QUARTERLY ANALYSIS:
THE PROGRESS OF MONETARY, BANKING AND PAYMENT SYSTEM
Quarter IV, 2011
Author Team of Quarterly Report, Bank Indonesia

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Market Power of Indonesian Banking
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Ascarya

Analysis of Sectoral Efficiency and the Response of Regional Policy
M. Abdul Majid Ikram, Andry Prasmuko, Donni Fajar Anugerah, Ina Nurmalia Kurniati
The Board of Governor Meeting of Bank Indonesia today decided to maintain the BI rate at the level of 6.0%. This decision is based on thoroughly examination on the recent economic performance, several recent risks, and the prospect of the economy. The Board of Governor view the level of BI rate is consistent with the targeted inflation ahead, and is conducive to maintain the financial stability, and also to mitigate the impact of global prospect on Indonesian economy.

In general, the evaluation of the performance and the prospect of Indonesian economy show the domestic economy remain strong and stable. Looking ahead, the Board of Governor will keep examining the risk of global economic worsening, maintain the macroeconomic and financial system stability, and stimulate the domestic economy. Board of Governor emphasize the mix of monetary and the other micro prudential policies, which is counter cyclical, is necessary on macroeconomic management and drive the actual inflation to the target of 4.5%±1% in 2012 and 2013.

Board of Governor noted the economy in 2011 was slowing down, mainly due to the uncertainty of economic and financial recovery in Europe and United States. The crisis escalation in Europe particularly on second semester 2011 triggered a high volatility in global financial market. With the reduction of global demand, the global trade volume and commodity price also decreased.

On price side, the inflation pressure in developed countries increased, while in emerging countries is moderate though still in high level. Along with this progress, by the end of 2011, the emerging market tended to choose neutral or slightly accommodative, while the developing countries maintained the accommodative monetary policy with liquidity easing.

On domestic side, the Board of Governor considered the economic performance in 2011 was still strong. This achievement is supported by the maintained macro and financial system stability. The economic growth in quarter IV 2011 is expected to be 6.5%; hence the economic growth in 2011 will be 6.5% (yoy). This growth is mainly triggered by the strong domestic demand and the maintained export performance. From production side, the main pro-growth sectors are Manufacture, Transport and Telecommunication and Hotel, Trade and Restaurant.
The performance of Indonesian Balance of Payment (BOP) for the whole 2011 recorded large surplus, even though there was a pressure on semester II, 2011. The pressure was on the capital and financial transaction, along with the increase of global economic and financial market uncertainty.

Several policies of Bank Indonesia and government have helped to restrain the pressure on Rupiah exchange rate. During 2011, the trend is till consistent with the regional exchange rate movement. Bank Indonesia keep monitoring the dynamics of Rupiah and its stability and make sure it moves along with its fundamental.

On price side, the inflation decrease in 2011. CPI inflation on November 2011 was recorded 0.034% (mtm) or 4.15% (yoy). The decline of inflation during 2011 occurred due to correction on volatile food prices inflation and minimum administered price inflation, while the core inflation tended to be moderate. The low of volatile food price inflation was supported by the well maintained supplies, either from domestic or import. Even though the rice recorded quite high inflation, there were major price corrections on seasoning such as onion, red chili and on the meat.

Meanwhile, the well-controlled inflation was supported by the sharp declining of the global commodity prices, the stability of exchange rate and a better inflation expectation. If the decline inflation continues, the overall CPI inflation for 2011 is expected to be lower than 4.0%.

The stability of banking system is well maintained with better intermediation function, even there was fluctuation on financial market because of the global influence. Banking industry is solid as reflected on high capital sufficiency (CAR, Capital Adequacy Ratio); way above the required minimum level of 8%, and also reflected on the maintained gross Non-Performing Loan (NPL) of below 5%. Meanwhile, the loan growth until the end of October 2011 reached 25.7% (yoy), consisting of investment loan by 31.1% (yoy), working capital loan 24.7% (yoy), and consumption loan 23.8% (yoy). With these progresses, the growth of loan for the whole 2011 will accord the Bank Business Plan.

The reliability and efficiency of payment system support the stability of financial system. As supporting infrastructure for economic activities, the payment system ensures the payment transaction of all economic agents. The supports of the payment system on the economic performances are reflected by several Bank Indonesia policies, including the standardized chip based ATM/debit card, the improvement of card payment system, the development of Bank Indonesia Real Time Gross Settlement (BI-RTGS), the second generation of Bank Indonesia Scrip less Security Settlement System (BI-SSSSS), the development of National Payment Gateway-NPG, the increase of government account management, and the preparation of standardized electronic money.
Looking ahead, the global economic growth is expected to slow down due to the high uncertainty of debt and fiscal settlement in Europe and US. This global slowing down will affect the domestic economy growth in 2012 to be around 6.3% - 6.7%. For 2013, the growth is expected to be in the range of 6.4% - 6.8%, along with the global economic improvement. On price side, the Board of Governor predicts the inflation in 2012 and 2013 can be directed to the target of 4.5% ± 1%.

Related to this, the reduction of BI rate, which has been done so far, is expected to stimulate the economy. The Board of Governor is aware of several risks impact on the macroeconomic balances, including the worsening of global economy. Along with this, beside continuing the monetary and financial system stabilization by ensuring the sufficiency of Rupiah liquidity and foreign exchange on the market, Bank Indonesia will keep optimize the momentum of interest rate decline to optimize the effectiveness of stimulus on the economy. In addition, Bank Indonesia continues and strengthens to coordinate with the government in order to increase the stimulus from fiscal and the real sector.
MARKET POWER OF INDONESIAN BANKING

Andi Fahmi Lubis

Abstract

This study aimed to estimate the degree of market power exercised by commercial banks in the credit market in Indonesia. The model used to answer this study’s objective was the Bresnahan-Lau oligopoly model that uses structural equations to estimate the degree of market power. This model uses a very different approach than Structure-Conduct-Performance (SCP) paradigm commonly used in market power studies. Without using actual cost data and accounting profit, the Bresnahan-Lau model was able to estimate directly the degree of market power from the structural equations. The main result of this study showed that the degree of market power exercised by commercial banks in the credit market is relatively low; in other words, the degree of competition in the credit market in Indonesia is quite high.

Keywords: market power, oligopoly, Bresnahan-Lau, structure, performance, conduct, SCP
JEL Classification: L13, G21

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I. INTRODUCTION

Market power is a measure of performance that shows how much a firm can increase the price above the marginal cost (Church and Ware, 2000). Associated with the market structure, a firm in perfectly competitive market does not have any market power, while a firm in a monopoly market has the strongest market power. Thus it can be concluded that the more competitive a market is, the lower the market power of a firm; conversely, the more uncompetitive a market is, the higher the market power of a firm.

Analysis of the level of competition in a market using market power measurement has been a major focus in industrial economic studies, including assessments of the level of competition in the banking industry. As an industry that serves as intermediary institutions between those who have excess funds (surplus spending units) and those who need the funds, the banks play a very vital role in supporting the process of development. If distortion occurs in the banking industry, which generates an inefficient performance, then the intermediary process between those who need funds and fund owners will have some barriers. The existence of these barriers would hinder the funds to finance projects for development.

Considering the importance of the banking function for the development of economy, the government will try to keep the banking industry performing its intermediaries function. Various government policies will be taken to increase efficiency in the banking industry. Indonesia’s banking industry had experienced significant developments since the implementation of the deregulation package in 1983, which Cole and Slade (1996) called the phase of Reformation in 1983, followed by the phase of free-entry in 1988, famously known as PAKTO 88. The impact of the deregulation was the increase of banking intermediaries function reflected by the increase of the collected third party funds and the distributed loan. The deregulation was surely believed to increase the efficiency of banking industry reflected by the decrease of concentration level in banking industry.

The decrease of concentration level in a market will give a positive impact on market efficiency according to Structure-Conduct-Performance (SCP) approach, in which the performance of a market depends on its structure. The more concentrated a market, the greater the ability of a firm to increase the price above the marginal cost, reflecting a higher market power. This higher market power indicates lower competition level.

The competition level based on the concentration ratio is the main hypothesis construction for the studies using SCP approaches. The concentration level of Indonesian banking industry declined after deregulation in 1983 and 1988, but after this period it tended to be stable at concentrations level of CR4 by 40-50’s and CR8 by 50-60’s. Table 1 shows that the concentration level of banking industry in Indonesia is still at the middle level, and has not reached competitive levels.
Analysis of market power based on the SCP approach that uses structure as an indication of the competition level in the market raises many criticisms. Among them is the endogeneity problem between the structure and the performance, where the SCP approach assumes the existence of a one-directional relationship between structure and performance; thereby asserting market performance can be indicated from the existing market structure. Another criticism is associated with the use of accounting profit or price cost margin (PCM) as a proxy of the difference between price and marginal cost. The weakness of SCP approach raised a new approach that tries to analyze the level of competition in the market that was not based on the structure of the market, but based on the behavior of existing firms in the market. New Industrial Economics (NIE) approach estimates the size of market power in a market, which is then used as an indicator of the competition level. One of the estimation models in this new approach is the oligopoly model developed by Bresnahan (1982) and Lau (1982).

The main goal of this paper is to investigate the limit of Indonesian banking in setting the price. The power of firms to influence the price in a market shows the strength of their exercising market power and the existing competition level in the market. Considering the market structure is concentrated on few banks, we predict the competition level within Indonesian banking industry is relatively low, which also indicates a high market power. Joint hypothesis on competition and market power of the loan market in Indonesian banking industry will be measured and tested using Bresnahan-Lau (BL) oligopoly model framework.

The second part of this paper examines the theory and the derivation of the empirical model to estimate. The third part will discuss the methodology, while the fourth part will discuss

<table>
<thead>
<tr>
<th>Year 2000</th>
<th>Bank’s Name</th>
<th>Loan Share (%)</th>
<th>Year 2005</th>
<th>Bank’s Name</th>
<th>Loan Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bank Mandiri</td>
<td>14.95</td>
<td>1</td>
<td>Bank Mandiri</td>
<td>15.83</td>
</tr>
<tr>
<td>2</td>
<td>Bank Negara Indonesia</td>
<td>10.98</td>
<td>2</td>
<td>Bank Rakyat Indonesia</td>
<td>10.84</td>
</tr>
<tr>
<td>3</td>
<td>Bank Rakyat Indonesia</td>
<td>9.42</td>
<td>3</td>
<td>Bank Negara Indonesia</td>
<td>10.08</td>
</tr>
<tr>
<td>4</td>
<td>Ban Int’l Indonesia</td>
<td>6.61</td>
<td>4</td>
<td>Bank Central Asia</td>
<td>7.13</td>
</tr>
<tr>
<td>5</td>
<td>Citibank N. A.</td>
<td>4.47</td>
<td>5</td>
<td>Bank Danamon</td>
<td>5.20</td>
</tr>
<tr>
<td>6</td>
<td>HSBC</td>
<td>2.91</td>
<td>6</td>
<td>Bank Niaga</td>
<td>3.84</td>
</tr>
<tr>
<td>7</td>
<td>Bank Tabungan Negara</td>
<td>2.71</td>
<td>7</td>
<td>Bank Permata</td>
<td>2.77</td>
</tr>
<tr>
<td>8</td>
<td>Bank Central Asia</td>
<td>2.68</td>
<td>8</td>
<td>Bank Int’l Indonesia</td>
<td>2.47</td>
</tr>
</tbody>
</table>

CR4 41.96 CR4 43.88
CR8 54.73 CR8 58.16

= until March 2005
Source: SEKI of Bank Indonesia
the estimation result and its analysis. The conclusion and policy implication will be presented in the last part of the paper.

II. THEORY

Measurement of market power or the level of competition of an industry can be divided into two main approaches. The first is the traditional SCP approach, based on the use of accounting data relating to the profit and cost to measure the market power. The second approach emerging lately is the New Industrial Economics (NIE) or the New Empirical Industrial Organization (NEIO) that reduces or even eliminates the use of accounting data to measure market power. NIE approach uses a structural framework for the relationship of demand and supply to estimate market power. The approach is based on the premise that a firm in perfectly competitive market, which is the price takers, and a firm in an imperfect market, which has market power, will have different reactions on exogenous changes in demand and supply (Church and Ware, 2000).

