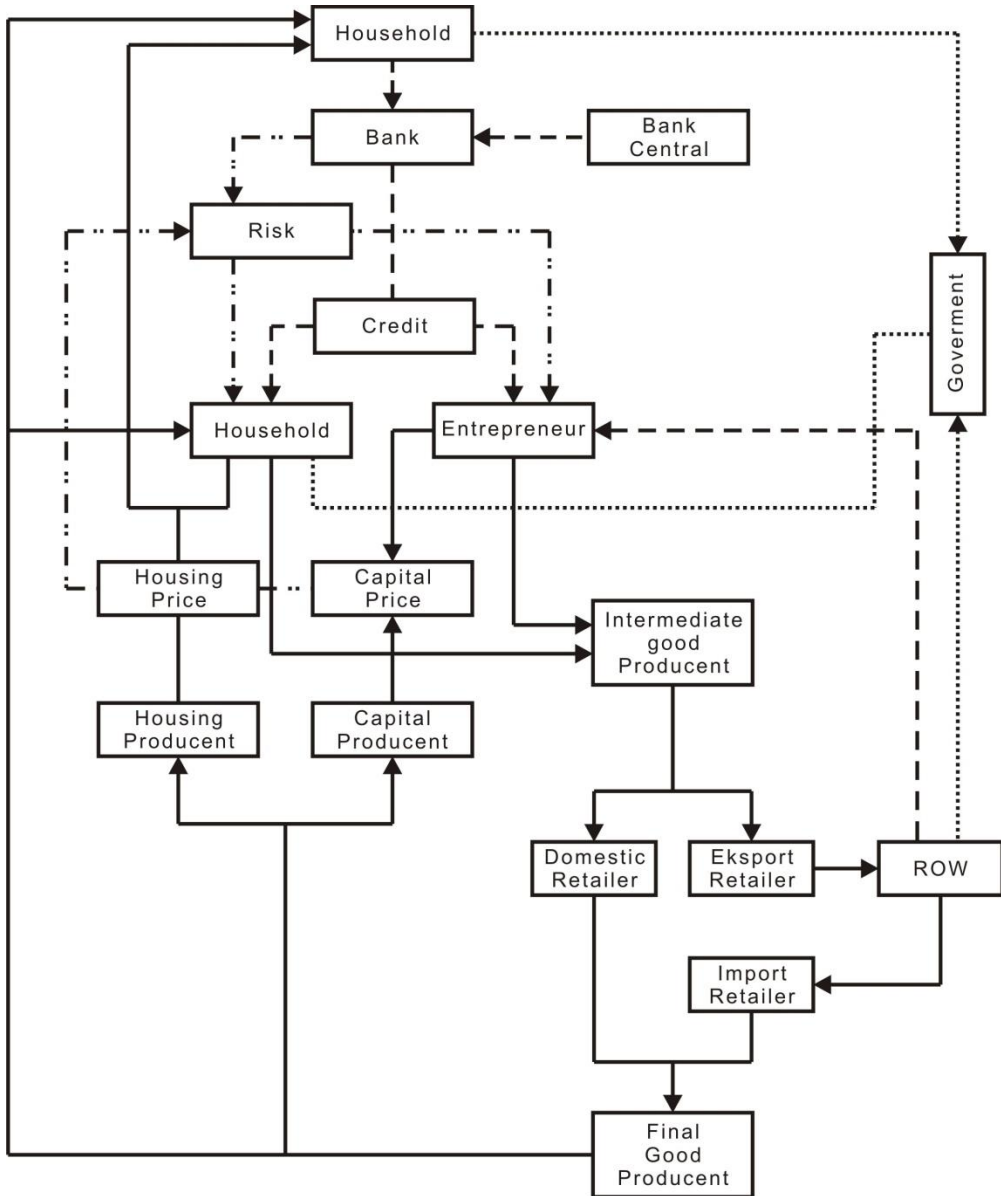
Furthermore, in the event of risk taking in the economies, using monetary and macroprudential policies that result the smallest welfare loss. Bank central and financial service authority of Indonesia must coordinate in order to reduce risk taking behavior.

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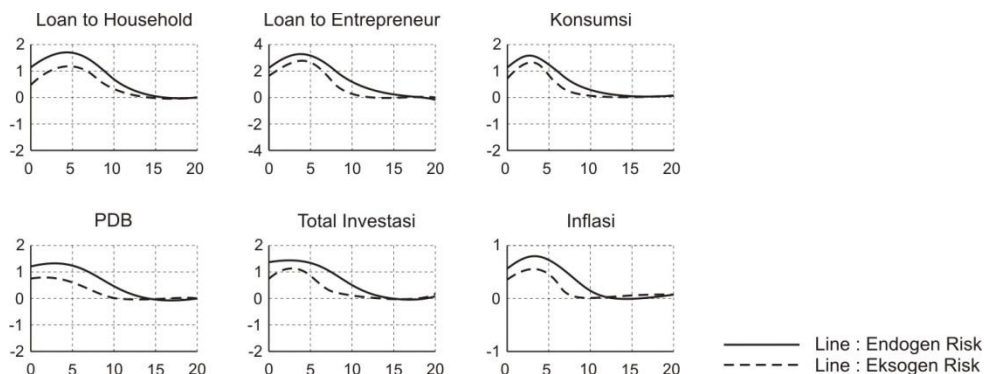
Appendix 1:
The Graphical Illustration of The Model