As a reconciled mainstream (between traditional SCP mainstream and Chicago), the New Industrial Economics did not achieve its popularity by attacking the other, therefore we cannot easily determine a clear boundary line to distinguish it from previous mainstream. However, we can at least determine the specific characteristics that put it as ‘new’ mainstream (Lubis, 1997).

There are several characteristic. The first includes the game theory as its tool of analysis. The most obvious difference between ‘traditional’ and ‘new’ industrial economies is the explicit presentation of the game theory on the problem being examined. On traditional industrial economy, the causality flow was started from the structure to behavior, then to performance. For example, a profit over ‘normal’ (performance) in industry will be associated with collusive behavior that occurs due to the high concentration (structure), which is possible with the existence of barriers to entry.

With the inclusion of the game theory into the industrial economy, the flow of causality-effect was not only one direction, but it can even flow to all directions. The correlation is not only from the structure to behavior then performance, but to the set of all possible permutations of the structure, behavior, and performance (Norman and La Manna, 1992). In the new industrial economy, the number of firms operating in the market (structure) is determined endogenously, and depends on the type of game chosen by the firm, in terms of the variable options (price, output, etc.), the timing of decision, number of games played, etc.. All factors within in the structure, behavior and performance became elements that were determined simultaneously, and were influenced by fundamental factors such as technology (or technological opportunities), demand conditions, and the degree of symmetrical acquired information. Factors such as the barriers to entry or firm-specific advantage now become the decision variables that are determined endogenously by the strategic decisions of firms.
The second important characteristic of the NIE is its higher concern on the role of behavior (conduct) in the form of appreciation for the strategic dimension of corporate decisions. The firm does not react and adapt only towards external conditions, but also tries to make the economic environment where he belongs, give some advantages to him, considering his competitors will also do the same (Norman and La Manna, 1992).

In any policy formulation, a firm engaged in imperfectly competitive market (particularly oligopoly) should consider the impact of his policy implementation to its competitors. The change of price or output determined by a firm does not only affect sales and profits, but can also affect its competitors’ sales and profit, vice versa. Every oligopolist realizes this. Depending on the completeness and the speed of information obtained, any policy changes of a firm will quickly be responded and anticipated by other firms.

From the above discussion we conclude there is interdependent characteristic among firms operating in an oligopoly market. The existence of this interdependent characteristic makes oligopolist stay in a situation where optimal decision depends on decisions taken by the other firms. Thus, in taking the best decision, a firm must be able to make the best guess possibility on the reaction of its competitors, or alternatively, its decisions should be at least difficult to be predicted by his competitors (Layard and Walters, 1978).

The use of oligopoly is the strong characteristic of NIE. Although the oligopoly theory was generally derived from the theories within the Chicago mainstream, it was the NIE approach that started to use it in empirical studies. Since NIE ‘fixed’ the empirical study of previous mainstreams, then the NIEW is often referred as the New Empirical Industrial Organization (NEIO).

The weaknesses of the traditional SCP approach in the empirical analysis raised a new approach that tried to decrease the use of accounting data. Market power level that belongs to a firm was obtained from the estimation to structural models that described the relationship between demand and supply curves. Timothy F. Bresnahan (1982) and Lawrence J. Lau (1982) were the first economists who put forward this approach based on the oligopoly model framework.

Model used to estimate market power in Indonesia’s banking industry is BL oligopoly model using structural equation consisting of demand function and price function or supply (supply relation). Given profit function that belongs to a firm:

\[ \Pi = Pq - C(q, W) - F \]  

2 Beside using structural model of supply and demand, market power estimation can be also conducted by using static comparison method, which is called as reduced-form approach. Panzar and Rose (1987) used derived revenue function of the firm (firm’s reduced-form revenue function) to indicate firm’s behavior.
where $q$ is output, $P$ is price, $C$ is variable cost, $W$ is exogenous variables that affects the marginal cost or supply, and $F$ is fixed costs.

While the market demand function faced by the firm is:

$$P = f(Q,Z) = f(q_1 + q_2 + \ldots + q_n, Z)$$

(2)

where $Z$ is exogenous variable that affects demand. By including the demand function (2) into the profit function (1), then it will be:

$$\Pi = f(Q,Z)q - C(q,W) - F$$

(3)

By looking for the first derivation of profit function (3) to the change of $q$, then function will be:

$$\frac{d\Pi}{dq} = P + f'(Q,Z) \frac{dQ}{dq} q - C'(q,W) = 0$$

(4)

Then by assuming the condition is the average of all firms, then:

$$P + f'(Q,Z) \frac{dQ}{dq} \frac{1}{n} Q - \sum C'(q,W) \frac{1}{n} = 0$$

(5)

and, if $\lambda = \frac{dQ}{dq} \frac{1}{n}$ then equation (5) can be rewritten as:

$$P = -\lambda f'(Q,Z)Q + \sum C'(q,W) \frac{1}{n}$$

(6)

where the first derivation of the demand function $f'(Q,Z)$ denotes marginal revenue and the first derivation of cost function $C'(q,W)$ is the marginal cost. Recall equation $\lambda$:

$$\lambda = \left( \frac{dQ}{dq} \right) \frac{1}{n} = \left( \frac{dq + d \sum q_{rest}}{dq} \right) \frac{1}{n}$$

where the $\left( \frac{dq + d \sum q_{rest}}{dq} \right)$ shows conjectural variation of the firm. Conjectural variation can be defined as a change in the overall output of other firms (the rest) that are anticipated by one firm as the result of changes in the firm’s output (Bikker, 2003).
Referring to the equation (6) we can draw conclusions related to the firm’s ability to play at market prices.

1. For firms that are in a perfectly competitive market, because they are price takers, then change in a firm’s output would not affect the overall output. It shows that \( \lambda = 0 \), so that equation (6) will be:

\[
P = \sum C'(q, W) \frac{1}{n} \quad \text{or} \quad P = MC
\]

2. If firms form perfect collusion in the market then the increase in output of a firm would be followed by the increase in firm’s output,

\[
\lambda = \left( \frac{dq + d \sum q_{rest}}{dq} \right) \frac{1}{n} = \left( 1 + \frac{(Q - q)}{q} \right) \frac{1}{n} = \frac{Q}{q} \frac{1}{n} = \frac{Q}{qn} = 1
\]

so we got \( \lambda = 1 \)

3. If firms compete in Cournot framework, changes in the overall output would be only from one firm’s output change, without any retaliation from the rest of the firms.

\[
d \sum q_{rest} = 0 \quad \text{so that} \quad \lambda = \frac{1}{n}
\]

Thus between perfect competition and perfect collusion, the value of \( \lambda \) will range from 0 to 1, which means it can be used as an indicator to show the market power level or the competition level that exists in the market. The empirical study of market power estimation to figure out the competition rate in the market can be conducted by estimating the variable \( \lambda \). Therefore, to answer the purpose of the research, this study will estimate the market power of the Indonesian banking industry by estimating the value of \( \lambda \) obtained from the Bresnahan-Lau (BL) oligopoly model.

As mentioned above, the BL oligopoly model is a structural model consisting of demand and supply function. The BL oligopoly model formulation was conducted by customizing the previous demand function (2) and the price function (6). By using the inverse of demand function (2):

\[
Q = f(P, Z, \alpha) + \varepsilon
\]

and with a little adjustment in the price function (6) which is a supply curve function, then we get:
Both functions (7) and (8) above can be solved by using a two-stage least squares (2SLS) with the price $P$ and the output $q$ as an endogenous variable. The value of $\lambda$ that was obtained from the estimation of the above structural model can be used to show the strength of market power or the competition level in the market.

The demand function specification required to estimate the market power is found by determining the exogenous variables $(Z)$, which does not only shift the parallel demand curve, but can also change the slope degree of demand curve (Bresnahan, 1982)\(^3\). It can be conducted by inserting an instrumental variable which is the multiplication (cross-term) of price $P$ with exogenous variable $Z$, as follow:

$$ Q = \alpha_0 + \alpha_1 P + \alpha_2 Z + \alpha_3 PZ + \epsilon $$

Thus the exogenous variable $Z$ does not only shift the demand curve but also rotates\(^4\) it. The price equation used is:

$$ P = \frac{-\lambda}{\alpha_1 + \alpha_3 Z} \cdot Q + \beta_0 + \beta_1 Q + \beta_2 W + \eta $$

By using Figure 1, the logic of this structural model can be described as follow. With the change of exogenous variable $Z$, the slope degree of the demand curve and intercept will change. If the market behaves competitively, the rotation of the demand curve around the previous equilibrium will not change the equilibrium, so it is fixed in $(Q_1, P_1)$. However, if the firm has the market power, there will be a change in the equilibrium to be $(Q_2, P_2)$. Thus, the rotation of the demand curve caused by the exogenous variable $Z$, gives a different response between competitive markets and monopoly markets.

---

3. The verification for this identification problem was conducted by Lau (1982) which he called it as impossibility theorem.
4. It is necessary to estimate $\lambda$ because in the equation (8), variable $\lambda$ is related to variable $Q$, while variable $q$ consists of two, $q$ that is bound with $\alpha$ and $q$ that is bound with $\beta$. By this rotation, then $q$ can be separated from which is only bound with $\alpha$ and $\lambda$. 

III. METHODOLOGY

Market power in this study uses a quantitative approach by conducting inferential testing to the empirical model that was developed. Basic modeling refers to a variety of empirical studies that apply the BL oligopoly model, such as Alexander (1988), Steen and Salvanes (1999), Toolsema (2002), Bikker and Haaf (2002), and Bikker (2003); the last three studies applied the BL oligopoly model in banking industry. Departing from these three models used to estimate market power in loan market, are two structural equations, the loan demand function and supply function (cost function).

Referring to the demand function format (9), then the loan demand function used is:

\[
KREDIT = \alpha_0 + \alpha_1 SKMK + \alpha_2 PDB + \alpha_3 SKMK \times PDB + \alpha_4 SBI3 \\
+ \alpha_5 SKMK \times SBI3 + \alpha_6 CABANG + \alpha_7 INFLASI + \alpha_8 KREDIT_{-1} + \varepsilon
\]  

(11)

where \( KREDIT \) is the total loans distributed by commercial banks to the private sectors (claims on private sector). For price, we use the interest rates of the working capital loan (SKMK)\(^5\), whereas exogenous variables that affect the loan use Real GDP (GDP) with base year 1993, as an indicator of the public income, 3-months Certificates of Bank Indonesia (SBI3), the number of branch offices (BRANCH), the inflation rate (INFLATION) and the quantity of loan in the previous period (CREDIT-1).

---

\(^5\) Besides the interest rate of working capital loan, the interest rate of investment loan can be used, however, because the movement of the both variables run in the same direction, there is almost no difference between using the interest rate of working capital loan or investment loan.
There are two interaction variables; the interaction between loan interest rate (SKMK) with GDP and the interaction between SKMK and SB13. These two variables are used to rotate the demand curve.

From the supply side, based on equation (10), then demand or cost function of loan can be specified by the following equation:

\[
SKMK = \frac{-\lambda KREDIT}{\alpha_1 + \alpha_3 PDB + \alpha_5 SBI3} + \beta_0 + \beta_1 KREDIT + \beta_2 SD1 + \beta_3 INFLASI + \nu \tag{12}
\]

where the exogenous variables used as cost determinant indicators of banking loan distribution is a deposit rate for 1 month-term (SD1), and the inflation rate (INFLATION).

Both of the structural equations in loan markets above were estimated by using Two Stage Least Square method (2SLS). The object of the study is the loan market of commercial banks (aggregate). Period used in the estimation model is the first quarter of 1990 (Q1: 1990) until the fourth quarter of 2004 (Q4: 2004). After adjustment, a total of 59 observations were obtained.

It should be underlined that there was an important test to be conducted on both structural models, which is the separability test. Technically, this procedure tested whether the interaction of variables used in the model is valid or not.

There are two structural equations in the empirical model, which respectively have one interaction variable. To estimate the market power \( \lambda \), then the necessary condition is that both demand functions of the credit market are non-separable, which means it is the expected null hypothesis \( H_0: \hat{\beta}_{SKMK \ast SBI3} = \hat{\beta}_{SKMK \ast PDB} = 0 \) would be rejected, so that the two interaction variables, denoted as SKMK \ast SBI3 and SKMK \ast GDP, are still valid to use in the model.

IV. RESULTS AND ANALYSIS

Loan demand model estimation results (11) using Two Stage Least Square (2SLS), is presented in Table 2. As previously stated, this market power estimation needs both equations to be non-separable. The result of the separability test conducted with Coefficient Test LR-Redundant Test is given as follows:

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6 Interaction with other exogenous variables, for instance branch offices and inflation did not give any significant result, so that they are not included in the model.
Interest rate of *market power*

### Table 2: Loan Demand Estimation Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constanta</td>
<td>-1.26E+15</td>
<td>-2.0204</td>
</tr>
<tr>
<td>Interest Rate of working capital loan (SKMK)</td>
<td>5.67E+13</td>
<td>2.0444</td>
</tr>
<tr>
<td>Real GDP (GDP)</td>
<td>11.9359</td>
<td>2.0005</td>
</tr>
<tr>
<td>3-months certificate of Bank Indonesia</td>
<td>1.34E+13</td>
<td>2.1306</td>
</tr>
<tr>
<td>Loan (-1)</td>
<td>1.1494</td>
<td>7.0338</td>
</tr>
<tr>
<td>SKMK*SBI3</td>
<td>-5.44E+11</td>
<td>-2.3886</td>
</tr>
<tr>
<td>SKMK*PDB</td>
<td>-0.5439</td>
<td>-2.0687</td>
</tr>
<tr>
<td>Branch Offices</td>
<td>-2.04E+12</td>
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<tr>
<td>Inflation</td>
<td>8.94E+14</td>
<td>2.9979</td>
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<tr>
<td>Adjusted R2</td>
<td>0.9344</td>
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<td>DW Stat</td>
<td>2.0124</td>
<td></td>
</tr>
<tr>
<td>F Stat</td>
<td>105.873</td>
<td></td>
</tr>
<tr>
<td>Prob (F Stat)</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>

Sources: author’s calculations  
Note: The dependent variable is the total loan value. Model Correction was conducted with White Heteroscedasticity

Based on the above test, the null hypothesis is rejected at the 5% level of confidence. It can be concluded that loan demand function is *non-separable* at interest rates of 3-months Certificates of Bank Indonesia (SBI3) and income (GDP).

For t-statistics test with null hypothesis $H_0: \beta = 0$, it indicates that the value of t-statistics of all independent variables rejected the null hypothesis at the 5% level of confidence. In other words, all independent variables, the interest rate of working capital loan (SKMK), Real GDP (GDP), 3-months Certificates of Bank Indonesia (SBI), branch offices (BRANCH), inflation rate (INFLATION) and Credit lag variable, and the interaction variable *cross-term* between SKMK with GDP (SKMK * GDP) and SKMK with SBI3 (SKMK * SBI3), significantly (*statistically significant*) have a relationship with the dependent variable which is credit demand.

The influence of the interest rate of the working capital loan (SKMK) to the total loan value demand works in two ways; direct and indirect effects. The direct effect is shown by the
SKMK coefficient by 5.67 E +13, which means each 1 percent increase of SMK would increase the number of SKMK loan demand by Rp. 56.7 trillion. The indirect effect is shown by two interaction variables, namely SKMK * SBI3 and SKMK * GDP. Both of interaction variables are negative, which are -5.44+11 and -0.5439 E. The effect of total SKMK to the loan take into account the three coefficients, which amounted to $\frac{dKredit}{dSKMK} = 5.67 \text{E} +13 - 5.44 \text{E} +11 * \text{SBI3} - 0.5439 * \text{GDP}$.

It shows that the effect of SKMK on loan demand depends on 3-months Certificates of Bank Indonesia (SBI) and the Real GDP. By using the mean\(^7\) for SBI3 and Real GDP during the

---

\(^7\) The average values of SKMK and GDP during the observation are 15.73 and 92,135.04, respectively.
period of observation, we obtained that the SKM effect on the total loan demand was $4.81 \times 10^{13}$. SKMK positive effect on credit is not consistent to the hypothesis. In the following figure we can see the movement of both variables during the observation period.

From the two above figures, it can be seen that in some periods before the economic crisis (1991-1997) and after crisis (2002-2004), loan and SKMK variable moved in opposite direction, except in the crisis period where the total loan values experienced a sharp decline even though the interest rates of working capital loan had been lower. This one-directional movement patterns after the crisis, explained the positive impact of SKMK on credit.

The interest rate of working capital loan (SKMK) positively influenced the total loan value demand. The increase of 1 percent SKMK interest rate would increase the amount of loan by Rp 56.7 trillion. It contradicts the hypothesis because the relationship between loan interest rate and loan demand should theoretically be negative. The possible explanation of these results is that the parties who demanded loans from banks did not consider the loan interest rate as a constraint. It means despite the high loan interest rates, they will keep demanding for loan. In addition, another reason is the bank policy which is fairly easy in giving a loan, although the feasibility of the loan is not certain.

As the SKMK variable, the influence of public income indicated by GDP also has a direct and indirect effect. The direct effect of GDP to total the loan demand is 11.9359, which means each 1 Rupiah rise in GDP will increase the loan demand by 11.9 Rupiahs. Meanwhile the indirect effect is shown by the coefficient of interaction variable by -0.5439 SKMK * GDP. The effect of the total GDP on credit is \( \frac{dKredit}{dPDB} = 11.9359 - 0.5439 \times SKMK \). By using the average SKMK, then the total GDP impact on the loan was 3.38. This positive effect was consistent with the hypothesis that the amount of loan will increase along with economic development because of the need for investment and enterprises which will also increase.

Public income variable (GDP) positively affects the loan demand. Each increase of 1 Rupiah GDP will increase the loan by 11.9 Rupiahs. It is consistent with the hypothesis that the more economy develops, the more loan demanded for investment.

The 3-months Certificates Interest Rate of Bank Indonesia (SBI) also positively affected the demand for loan, although the size effect of SBI3 also depends on the value of SKMK, as shown by the coefficient of interaction variable SKMK * SBI3. Although the interaction variable is negative, but overall, \( \frac{dKredit}{dSBI3} = 1.34 \times 10^3 - 5.44 \times 10^1 \times SKMK \) SBI3 effect on the total loan value demanded remains positive by 1.97 \( \times 10^2 \). The one-directional relationship between loan and SBI3 shows that the role of SBI3 as an instrument in encouraging the banking intermediary function does not work according to the hypothesis. When the SBI gets lowered, the Certificate of Bank Indonesia remains relatively less attractive than the banking products, then we expect collected third party funds to increase and ready to be injected into the economy. However, what happened in the period of analysis is, when the SBI rate declines, the total loan value distributed decreased as well. In the following figure, the positive relationship was likely
caused by conditions in the crisis period, where after its peak in the third quarter of 1998, SBI3 dramatically dropped, but the total loan value also remained low until 2001.

![SBI3 Interest rate Movements, 3-Month SBI](image)

Interest rate variable of 3-months certificates of Bank Indonesia (SBI) also positively affected the demand for loans. An increase of 1 percent SBI3 will increase the loan by Rp 13.4 trillion.

The total loan value in the previous period also had a positive influence. This variable is essentially representing the speed of adjustment lag from one quarter to the next quarter. The total loan value in the previous period also positively influenced the current loan demand. Each 1 Rupiah increase in loan in the previous period will increase the demand for current loan by 1, 15 Rupiahs.

Number of branch offices (BRANCH) has a negative correlation with the total loan value, where each increase of one unit of branch office will decline the total loan value by Rp 2.04 trillion. This is contrary to the hypothesis that expressed the more number of branches, the greater the service coverage, would eventually increase the distribution of loan. At the beginning of observation, the number of branches was 2842, this value then increased significantly until the end of the analysis period by 7826. If it is associated with loan’s movement as shown in Figure 2, then the negative relationship is, again, due to the movement over the crisis period.

Number of branch offices (BRANCH) has a negative correlation with the total loan value. It means branch offices will decline the total loan value by Rp 2.04 trillion. It is contrary to the hypothesis that expressed the more number of branches, the greater the service coverage, which eventually would increase the demand for loan.

Inflation rate (INFLATION) was positively related to the demand for loan. 1 point increase of inflation will increase the demand for loan by Rp 894 trillion. In the literature of banking and
loan, the relationship between inflation and loan demand can be uni-direction or bi-directional. Explanation on this positive relationship is a firm using two funding resources to finance working capital, i.e., money (own capital) and capital loans (from banks). The high inflation rate penalizes the firm for using much more of its own capital; hence the loan from bank would be more desirable.

Inflation rate (INFLATION) was positively related to demand for loan. The increase of 1 point will increase the demand for a loan by Rp 894 trillion. Meanwhile, both interaction variables significantly influenced the demand for credit, but this will not be specifically analyzed because its function is to determine the market power level acquired by Bank Indonesia.

In Table 3, it is shown the results of estimation of the cost equation by using the interest rate variable of credit working capital loan (SKMK) as dependent variable. From first estimation result, the correlation test result of Ljung-Box test Q-statistics show that the estimation cost equation of the interest rates of working capital loan (SKMK) contained a serial correlation. By using ARIMA models in the first-order level to overcome the problem of serial correlation, and the White Heteroscedasticity-Consistent Covariance to overcome heteroscedasticity problem, then the equation of the cost of working capital loan interest rates (SKMK) after being fixed is as shown in Table 3.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constanta</td>
<td>15.1608</td>
<td>11.9184</td>
</tr>
<tr>
<td>Loan</td>
<td>-1.11E-14</td>
<td>-4.0635</td>
</tr>
<tr>
<td>Interest Rate of 1-month deposit (SD1)</td>
<td>0.5501</td>
<td>8.2691</td>
</tr>
<tr>
<td>Mark-up ($\lambda$)</td>
<td>-0.0233</td>
<td>-1.6961</td>
</tr>
<tr>
<td>Inflation</td>
<td>-40.3296</td>
<td>-2.1643</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.1336</td>
<td>0.1372</td>
</tr>
<tr>
<td>MA(1)</td>
<td>0.1275</td>
<td>0.1279</td>
</tr>
</tbody>
</table>

For t-statistics test with the null hypothesis $H0: \beta = 0$, it indicated that the value of t-statistics of all independent variables rejected the null hypothesis at 5% confidence level (except for mark-up variable at 10% confidence level). In other words all independent

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8 Refer to Amidu (2006), who explained some studies in terms of the relationship between inflation and demand for loan.
variables, including loan, interest rate of 1-month deposits (SD1), inflation rate (INFLATION), even the variable that became the main object in this study mark-up variable ($\lambda$), were significantly related to the dependent variable, which is the interest rates of the working capital loan (SKMK).

The total loan value negatively influenced the interest rate of SKMK. The increase of 1 trillion Rupiahs of loan will decrease SKMK by 1.11 percent. The negative relationship is contrary to the hypothesis where the total loan value should have increased then the cost of managing the loan would be increasing so that the bank would increase the interest rate of working capital loan (SKMK). The negative effect of the total loan value distributed to SKMK allegedly occurred because banks try to reduce the risk of non-performing loans. In the early period (1990), the ratio of non-performing loans was estimated at 4.5%, but increased to 12% in 1994, and the bank managed to reduce it to 8.8% in 1996. However, the ratio increased again after the crisis. During the period after the crisis, the ratio was successfully decreased where in 2001 it was 12.13% and dropped down to 4.5% in 2004 (December).

The total loan value negatively affected the interest rate of SKMK. The increase of 1 trillion Rupiahs of the amount of loan will decrease SKMK by 1.11 percent. It is contrary to the hypothesis expressed, which means the greater the amount of loan distributed, does not necessarily add to the cost of banking reflected through the interest rate of SKMK, but instead, banks would cut the interest rate to reduce the risk of non-performing loans.

1-month interest rate deposits (SD1) affected positively on the interest rate of working capital loan (SKMK). The increase of SD1 by 1 percent will increase SKMK by 0.55%. This is consistent with the hypothesis that interest rates of SD1 acts as the main cost (cost of fund) of the distribution of credit. The larger banks pay interest on funds collected, and then it requires

![Figure 5. Movement of the SD1 and SKMK](image-url)
Market Power of Indonesian Banking

The variable of 1-month interest rate of deposits (SD1) influenced positively on the Interest Rate of working capital loan (SKMK). The increase by 1 percent on SD1 will increase SKMK by 0.55%. This is consistent to the hypothesis that the SD1 interest rate serves as a major cost of loan distribution. The more banks pay the interest from the collected fund, and then they require a larger income as well. That is why SKMK interest rates would be increased.