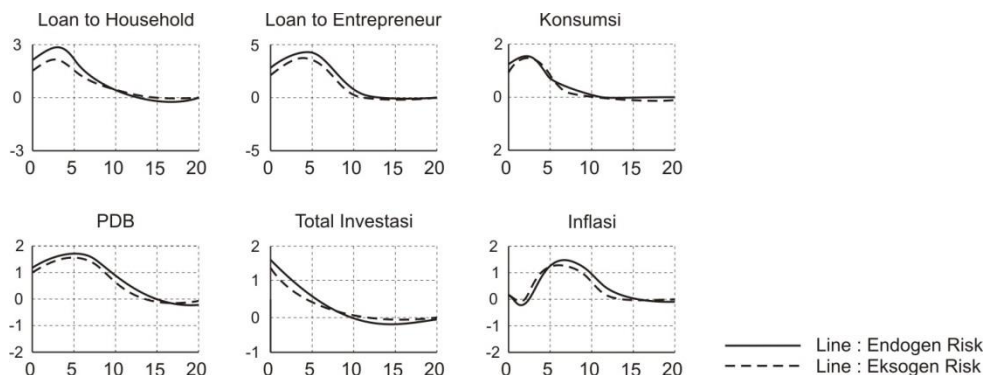
Appendix 2

Model Exsogen and Endogenize credit risk

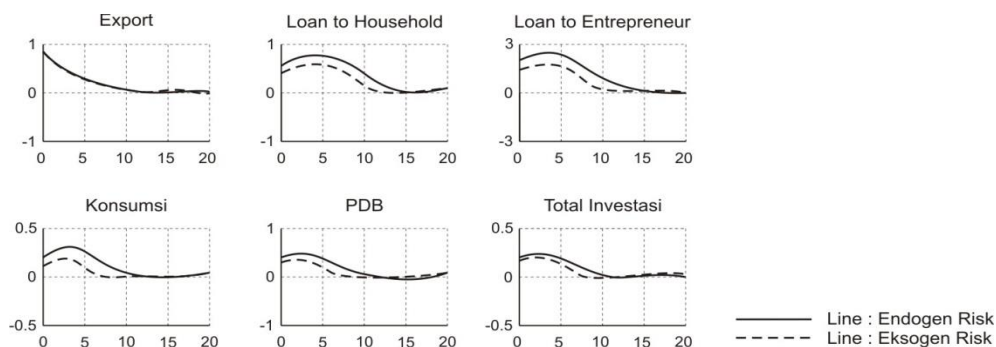
The Effect of Decreasing BI Rate (Endogenize Risk Model)



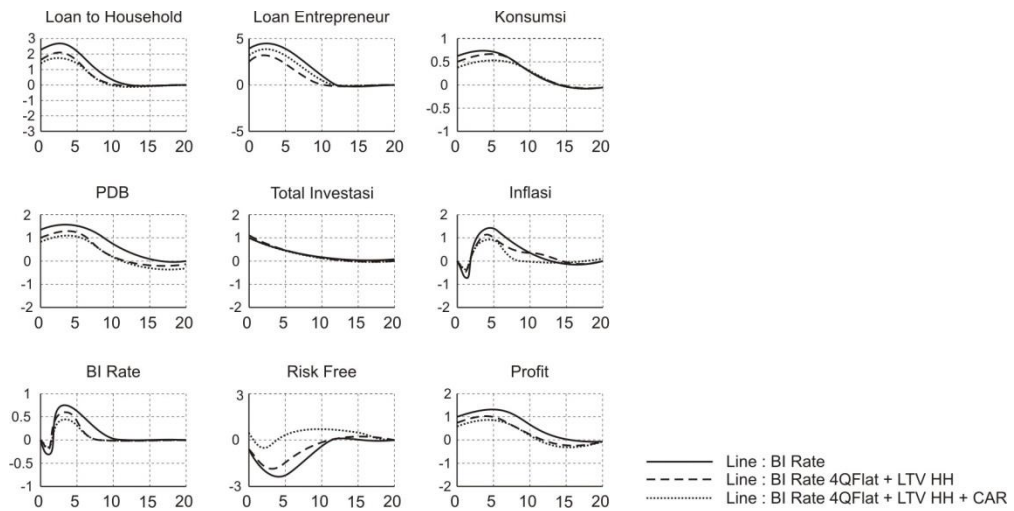
The Effect of Increasing Price of Asset (Endogenize Risk Model)



The Effect of Increasing World GDP (Endogenize Risk Model)



Result of Policy Simulation
Increasing Collateral Price



Increasing World GDP