Inflation rate (INFLATION) negatively influenced the interest rates of working capital loan (SKMK), in which each increase of 1 percent Inflation would decrease SKMK by 0.4 percent. This negative relationship is contrary to the hypothesis, whereby when the inflation rate rises, the cost of funds collected by banks would increase because the banks receive a repayment which is fewer than the funds distributed at the first time. To prevent it, the banks will increase the loan interest rate. However, in this paper, the relationship between inflation and loan interest rates would be negative.

A possible explanation of these results is the existing positive relationship between the risk of bad debts and the inflation rate. To reduce the risk of bad debts when inflation increases, the bank should lower the interest rate of the loan. As in the previous description, the ratio of bad debts was relatively high during the period of analysis and only decreased at the end of the period of analysis.

What became the main object of this study is the level of market power exercised by Indonesia's national banks. In constructing the main hypothesis of this study, the market power in the loan market of the Indonesian banking industry is expected to be high because it has a high level of concentration. In other words, it estimated that the level of competition in Indonesian banking industry is relatively low. From the result estimation of the above model, it obtained the level of market power (mark-up) by 0.023. With the low level of market power, it proved that the joint hypotheses which expressed that the empowerment of market power in the banking loan market was high, which also shows that the relatively low level of competition cannot be accepted.

The estimation result of market power in the loan market of the Indonesian national banking industry generated quite a low mark-up value. The table below shows a comparison of the market power level between loan market of Indonesian banking and hypothetical oligopoly condition.
Table 4 shows that the mark-up value in the loan markets is 0.0233. Based on Wald test, these values are also different significantly from zero (10% confidence level).

Thus market power in the loan market is not the same as the market power in perfectly competitive market, even when it is compared with the level of market power of Cournot competition by 0.00527. However, since the mark-up value is far less than 1 (monopoly market power), then it can be inferred that the level of competition in it is also quite high.

From these results, it can be concluded that the use of (exercising) market power in the loan market of the Indonesian banking industry is still quite low, which means the level of competition in the loan market of the Indonesian banking industry is still quite high.

V. CONCLUSION

This paper is intended to test the joint hypotheses regarding the level of competition and market power of the loan market in Indonesian banking industry using the Bresnahan-Lau (BL) oligopoly model framework. Market power indicates the ability of firms in the market to influence prices, and shows the level of competition in the market.

BL oligopoly model used in this paper is a structural model that describes the relationship between the demand and supply curve, within which the determination of market power does not need production cost data that is often difficult to access.

By using the model, the findings showed that the level of competition in the loan market of the Indonesian banking industry is still high as seen from the mark-up coefficient by 0.0223.
However, although the level of competition is high, the credit market of the Indonesian banking industry cannot be said to be a perfectly competitive market.

The study results using BL oligopoly model estimated that the competition level of the structural equations have different results when compared ‘measuring’ the level of competition based on the level of banking concentration. Based on the concentration level at the value of CR4 estimated by 40s, it shows that banking industry remains relatively competitive. However, with the BL oligopoly model, it is seen that the banking industry in the credit market has already been relatively competitive.

The study uses the BL oligopoly model that estimates market power directly from the structural equation, and implies that it is not valid to use market structural data as an indication of the level of competition in the loan market for the Indonesian banking industry. Even though the Indonesian banking industry in the loan market is structurally quite concentrated, the competitive behavior of commercial banks in distributing credits is quite high.
REFERENCES

THE IMPACT OF EXCESS LIQUIDITY ON MONETARY POLICY

M. Barik Bathaluddin
Nur M. Adhi P.
Wahyu A.W. 1

Abstract

This paper analyzes the excess liquidity especially on banking industry and its impact on monetary policy in Indonesia. We firstly investigate the determinants of bank behavior on their favor for excess liquidity both for precautionary motive and involuntary. Furthermore we determine the threshold between the low and high excess liquidity regimes. On the next step, this paper evaluates and compares the impact of excess liquidity on monetary policy between the two regimes. The first result shows that the excess liquidity on bank with their precautionary motive is significantly determined by the volatility of money demand, the volatility of economic growth, the bank cost of the bank, and also by the lag of excess liquidity, which conform its persistence. Secondly, using the Threshold-VAR approach, this paper shows the switching regime occurs in 2005 from low to high excess liquidity. Lastly, the excess liquidity reduces the effectiveness of monetary policy on controlling inflation.

Keywords: Excess liquidity, Threshold VAR, monetary policy transmission mechanism.
JEL Classification: B23, E5

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I. INTRODUCTION

Excess liquidity in Indonesian banking started since economic crisis 1997. At that time, the worsen condition of national banking due to the high non-performing credit and the decline in public confidence urged the government to provide liquidity support for the troubled banks. The aim was to rescue the entire banking system. However, since the government fund was not sufficient, in 1998 Bank Indonesia provided bailout fund, known as Bank Indonesia Liquidity Support (BLBI), by Rp 144.5 trillion. Other programs to save the banking system was banking restructuring and recapitalization program. For the latter program, government issued bond for capital participation in 24 banks, to help them meet the capital requirements ruled by Bank Indonesia. These two programs; BLBI and banking recapitalization program, started the era of soaring and persistent excess liquidity in national banking system, until now.

Along with the economic development, the persistency of excess liquidity often creates problems for the central bank and for the economy in general. Excess liquidity can reduce the effectiveness of monetary policy transmission mechanism, especially in affecting demand side to reach the targeted inflation. In addition, the excess liquidity in banking system will push the central bank to absorb it through monetary operation in forms of SBI auction (Certificate of Bank Indonesia), Fasbi, and FTK, to eliminate its pressure on financial market.

Nevertheless, when the excess liquidity is very large and persistent, it gives pressure to the sustainability of central bank’s balance because central bank should pay interest for banking fund placement in SBI, Fasbi, or FTK. Noted to October 2010, excess liquidity absorbed through Open Market Operation (OMO) reached Rp 381 trillion.

On the other hand, from the bank perspective, the excess liquidity raise the risk of real sector and make them reluctant to distribute their fund to productive loan, and choose to place...
it in monetary instrument. Consequently, the fund for the real sector is limited and even if it is available, the price would be higher.

However, not all excess liquidity portions negatively affect the effectiveness of monetary policy transmission mechanism. In certain portion, excess liquidity is useful as a buffer for banking towards the uncertainty of fund withdrawal by customer and exchange rate volatility, influence the banking capital. Within this necessary portion, excess liquidity is called *precautionary excess liquidity*. The remaining excess liquidity is unnecessary and is potential to give negative impacts for effectiveness of monetary policy. This remaining excess liquidity is called *involuntary excess liquidity*.

Therefore, it is necessary to determine the magnitude of precautionary and involuntary excess liquidity. By having this knowledge, authority monetary can determine how much excess liquidity to absorb through open market operations (OMO).

Empirical research on excess liquidity and its consequences toward the effectiveness of monetary policy are widely available. Saxegaard (2006) is one of the most cited references. Saxegaard underline the necessity to quantify how much excess liquidity needed by banking for precautionary purpose. Using the sample of African countries in Sahara, he found that significant amount of involuntary excess liquidity reduced the effectiveness of monetary policy transmission in controlling inflation. The reason is better aggregate demand increase the lending rapidly, and then increases the risk of inflation pressure.

Absorbing excess liquidity through OMO is expensive for the central bank. On the other hand, during cyclical downturn condition, stimulating aggregate demand would be ineffective since banking cannot put this unproductive excess liquidity in the form of lending or treasury bills.

Following Saxegaard method (2006), this paper will (i) calculate precautionary and involuntary excess using banking excess liquidity model; (ii) estimate regime-switching models of monetary policy transmission mechanism, using threshold-VAR to determine the regime period of high and low precautionary excess liquidity. In general, the objectives of this research are to acknowledge the impact of excess liquidity persistency on monetary policy effectiveness; and to give policy recommendation toward excess liquidity persistency condition.

The second session of this paper covers theories and literature studies. The third session covers methodology and data, while the fourth session analyzes the result and analysis. Conclusion will be given in the last session part and close the presentation.

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II. THEORY

Excess liquidity is the bank reserves deposited in central bank, plus cash for daily operational needs (cash in vaults), minus minimum reserve requirement, (Saxegaard, 2006). In this context, excess liquidity is used by banks as a precautionary, and representing the bank optimization behavior.

The sources of precautionary excess liquidity can be varied. Crisis with high uncertainty and high default risk can be one of them, where banking tends to keep non-remunerated liquid assets as precautionary strategy (Agenor et.al, 2004). Another source of excess liquidity is institutional factor, where under developed interbank money market (IBM) will stimulate bank to increase liquidity for precautionary, since they often find it hard to borrow in emergency situation. Two other sources of excess liquidity are the difficulty on watching their minimum reserve requirement position; therefore the banks will hold reserves above the level set, and also the problems in payment system.

Not all excess liquidity arises from bank precautionary behavior. In a certain condition, excess liquidity owned by banks is neither precautionary nor involuntary. In this involuntary context, non-remunerated reserves owned by banks do receive return to balance the opportunity cost when it is held by banks.

Banks prefer holding excess liquidity than giving loan or buy government obligation, especially in a long run. The reason is the economic condition is in liquidity trap. Liquidity trap is a condition where return from banking credit is too small to cover intermediation cost and banks get higher yield in reserves than giving loans. In this condition, expansive monetary policy will only cause increase in excess reserves.

Agenor et.al. (2000) developed theoretical model of excess liquid reserves demand by commercial banks, where liquidity and volatility risks of real sector exist. To manage both of these risks, and to determine the amount liquid assets to hold, commercial banks can get fund from interbank money market or from the central bank.

There is one representative commercial bank that collect exogenous fund from third parties (Deposit, D). The bank has to determine the amount of non-interest-bearing liquid asset (reserve, R) and the amount of interest-bearing non-liquid asset (in credit form, L). The balance sheet for this commercial bank is:

\[ R + L = D \] (1)

Reserve is needed by banks because liquidity risk exists. A net flow of third parties is random based on density function; \( \Phi = \Phi' \). When net outflow from third-party funds (TPF) exceed reserves owned by the banks, \( u > R \), banks have to bear illiquidity cost, proportional to reserve shortage, \( \max (0, u - R) \). In illiquid condition, banks have to borrow reserve with penalty.
rate \(q\), which is higher that the loan rate, \(q > r_L\). Defining \(r_D\) as a deposit rate, the banks profit can be formulated as:

\[
\Pi = r_L L - r_D D - q \max(0, u - R)
\]

(2)

So the expected profit from the bank is:

\[
\Pi = r_L L - r_D D - q \int_R^{u_k} (u - R) \phi(u) \, du
\]

(3)

By assumption, loan demand is negatively influenced by interest rates and is proportional to expected output \(Y^e\). Similarly, TPF is proportional to expected output, but positively influenced by deposit interest rates:

\[
L = f(r_L) Y^e, f' < 0
\]

(4)

\[
D = g(r_D) Y^e, g' > 0
\]

(5)

It is also assumed that economic agents determine \(L\) and \(D\) in the beginning of the period, before a shock in the output. Moreover, there is also demand for cash determined in the end of the period, after a shock in output and liquidity. Banks have to maintain liquid reserve, at certain proportion of third-party fund they owned, with interest rate \(r\). Defining \(\theta\) as reserve requirement rate and \(R\) as total reserve, the excess reserve, \(Z\), is:

\[
Z = R - \theta D = (1 - \theta)D - L
\]

(6)

The balance condition of money market is:

\[
C + D = kY
\]

(7)

where \(C\) is currency holding; \(k > 0\) is constant reciprocal of velocity; while \(Y\) is the realized output.

This model also assumes that demand on cash is proportional to realized output. Specifically, the assumption is as follows:

\[
C = c/(1 + c) \cdot kY
\]

(8)

Where \(c = C / D\). Output and \(c \cdot k / (1 + c)\) is assumed as random based on the following equation:
Where $\varepsilon$ and $\xi$ are random shocks.

By applying equations (8) and (9), a demand on cash is formulated as:

$$C = \Lambda kY^e(1 + \varepsilon)(1 + \xi)$$
$$= \Lambda kY^e x, (1 + \varepsilon)(1 + \xi) = x \sim N(\mu, \sigma^2)$$

To fulfill the needs of unanticipated demands for cash, banks can borrow cash followed by interest by $q$, and take some of the excess reserve ($Z$). By using equation (6), the expected reserve deficiency is:

$$E \max [0, C - ((1 - \theta)D - L)]$$

Based on equation (11), (4), (5), and (7), we can get the equation for expected profit from banks as follows:

$$\Pi = [r_Lf(r_L) - r_Dg(r_D)]Y^e + rR - qE \max [0, C - ((1 - \theta)D - L)]$$

By assumption, the functions and are quasi-concave functions. We can prove the following propositions (the complete proofs can be seen on Agenor et. al, 2000).

1. The increase of penalty rate ($q$) will increase the deposit interest rates, credit interest rates and excess reserve owned by banks.
2. The increase of output's volatility and liquidity shock causes ambiguous effects to deposit interest rates, loan interest rates, and excess reserve. If the initial level of penalty rate is pretty high, the increase of this volatility will also rise up the deposit interest rates, loan interest rates, and excess reserve.
3. The increase of reserve requirement rate will increase the credit interest rates and decrease excess reserve. If the level of volatility is not too high, an increase of reserve requirement rate will increase the deposit interest rates.

Based on the three propositions above, if the level of penalty rate is high, there will be interrelationship among excess reserve ($Z$), penalty rate ($q$), reserve requirement rate ($\theta$), and output's volatility and liquidity shock ($\sigma$) as follows:

$$Z = Z(q, \theta, \sigma)$$

$$Y = Y^e(1 + \varepsilon), \quad c.k/(1 + c) = \Lambda(1 + \xi)$$
By sorting excess liquidity into the precautionary and the involuntary, we have deeper understandings about their impact on the monetary policy transmission mechanism. On inflationary contexts, involuntary excess liquidity will be released promptly when the aggregate demand side grows stronger. Therefore, the total liquidity in economy will increase rapidly without involving policy rate reduction mechanism (loosen monetary policy), just when the liquidity should be restricted. This triggers the risk of inflation pressure.

Furthermore, when banking has involuntary excess liquidity due to the problem in distributing loan, an effort to increase the demand by decreasing the lending cost would be ineffective. The expansive monetary policy will only increase the excess reserve in banks and not the loan expansion. In contrast, if tight monetary policies are chosen, banks will reduce their unwanted reserve. O’Connell (2005)\(^3\) states that:

\[ When \text{there is involuntary excess liquidity in the economy in equilibrium, the transmission} \]
\[ \text{mechanism of monetary policy, which usually runs from a tightening or loosening of liquidity} \]
\[ \text{conditions to changes in interest rates or asset demands and then to economic activity, is altered} \]
\[ \text{and possibly interrupted completely.} \]

On the other hand, monetary policy is expected to be more effective if banks have the precautionary liquidity access. For example, when monetary policy is loosening by decreasing minimum reserve requirement, bank liquidity will rise; hence will increase the allocation for loan with lower interest rate. On the other hand, when the central bank chooses tight monetary policy, banking will reduce their loans to maintain the level of expected excess reserve.

Based on the descriptions above, the analysis on the effects of excess liquidity to monetary policy transmission mechanism requires better understanding on how consistent the policy on reserve requirement is, on driving the excess reserve demand of bank. Moreover, the understanding on the sources of excess liquidity is important to decide what policy should be taken.

There have been a lot of researches about excess liquidity in Indonesia. They focus on different views about source and impact of the excess liquidity. Some of the researches are summarized in the table below.

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III. METHODOLOGY

3.1. Estimation of Precautionary and Involuntary Excess Reserve

Following Henry et al. (2010), who use theoretical model of Agenor et al. (2000), we estimate the precautionary excess reserve with the following empirical model:

\[
\ln \left( \frac{EL}{D} \right) = a_1(L) \ln \left( \frac{EL}{D} \right) + a_2(L) \ln \left( \frac{RR}{D} \right) + a_3(L) CV_C + a_4(L) CV_Y \frac{Y}{V_T} + a_5(L) \ln \left( \frac{Y}{V_T} \right) + a_6(L) r + v_t \quad (14)
\]

Where \( EL \) is Excess liquidity; \( CV_{c/d} \) is Cash/Deposit volatility; \( D \) is Deposit; \( CV_{y/y_t} \) is Output gap volatility; \( RR \) is Reserve requirement; \( Y/Y_t \) is Output gap; and \( r \) is Penalty rate.

### Table 1. Literatures on Excess Liquidity

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Analysis Method</th>
<th>Result</th>
</tr>
</thead>
</table>
| Mochtar & Kolopaking     | 2010 | Regression          | - The strategy of foreign exchange reserves accumulation could disturb the effectiveness of monetary policy since there will be liquidity expansion by the central bank without any mechanism on the influences of interest rates.  
- Some of the negative impacts for the action are:  
  - The efforts in controlling inflation are not optimal.  
  - The increasing of exchange value potency as a shock amplifier.  
  - There is a disturbance in the interaction between fiscal and monetary policies. |
| Saxegaard                | 2006 | Regression, Threshold VAR | - A persistent high excess liquidity will weaken the monetary policy transmission mechanism; hence reduce the capability of central bank to influence demands in economy. |
| Prastowo & Prasmuko      | 2008 | Qualitative         | - There is a large substitutive correlation between the decrease of SBI (Bank Indonesia Certificate) and the delivery of credits in Indonesian banking.  
- The liquidity of banking depends mostly on the sale of SBI (Certificate of Bank Indonesia). |
| Widayat, et al.          | 2005 | Qualitative, Accounting | - The volatility of inter-bank interest rates, PUAB) depends on the high excess liquidity, both short-term and relatively permanent one (long term).  
- The discretionary monetary policy creates uncertainty in prices and the banking liquidity placement. |
We use Certificate of Bank of Indonesia (SBI) owned by bank as the proxy for excess liquidity. This is in line with Prastowo and Prasmoko (2008), which argue that banks prefer to put their excess liquidity in the form of SBI rather than in giral account in Bank Indonesia. We use monthly data as listed on the following table:

<table>
<thead>
<tr>
<th>Table 2. Data for Precautionary and Involuntary Excess Liquidity Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>Excess Liquidity</td>
</tr>
<tr>
<td>Third Party Funds</td>
</tr>
<tr>
<td>Reserve Requirement</td>
</tr>
<tr>
<td>Coefficient of variation of Cash to deposit ratio (volatility risk)</td>
</tr>
<tr>
<td>Coefficient of variation of output from trend</td>
</tr>
<tr>
<td>Penalty rate</td>
</tr>
<tr>
<td>Output Gap (proxy for demand for Cash)</td>
</tr>
</tbody>
</table>

After estimating precautionary excess reserve using Equation (13), we proceed to estimating involuntary excess reserve. In this step, we subtract the actual independent variables in Equation (13), which were the proxy for total excess liquidity owned by banks, with the estimated one from Equation (13). In the other words, involuntary excess reserve is estimated with residual from Equation (13) estimation.

3.2. The Impact of Involuntary Excess Reserve on Monetary Policy Transmission

On this step, we test the hypothesis; that the presence of high involuntary excess reserve in banking may weaken the monetary policy transmission mechanism. Following Saxegaard (2006), we use estimated involuntary excess reserve from the first step as a threshold variable in analyzing VAR model, which represent the transmission of monetary policy in Indonesia. In this stage, we allow the possibility for non-linearity in monetary policy transmission caused by deviation of involuntary excess liquidity relative to certain threshold.
We estimate the reduced form two-regime TVAR below:

\[
\begin{pmatrix}
Y_t \\
M_t
\end{pmatrix} = C_t(L) \begin{pmatrix}
Y_{t-1} \\
M_{t-1}
\end{pmatrix} + \begin{pmatrix}
\nu_{it}^Y \\
\nu_{it}^M
\end{pmatrix}, \quad \text{untuk } i = 1,2
\]

\[\begin{array}{c}
i = 1 \text{ jika } EL_t^{inv} \leq \tau, \\
i = 2 \text{ jika } EL_t^{inv} > \tau
\end{array}\]

Where \( \nu_{it}^Y \) and \( \nu_{it}^M \) are shock vectors that are not regime dependent, representing non-policy and policy variable respectively; \( C_t(L) \) is regime-dependent matrix of polynomial lag from autoregressive parameter; \( EL_t^{inv} \) is threshold variable (involuntary excess reserve), which determine the current regime, relative to certain threshold (\( \tau \)).

As in Bernanke and Milhov (1995), the dependent variables are divided into two group in reduced form VAR; non-policy variable such as GDP and inflation, and policy variable including nominal exchange rate and BI rate policy. The data we use on this step is explained in Table 3. All variables are transformed into natural logarithm and are de-trended using HP Filter.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involuntary Excess liquidity</td>
<td>Estimated from step 1</td>
</tr>
<tr>
<td>Output</td>
<td>Industrial production (CEIC)</td>
</tr>
<tr>
<td>Inflation (yoy)</td>
<td>Source: DSM</td>
</tr>
<tr>
<td>Exchange rate</td>
<td>Source: CEIC</td>
</tr>
<tr>
<td>BI rate</td>
<td>Source: DSM</td>
</tr>
</tbody>
</table>

In estimating this reduced form VAR, we apply MSVAR software (Krolzig-1998). The existence of non-linearity in monetary policy transmission mechanism will formally be tested using this program. Furthermore, regime-dependent impulse response will be used to analyze the difference of economics response towards monetary policy shock between the 2 regimes.

Christiano and Echenbaum (1996) argue that one cannot identify the impact of monetary policy shock directly using the reduced form two-regime TVAR model in Equation (14), since the covariance matrix of residual vector is not diagonal. This is because the monetary policy depends on economic condition; hence response of the economic variable reflects the combination effect between monetary policy and other variables which also change the monetary
The Impact of Excess Liquidity on Monetary Policy

To solve this problem, we need to implement restriction in TVAR model. This restriction is obtained by searching matrix $A_i$, which fulfill the following conditions:

$$A_i^{-1}(Y_t - M_t) = A_i^{-1}C_i(L)(Y_{t-1} - M_{t-1}) + \begin{pmatrix} u_{it}^Y \\ u_{it}^M \end{pmatrix}$$

for $i = 1, 2$ or

$$A_i^{-1}\begin{pmatrix} v_{it}^Y \\ v_{it}^M \end{pmatrix} = \begin{pmatrix} u_{it}^Y \\ u_{it}^M \end{pmatrix}$$

for $i = 1, 2$ \hspace{1cm} (16)

For $\begin{pmatrix} u_{it}^Y \\ u_{it}^M \end{pmatrix}$ is error vector with diagonal covariance matrix $A_i \sum_i A_i'$.

We need to identify the influence of policy variable shock (policy interest rate), which is not anticipated by other endogenous variable. Bernanke and Blinder (1992) argue that to identify the impact of policy monetary shock without identifying the complete model structure, we can assume the policy variable react contemporaneously on non-policy variable, but not the other way around. Following this, we use the following restriction:

$$\begin{pmatrix} v_{it}^{GDP} \\ v_{it}^P \\ v_{it}^{Ex} \\ v_{it}^M1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} \\ a_{41} & a_{42} & 0 & 1 \end{pmatrix} \begin{pmatrix} u_{it}^{GDP} \\ u_{it}^P \\ u_{it}^{Ex} \\ u_{it}^M1 \end{pmatrix}$$ \hspace{1cm} (17)

IV. RESULT AND ANALYSIS

Following the steps explained before, we estimate the precautionary and involuntary excess liquidity, and measure the threshold using maximum likelihood estimation (MLE) method in MSVAR (Krozlig-1998). This threshold will be our benchmark to classify the excess liquidity regime; the low or the high regime. On the impact of excess liquidity towards monetary policy transmission, we compare the impulse response function of macro variable, between the low and high EL regime.

Firstly we test for the EL persistence, using simple regression model, with the following results:

$$E L_t = 0.99 \ E L_{t-1} + \epsilon$$

$$\begin{align*}
(0.01) & \quad *** \\
R^2 &= 0.70
\end{align*}$$
Since the coefficient of excess of liquidity variable in $t-1$ is close to 1, we conclude the excess of liquidity during the observation period is persistent.

### 4.1. Precautionary and Involuntary Excess Liquidity Estimation

Following Henry et al. (2010) and theoretical model of Agenor et al. (2000), our estimation result for excess liquidity determinant is:

<table>
<thead>
<tr>
<th>Table 4. Excess of Liquidity Determinant Estimation Result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variabel: Log(EL)</strong></td>
</tr>
<tr>
<td><strong>Variabel</strong></td>
</tr>
<tr>
<td><strong>Koefisien</strong></td>
</tr>
<tr>
<td>Intercept</td>
</tr>
<tr>
<td>-0.438*** (0.113776)</td>
</tr>
<tr>
<td>Log(EL(-1))</td>
</tr>
<tr>
<td>0.864*** (0.070112)</td>
</tr>
<tr>
<td>Volatility_CD(-3)</td>
</tr>
<tr>
<td>1.546** (0.672642)</td>
</tr>
<tr>
<td>Rate_PUAB(-4)</td>
</tr>
<tr>
<td>0.007* (0.004533)</td>
</tr>
<tr>
<td>Volatility_IPGap(-4)</td>
</tr>
<tr>
<td>0.002*** (0.000461)</td>
</tr>
<tr>
<td>R-Squared</td>
</tr>
<tr>
<td>0.74</td>
</tr>
<tr>
<td>Prob (F-Statistic)</td>
</tr>
<tr>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: t-Statistic in parentheses. Level signficancy: *** on 1%; ** on 5%; * on 10%.

Several alternative variable proposed by Henry et al. (2010) including reserve requirement, is not significant for Indonesian case. Referring to the best estimation result above, all variable (lag EL, cash deposit volatility, PUAB interest rate, and gap output volatility) already have correct signs and statistically significant.

Next, we use the estimation result above to calculate the precautionary excess liquidity, which is needed by banking industry. Following Henry et al. (2010), involuntary EL is calculated as: Involuntary EL = EL Total - EL Precautionary. The result is presented at Figure 2.

We use this estimated involuntary EL as threshold variable to split the regime in Threshold – Vector Auto Regression (T-VAR) method, using MS-VAR module (Krolzig, 1998) in OxMetrics application.
4.2. Excess Liquidity Threshold and Regime Classification

T-VAR estimation refers to Saxegaard (2006) and Bernanke and Blinder (1992), using 4 endogenous variables; namely Production Index (GDP proxy), Inflation, Exchange Rate, and BI Rate. Production Index and Inflation variable are non-policy variable, while Exchange Rate and
BI Rate variable are policy variable. Again, policy variable react contemporaneously on non-policy variable, but not the other way around. In addition, we adjust the S-VAR structure by including NFA variable as exogenous variable, to suit the condition for Indonesia. NFA is also policy variable, and potentially affects the exchange rate and inflation.

The result of T-VAR estimation is presented below. Complete result is provided in Appendix A.

We try several lag alternatives (from lag 0 to 8) for the threshold variable (EL variable), and found lag 2 to be the best choice because it provides more intuitive results. In addition, it suits the economic condition break in 2005 due to inflation hike, a high BI rate, and reserve requirement policy.

During the period from October 2001 to September 2009, we found two excess liquidity regimes; low EL Regime for August 2001-September 2005, and high EL Regime for October 2005 to September 2010. Using maximum likelihood estimation (MLE) in MS-VAR module, the estimated threshold is:

<table>
<thead>
<tr>
<th>Estimated Threshold</th>
<th>0.00048870</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rezim Classification</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>2001:08 - 2005:9</td>
</tr>
<tr>
<td>High</td>
<td>2005:10 - 2010:9</td>
</tr>
<tr>
<td>LR Test</td>
<td>237.7847</td>
</tr>
<tr>
<td>p-values (adjusted χ²)</td>
<td>[0.0000]</td>
</tr>
</tbody>
</table>

The Likelihood Ratio (LR) above is important to test the linearity of EL threshold within the sample range 2001:8 to 2010:9. According to that result, high LR coefficient value (237.7847) and p-values (below 5%) confirms nonlinearity on EL, hence support our EL regime classification.

### 4.3. The Impact of Excess Liquidity on Monetary Policy

We use policy rate as the proxy for monetary policy and analyze its effectiveness toward other macro variables such as production index (GDP proxy), inflation and exchange rate. On VAR structure, we evaluate the monetary policy transmission by giving one standard deviation shock (impulse) on BI rate, then compare its impact on the two classified regime. The result is presented below.
According to impulse-response function above, the increase in BI rate will be transmitted into three macro variables as follow:

a) Towards Index of Production (GDP proxy)

For low and high EL regime, an increase of BI rate by one standard deviation will lower the GDP as expected and is compatible with theory. Though slightly differ, a tight monetary policy will lower Indonesia economic growth, both in low and high excess liquidity regime.
b) Towards Inflation
During low EL regime (left picture), an increase of BI rate will reduce the inflation pressure, which is in line with Inflation Targeting Framework (ITF). Though it needs few lags for the inflation to response the policy rate, the interest-based policy performs fairly well on this regime. Nevertheless, we do not find condition during high EL regime (right picture).
Interestingly, when economic is in high excess liquidity, the monetary policy transmission is not effective to restrains inflation. In fact, in high EL regime, an increase of BI rate is responded with an increase of inflation.
One possible explanation is that over accelerated economic needs to be responded with an increase of BI rate, which reduce the fund on market. However, in high excess liquidity regime, the public fund remains largely available; hence the demand will be relatively higher compared to low EL regime.
This positive relationship between BI rate and inflation require further research. As for current paper, we only focus on comparison between the two regimes, and conclude that the high excess liquidity in economics will lower the effectiveness of BI rate to control inflation.
c) Towards exchange rate
In line with the uncovered interest parity (UIP) theory, the increase of BI rate will raise the value of IDR. An increase of domestic interest rate will make domestic more attractive, therefore increase the demand for IDR. This result applies for both low and high EL regime.
The analysis of impulse response function above is based on SVAR structure with the following endogenous variables: Index of Production, Inflation, Exchange rate, BI rate, and NFA (Net Foreign Assets). As additional analysis and comparison, we specify two alternatives of SVAR structure namely alternative A which only include Index of Production, Inflation, Exchange rate, and BI rate variables, and exclude NFA. However the result of this pure structure from Bernanke and Blinder (1992), give inconclusive result and does not consistent with the theory. Alternative B, we use Non-Performing Loan (NPL) variable to capture the constraint on loan supply. Likewise, this alternative also does not provide conclusive result. We report the complete result for both alternatives on appendix.
In general, we have shown that excess liquidity affect the effectiveness of monetary policy. In high EL regime condition, the impact of BI rate as a monetary policy instrument in order to reach the monetary policy objective (which is low and stable inflation), is relatively lower than in low EL regime. Therefore, several initiative programs of Bank Indonesia related to controlling and managing liquidity are necessary and require further improvement.

V. CONCLUSION
This paper gives several important conclusions. First, the behavior of bank to keep excess liquidity for precautionary is affected significantly by the volatility of cash demand, the volatility
of economic growth, the cost of fund for bank, and the liquidity condition in previous period.

Second, the application of Threshold-VAR (TVAR) method shows that there are two regimes of excess liquidity in Indonesia; the Low EL Regime (2001:08 – 2005:9) and the High EL Regime (2005:10 – 2010:9). The regime switch occurred in 2005, when there were significant changes in Indonesia economics condition including the increases of inflation, BI Rate, higher open market operation, policy change on minimum reserve requirement, and also the rise of foreign reserve accumulation in Bank Indonesia.

The policy implication is straightforward. Bank Indonesia needs to control and to direct the high excess liquidity condition. Further endorsement on several existing programs is necessary, including the conversion of SUP (Surat Utang Pemerintah) to be tradable, Treasure Single Account (TSA) with Asset Liability Management (ALM), and the use of SPN (Surat Perbendaharaan Negara) as monetary instrument.

This paper calls for further research, especially related to structure of SVAR, which only consists of 4-5 variables. The model proposed by Bernanke and Blinder (1992) may be appropriate for developed countries because of the stability of their institutional economics. On the other hand, Indonesia is a transition country, where the policy is often adjusted to economic situation and sometimes to the political situation. Therefore, future study should account for this issue, using the T-VAR method.
REFERENCES


APPENDIX A.
ESTIMATION RESULT OF T-VAR MODEL (LAG 2)

LogLikelihood and estimated threshold for given number of regimes

Threshold variable
The Impact of Excess Liquidity on Monetary Policy

Correlogram : Standard residuals

- ACF-ER
- PACF-ER

Spectral density : Standard residuals

Density : Standard residuals

QQ Plot : Standard residuals

Correlogram : Standard residuals

- ACF-BIRate_R
- PACF-BIRate_R

Spectral density : Standard residuals

Density : Standard residuals

QQ Plot : Standard residuals
### APPENDIX B. IRF SVAR

#### IRF ALTERNATIVE A: SVAR WITHOUT NFA

<table>
<thead>
<tr>
<th>REGIME 1 (Low EL)</th>
<th>REGIME 2 (High EL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response to Nonfactorized One S.D. Innovations ± 2 S.E.</td>
<td>Response to Nonfactorized One S.D. Innovations ± 2 S.E.</td>
</tr>
<tr>
<td><strong>Response of IP to BIRATE_R</strong></td>
<td><strong>Response of IP to BIRATE_R</strong></td>
</tr>
<tr>
<td>-0.12</td>
<td>-0.08</td>
</tr>
<tr>
<td>-0.08</td>
<td>-0.00</td>
</tr>
<tr>
<td>-0.04</td>
<td>0.00</td>
</tr>
<tr>
<td>0.00</td>
<td>0.04</td>
</tr>
<tr>
<td>0.04</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>Response of INF_Y to BIRATE_R</strong></td>
<td><strong>Response of INF_Y to BIRATE_R</strong></td>
</tr>
<tr>
<td>-1.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>-0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Response of ER to BIRATE_R</strong></td>
<td><strong>Response of ER to BIRATE_R</strong></td>
</tr>
<tr>
<td>-0.04</td>
<td>-0.02</td>
</tr>
<tr>
<td>-0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>0.04</td>
<td>0.06</td>
</tr>
</tbody>
</table>

**Graphs**

- Response of IP to BIRATE_R
- Response of INF_Y to BIRATE_R
- Response of ER to BIRATE_R


## ALTERNATIVE B: SVAR WITH REPLACING NFA FOR NPL

<table>
<thead>
<tr>
<th>REGIME 1 (Low EL)</th>
<th>REGIME 2 (High EL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response to Nonfactorized One S.D. Innovations ± 2 S.E.</td>
<td>Response to Nonfactorized One S.D. Innovations ± 2 S.E.</td>
</tr>
</tbody>
</table>

### Response of IP to BIRATE_R

- **REGIME 1 (Low EL):**
  - Initial Response: -0.12
  - Later Response: -0.08
  - Further Response: -0.04
  - Maximal Response: 0.00

- **REGIME 2 (High EL):**
  - Initial Response: -0.12
  - Later Response: -0.08
  - Further Response: -0.04
  - Maximal Response: 0.00

### Response of INF_Y to BIRATE_R

- **REGIME 1 (Low EL):**
  - Initial Response: -1.0
  - Later Response: -0.5
  - Further Response: 0.0
  - Maximal Response: 0.5

- **REGIME 2 (High EL):**
  - Initial Response: -1.0
  - Later Response: -0.5
  - Further Response: 0.0
  - Maximal Response: 0.5

### Response of ER to BIRATE_R

- **REGIME 1 (Low EL):**
  - Initial Response: -0.12
  - Later Response: -0.08
  - Further Response: -0.04
  - Maximal Response: 0.04

- **REGIME 2 (High EL):**
  - Initial Response: -0.12
  - Later Response: -0.08
  - Further Response: -0.04
  - Maximal Response: 0.04

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TRANSMISSION CHANNEL AND EFFECTIVENESS OF DUAL MONETARY POLICY IN INDONESIA

Ascarya

Abstract

This paper investigates the transmission mechanism of dual monetary system from conventional and Islamic policy rates to inflation and output. We apply Granger Causality and VAR methods on monthly data of Indonesian banking, during the period of January 2003 to December 2009. The result shows that conventional policy rate is transmitted to output and inflation, while Islamic policy rate are not. In addition, the shock of conventional interest rate, credit and interbank rate give a negative and permanent impacts on inflation and output, except for SBI (Certificate of Bank Indonesia) with positive impact to inflation though negatively affect the output. On the other hand, the shock of PLS, financing and Islamic interbank PLS, as well as SBIS (Central Bank Shariah Certificate) give positive and permanent impacts on inflation and output.

Keywords: Monetary transmission mechanism, Interest rate pass through, Conventional Banking, Islamic Banking

JEL Classification: E43, E52, G21, G28

1 Researcher on PPSK – Bank Indonesia; ascarya@bi.go.id. The views on this paper are solely of the author and not necessarily represent the views of Bank Indonesia. Author thanks to anonymous referees and the editors, for their constructive discussion.
I. INTRODUCTION

The central bank monetary policies intend to affect the real economic activities and the prices through transmission mechanisms. This requires sufficient understanding of the transmission mechanisms within the economy. Monetary policies can be transmitted through various channels, such as interest rates, monetary aggregates, credit, exchange rates, asset prices, and expectations (Warjiyo and Agung, 2002). Thus, a clear understanding of the transmission is the key for monetary policies to influence the direction of the real economy and prices in the future.

Since New Banking Act in 1998, Indonesia has implemented a dual banking system, where conventional and Islamic banks can operate side by side throughout Indonesia. With the implementation of Bank of Indonesia’s Act in 1999, Bank of Indonesia has a dual mandate to conduct both conventional and Islamic monetary policies. Since then, the Islamic banking and finance has been growing rapidly.

In 2000, there were two Islamic banks and three Islamic business units (Unit Usaha Syariah) with 65 offices, controlling only 0.17% of total banking assets. At the end of 2010, 11 Islamic banks and 23 Islamic business units have been established with a total of 1,477 offices and 1,277 channeling office. The market share for Islamic banks reached 3.24% of the total assets, or equivalent of Rp 97.52 Trillion with 48% growth per year.

The growth of Islamic banks can be observed from the expansion of the deposit and financing. In 2000, the deposits reached a total of Rp 1.03 Trillion, and financing reached Rp 1.27 Trillion with an FDR (Financing to Deposit Ratio) of 123%. By the end of 2010, total deposits grew by 45.47% annually, reaching Rp 76.04 Trillion, while financing grew
Transmission Channel and Effectiveness of Dual Monetary Policy in Indonesia

by 45.42% annually, reaching Rp 68.18 Trillion, with 89.67% FDR. This FDR level was an enormous achievement compared to Islamic banks in other countries, and also far beyond the LDR (Loan to Deposit Ratio) of conventional banks in Indonesia, which only reached 75.21%.

In terms of monetary policies, Bank of Indonesia introduced the first Islamic monetary instrument in 2000, the Wadi’ah Certificate of Bank Indonesia (SWBI)\(^2\), which is still passive. Along with the rapid grow of Islamic banking; Bank Indonesia replaced SWBI with better Islamic monetary instruments in 2008, namely the Shariah Certificate of Bank Indonesia (SBIS), which is based on Ju’alah contracts\(^3\).

Since 2005, the Bank of Indonesia as the monetary authority in Indonesia has implemented full-fledged inflation targeting. This monetary policy framework is characterized with an official announcement of inflation target for a specific timeframe. In addition, the monetary policy is implemented independently to achieve high transparency and credibility. The inflation targeting framework has been implemented by most central banks, particularly in developed countries in the last seventeen years, hence the interest rate pass through has attracted more attention than before. The empirical application of the inflation targeting framework in some developed and developing countries has been proven successfully in controlling inflation at a relatively low level (See Figure 2), except for in Argentina and Indonesia.

![Figure 2. Inflation on Selected Countries with Inflation Targeting Framework](image)

However, developed countries recorded a low economic growth of around 2-3%, while Asean countries and Latin America could achieve higher economic growth of around 4-6%. The countries with the most prominent economic growth are China followed by Argentina.

---

2 Wadi’ah (deposit) is a kind of contract whereby a person leaves his valuable in the custody of others as a trust for safe keeping.
3 Ju’alah (reward for service) is a kind of contract of hiring for services, in which one party undertakes to pay a specified amount of money for rendering a defined service in accordance with the terms negotiated between them.
On the other hand, Indonesia’s economic growth remains quite stable between the ranges of 4-6%, including during the global financial crisis (see Figure 3.)

The interest rate pass-through illustrates the degree and the speed of market adjustment to the changes in interest rate policies set by the central bank. Interest rate pass-through is one of the prerequisites for the transmission of monetary policies to work through interest rates. Transmission channel through interest rate emphasizes the importance of price in the financial markets, towards various economic activities in real sector.

Along with the development of Islamic banking, monetary policies affect not only conventional banking but also affect Islamic banking since the transmission mechanism may also pass through Islamic banking. Multiple monetary policy instruments are not limited to interest rates only, but they also can use the profit sharing, margins or fees. Thus, in the dual monetary system, the interest rate pass-through is more appropriately termed as the ‘policy rate pass-through’, where the policy rate in conventional bank is interest rates, and the policy rate for Islamic banks is either profit sharing, margins, or fees.

The first aim of this paper is to identify the transmission channels of dual monetary policies in Indonesia, both through conventional banks interest rates and the Islamic banks profit sharing, margins, or fees. We also identify the relationship between the two systems and their effects towards inflation controlling. Second aim is to analyze how far the conventional bank interest rates will follow the policy rate, and how far the Islamic bank will follow the policy on profit sharing, margins or fees. We will analyze them both in short and in the long run, and compare their transmission speed. Third is to formulate an effective dual monetary policy, to increase the welfare and equalities of the society.

The second session of this paper will discuss the theoretical background and literatures, while the third session will discuss the methodology and data. The fourth session will discuss the results of the analysis, while conclusion will be presented on the last session.
II. THEORY

In the last 30 years, Islamic economics and finances have been gradually implemented in various countries, alone or together with the conventional banking system. Along with the larger size and the more significant of the Islamic economics and finances, the monetary policies in Islamic perspective have also evolved.

In countries with multiple financial systems—such as Pakistan, Malaysia, and Indonesia—the central bank should conduct monetary policies of both conventional and Islamic banking systems, to effectively influence the overall macroeconomic condition.

Monetary policies rest on the relationship between interest rates in the economy (which is the price of borrowing money) to the money supply to influence economic development goals, such as control of prices (inflation and exchange rates), economic growth, and the unemployment rate. This is possible because monetary authorities have the sole authority to print and to circulate the official currency of the country.

There are various types of monetary policies, and all of them try to influence the primary money (M0) by trading the debt or loan instruments of the government in open market operations. The differences among these types of monetary policy are on the instruments selected, and their target (see Table 1).

<table>
<thead>
<tr>
<th>Monetary Regime</th>
<th>Instrument</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation Targeting</td>
<td>Overnight rate</td>
<td>Targeted inflation</td>
</tr>
<tr>
<td>Price Level Targeting</td>
<td>Overnight rate</td>
<td>Certain targeted inflation</td>
</tr>
<tr>
<td>Monetary Aggregates</td>
<td>Growth of money supply</td>
<td>Targeted inflation</td>
</tr>
<tr>
<td>Fixed Exchange Rate</td>
<td>Spot exchange rate</td>
<td>Targeted exchange rate</td>
</tr>
<tr>
<td>Gold Standard</td>
<td>Spot gold price</td>
<td>Low inflation measured with gold price</td>
</tr>
<tr>
<td>Mixed Policy</td>
<td>Interest rate</td>
<td>Unemployment and inflation rate</td>
</tr>
</tbody>
</table>


The application of a particular monetary regime evolves over time. Gold standard regime, which sets the exchange rate of a national currency against the value of gold, was widely applied throughout the world before 1971, but no longer used after the collapse of the Bretton Woods Agreement in 1971. Price level targeting, which sets the rate of inflation each year and corrects it in the next period so that the price level does not change in the long run, was once applied in Sweden in the late 1930s. This regime was no longer implemented by any country since 2004.
The regime of monetary aggregates of the monetarist mainstream, which is based on fixed money supply growth, was widely applied in various countries in the 1980s. In addition, the fixed exchange rate regime, which is based on fixation of the national currency value on foreign currencies, was applied by around 56 developing and small countries at different grade.

There are also mixed policy, which is based on Taylor rule and believe the interest rates will respond to the shocks of inflation and output. United States apply this since the 1980s.

The inflation targeting regime, which explicitly maintains certain level of inflation for certain period (i.e. CPI inflation), has been gaining popularity since the early 1990s and the more widely adopted by the developed and developing countries nowadays.

<table>
<thead>
<tr>
<th>Developed Countries</th>
<th>Developed Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Mixed Policy</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Inflation Targeting + secondary target on output &amp; employment</td>
</tr>
<tr>
<td>Eurozone</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>Australia</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>Canada</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>Singapore</td>
<td>Exchange Rate Targeting</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>Thailand</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>India</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>Latin America</td>
<td>Others</td>
</tr>
<tr>
<td>Brazil</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>Chile</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>Korea</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>Turkey</td>
<td>Inflation Targeting</td>
</tr>
<tr>
<td>China</td>
<td>Monetary Targeting &amp; targeted currency basket</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>Currency Board – fixed against USD</td>
</tr>
</tbody>
</table>

Source: Compiled from various sources.

Inflation targeting is a monetary policy regime, where the central bank tries to keep inflation close to the announced target range, and is usually using the interest rate policy as the instrument. According to Alam and Masyhuri (2000), inflation targeting is primarily a framework in monetary policies that seeks to eliminate the inflation bias of discretionary monetary policy, in a transparent inflation targeting framework. Naturally, inflation targeting is a constrained discretion in monetary policies.

This monetary regime is a “compromise” between the classical mainstream, which argues that inflation is always a monetary phenomenon, hence must follow strict rules; and the
Keynesians mainstream, which argues that inflation is not caused by the higher amount of money than goods, but because of the number of worker seeking for job exceed the available employment capacity. With this context, monetary policies are responsible to ensure the equilibrium between demand and supply of the economy, hence must be conducted wisely (discretion) in accordance with the current development. The compromise is, in the long run the monetary policy follow the rules, whereas in the short run the monetary policies may have discretion.

2.1. Conventional Monetary Policy Transmission

From the conventional perspective, the monetary policy can be transmitted through interest rate channel, credit line, exchange rate, asset prices, and expectations channel. The use of interest rate instruments in inflation targeting, put the interest through pass-through as important topic.

Models for interest rate pass-through have been developed for a long time. The model developed by Rousseas (1985), marginal costing pricing model, argue that changes in bank interest rates will be forwarded in the form of changes in interest rates to their customers because it reflects the changes of bank’s marginal cost. This model is still considered as the best model to explain the interest rate pass-through from policy rates to bank interest (Egert et al, 2006). The general representation of the model equation is:

\[ br_{n,t} = \gamma_0 + \gamma mr_{n,t} \]  

Where \( br \) is interest rates set by banks; \( \gamma_0 \) is mark-up; and \( mr \) is the marginal cost price, substituted with the market interest rate.

Several factors can explain the spread between the retail rate and the marginal cost of funds, such as the level of competition (the higher the competition the lower the spread), the difference in interest rates for different customers, and the asymmetric information between borrowers and lenders. According to Bredin (2002), there are three categories of variable that may affect the level and speed of pass-through from policy rates to bank interest rates; monetary policies, the level of banking competition, and other factors.

On empirical ground, some studies use a standard single equation Error Correction Model (ECM), for example Mojon (2000), Bredin (2001), de Bondt (2002), Espinosa-Vega and Rebucci (2003), Chmielewski (2004), Tiemen (2004), Horvath et al. (2005), Betancourt et al. (2008), and van Leuvensteijn et al. (2008). The estimated equation proposed by de Bondt (2002) is:
\[
\Delta br_{n,t} = \eta_n + \alpha \Delta mr_t - \beta (br_{n,t-1} - \gamma mr_{t-1}) + \varepsilon_{n,t}
\]

(2)

where \(\alpha\) is pass-through parameter in one period, and \(\beta\) is speed of adjustment parameter for pass-through effect. This estimation was conducted in two steps; hence two-step ECM method. The first step calculates the residual from the first equation \((br_{n,t} - \gamma mr_{t})\). The second step estimates the Equation 2 by including the residual value \((br_{n,t} - \gamma mr_{t})\).

The standard ECM was then developed to non-linear or asymmetric ECM, applied by Scholnick (1999) and Chmielewski (2004), with the following modification on Equation 2:

\[
\Delta br_{n,t} = \eta_n + \alpha \Delta mr_t + \beta_1 ec_t^{+} + \beta_2 ec_t^{-} + \varepsilon_{n,t}
\]

(3)

where \(\beta_1\) is positive adjustment level at \(t\) and \(\beta_2\) is negative adjustment level at \(t\).

Standard ECM are also developed in the form of extended ECM to detect the complete or incomplete pass-through, as in Weth (2002) and Chmielewski (2004), with the following modification on Equation 2:

\[
\Delta br_{n,t} = \eta_n + \alpha \Delta mr_t + \beta (br_{n,t-1} - mr_{t-1}) + \delta br_{n,t-1} + \varepsilon_{n,t}
\]

(4)

For \(\delta \neq 0\) reflects an incomplete pass through.

Another version of the ECM is the auto regressive distributed lag (ARDL), proposed by Crespo-Cuaresma et al. (2004), Burgstaller (2005), Lie et al. (2005), Egert et al. (2006), and Marotta (2007), with the following model:

\[
\Delta br_t = \delta_0 + \sum_{j=1}^{p-1} \mu_j \Delta br_{t-j} + \sum_{k=0}^{q} \kappa_k \Delta mr_{t-k} + \gamma (br_{t-1} - \lambda mr_{t-1}) + \varepsilon_t
\]

(5)

where \(\gamma\) is the speed of adjustment, and \(\lambda\) is the long run multiplier (pass-through).

Another development of the standard ECM, such as Dynamic Ordinary Least Squares models or DOLS, threshold autoregressive or TAR models (Horvath et al., 2005), transfer function approach model (Qayyum et al., 2005), dynamic seemingly unrelated regression models or DSUR (Sorensen and Werner, 2006), and the panel ARDL models (Aydin, 2007).

On empirical ground, Espinosa-Vega and Rebucketi (2003) compared Chile and other countries (Euro, Canada, U.S., Australia and New Zealand), Egert et al. (2006) used a sample of five countries in Central and Eastern Europe, or CEE-5 (Czech Republic, Hungary, Poland,
Slovakia, and Slovenia), while Sorensen and Werner (2006) used a sample of Euro area countries with the dynamic data panel and ECM method.

Egert et al. (2006) found that the interest rate pass-through effect in the CEE-5 was low and decreased along years of observation, due to the absence of co-integration between the policy rate and the bank interest rates (short and long run), and is expected to continue declining in the future.

Sorensen and Werner (2006) found a large heterogeneity in the Euro countries both on the long-run pass-through equilibrium and its speed of adjustment. These results also confirm the slow and incomplete adjustment process of bank interest rate on policy rate.

Horvath et al. (2005) found corporate lending rates adjusted quickly and completely to the changes of interest rate policy, while the deposit rates and household loans adjusted slowly and incompletely. Qayyum et al. (2005) found the pass-through of policy rate (T-Bills rate) to the call money rate is complete in a month, while the pass-through from policy rates to deposit rates and bank loans take longer. Liu et al. (2005) concluded that there is a complete long run pass-through for some interest rates in New Zealand, and generally, confirmed that the policy rates have greater influence on short-run interest rates and that an increase in transparency increases the effectiveness of monetary policy.

Recent studies link the interest rate pass-through to the implementation of Euro (Marotta, 2007), to the macro-economic variables that also affect interest rates (Betancourt et al., 2008), to the optimal monetary policy (Kobayashi, 2008), and to the competition among banks (Van Leuvensteijn et al., 2008).

Marotta (2007) examined the structural breaks in the interest rate pass-through from policy rates to bank lending rates and the process of unification of the Euro. The result shows that the EU members have different speeds of adjustment to the Euro unification in the January 1999, and they adjusted to the new monetary regime slowly. He also found that the interest rate pass-through in EU countries are incomplete, which means that the uniform monetary policy is less effective. These results are contrary to the economic intuition that the decline in the volatility of policy rate (money market rate) will faster the transmission from policy rate to the bank’s interest rate.

Betancourt (2008) conducted a study on interest rate pass-through in Colombia from micro banking perspective with monthly data during 1999-2006, using the single equation error correction model (EC) and the vector autoregressive model (VAR). It is based on the microeconomic theory that the effect of interest rate policy on banking is a complex process and also depends on the macroeconomic variables. The result of the two models supports the hypothesis that besides interest rate policy, macroeconomic variables also affect the transmission mechanism of monetary policy to the banking interest rate. In addition, the EC
model results indicate incomplete pass-through, where as the VAR model indicates complete pass-through.

Kobayashi (2008) analyzed the incomplete interest-rate pass-through in Euro area and the optimal monetary policy. He stated that if not all commercial banks directly respond to changes in interest rates policy, then monetary policy will provide different impact on the economy. The results show that if only part of banking loan rate adjust for changes in policy rate, then fluctuations in average lending rate raises the cost of welfare, then the central bank needs to stabilize this fluctuation policy rates smoothing. However, drastic changes in policy rate are still required when there is a shock that directly affects interest rates.

Van Leuvensteijn et al. (2008) conducted a study on the impact of bank competition towards the interest rate pass-through in the Euro area over the periods of 1994-2004 in two stages. The first stage of the method was to measure the level of competition using Boone indicator. The second stage measured the effect of competition on interest rate pass-through using panel error correction model (ECM) method. The first stage showed that higher competition increase the spread between interest rate policy (market rate) and bank interest rates, particularly credit. The second stage’s results showed that the higher the level of banking competition in a country, the bank sets loan interest rates in accordance with the policy rate. In addition, the pressure of competition is more severe in loans than in deposits. Bank interest rates in a more competitive market respond stronger to changes in interest rate policy. The implication is the regulation to increase banking competition will improve the effectiveness (strength and speed) of transmission mechanism of monetary policy.

The results of interest rate pass-through with the standard ECM method for some countries are presented in Table 3. Overall, the results of IRPT are not the same across countries. One thing in common about the interest rate pass-through across countries is that the level of short-run pass-through is lower than the level of long-run pass-through, except for the US, where the level of short-run pass-through rate is equal to the long-run pass-through. The level of pass-through effect between deposits and loans vary widely. In some countries, the pass-through effect on deposit is lower than the loans, in some countries the opposite occurs, and in the other countries, the pass-through effect on deposit is equal to the effect on loans. Thus, in this case we can not draw general conclusion. Similarly, the speed of adjustment of the interest rate pass-through is also varying across countries.
### Table 3.
Interest Rate Pass-Through using Standard ECM on selected Countries

<table>
<thead>
<tr>
<th>Author</th>
<th>Country</th>
<th>Short Term</th>
<th>Long Term</th>
<th>Adjustment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bredin et al. 2001</td>
<td>Ireland</td>
<td>0.32-0.35</td>
<td>0.35-0.98</td>
<td>0.64-0.88</td>
<td>S 3-15 month P 3-10 month</td>
</tr>
<tr>
<td>De Bondt 2002</td>
<td>Euro area</td>
<td>0.13-0.54</td>
<td>0.35-0.98</td>
<td>0.92-1.53</td>
<td>S&gt;P    S&lt;P</td>
</tr>
<tr>
<td>Espinosa-Vega &amp; Rebuccion 2003</td>
<td>Chile</td>
<td>0.20-0.68</td>
<td>0.39-0.68</td>
<td>0.55-0.88</td>
<td>S 1/2-4 month P 2/3-2 month</td>
</tr>
<tr>
<td>English</td>
<td>Euro</td>
<td>0.18-0.63</td>
<td>0.60-0.72</td>
<td>0.57-0.82</td>
<td>S&gt;P    S&lt;P</td>
</tr>
<tr>
<td>Canada</td>
<td>1.05-1.13</td>
<td>0.46-0.83</td>
<td>0.93-0.98</td>
<td>0.24-1.01</td>
<td>S &gt;0 month P _4 month</td>
</tr>
<tr>
<td>US</td>
<td>0.84-1.00</td>
<td>0.86</td>
<td>0.64-1.00</td>
<td>1.00</td>
<td>S&gt;0 2 month P 0.2 month</td>
</tr>
<tr>
<td>Australia</td>
<td>0.40-0.87</td>
<td>0.46</td>
<td>0.67-0.81</td>
<td>1.09</td>
<td>S&gt;0 1.4 month P 3.86 month</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.34-0.42</td>
<td>0.21</td>
<td>0.71-0.74</td>
<td>0.77</td>
<td>S&gt;2 2 month P 2 month</td>
</tr>
<tr>
<td>Chmielewski 2004</td>
<td>Polandia</td>
<td>0.22-0.57</td>
<td>0.75-0.88</td>
<td>0.85-1.02</td>
<td>S&gt;0 1-4 month P 1 5 month</td>
</tr>
<tr>
<td>Tieman 2004</td>
<td>Czech</td>
<td>0.09 -0.02</td>
<td>0.80 0.49</td>
<td>0.76 0.65</td>
<td>S&gt;P    S&gt;P</td>
</tr>
<tr>
<td></td>
<td>Hungary</td>
<td>0.22 0.07</td>
<td>0.82 0.90</td>
<td>1.10 0.67</td>
<td>S&gt;P    S&gt;P</td>
</tr>
<tr>
<td></td>
<td>Polandia</td>
<td>0.29 0.23</td>
<td>0.18 0.10</td>
<td>0.98 0.91</td>
<td>S&gt;3 6.8 month P 6.4 10 month</td>
</tr>
<tr>
<td></td>
<td>Romania</td>
<td>..... -0.30</td>
<td>..... -0.78</td>
<td>0.80 0.73</td>
<td>S&gt;0 5 month P 3 4 month</td>
</tr>
<tr>
<td></td>
<td>Slovak</td>
<td>0.04 0.23</td>
<td>1.00 1.27</td>
<td>1.62 0.79</td>
<td>S&gt;P    S&gt;P</td>
</tr>
<tr>
<td></td>
<td>Slovenia</td>
<td>0.16 0.11</td>
<td>0.16 0.15</td>
<td>1.41 1.57</td>
<td>2.08 1.85</td>
</tr>
<tr>
<td>Horvath et al. 2005</td>
<td>Hungary</td>
<td>0.41 0.64</td>
<td>0.86 0.87</td>
<td>0.81 0.98</td>
<td>S&gt;3 2 month P 4-2 month</td>
</tr>
</tbody>
</table>

Note: S is deposit; P is loan; Pdk is short term; Pjg is long term. The highlighted cell represents complete pass-through condition.
Table 4 gives the variation of the level of pass-through on deposit and loans across countries. However, in general there is a certain pattern. In the short run, the pass-through deposit is equal to or greater than the pass-through loans. In the long run, the pass-through deposit is equal to or smaller than the pass-through loans. Most empirical studies show that the level of pass-through deposit equal to the level of pass-through loans in the short and long run.

<table>
<thead>
<tr>
<th>Deposit &lt; Loan</th>
<th>Deposit = Loan</th>
<th>Deposit &gt; Loan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chile (Pjg)</td>
<td>Chile (Pdk)</td>
<td></td>
</tr>
<tr>
<td>Euro area (Pjg)</td>
<td>Euro area (Pdk)</td>
<td>Euro (Pdk, Pjg)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Canada (Pdk, Pjg)</td>
</tr>
<tr>
<td>US (Pjg)</td>
<td>US (Pdk)</td>
<td></td>
</tr>
<tr>
<td>Australia (Pjg)</td>
<td>Australia (Pdk)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>New Zealand (Pjg)</td>
<td>New Zealand (Pdk)</td>
</tr>
<tr>
<td>Czech (Pdk, Pjg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polandia (Pdk, Pjg)</td>
<td>Polandia (Pjg)</td>
<td>Polandia (Pdk)</td>
</tr>
<tr>
<td></td>
<td>Romania (Pdk, Pjg)</td>
<td></td>
</tr>
<tr>
<td>Slovak (Pjg)</td>
<td>Slovak (Pdk)</td>
<td></td>
</tr>
<tr>
<td>Hungary (Pdk, Pjg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slovenia (Pdk, Pjg)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.2. Islamic Monetary Transmission Policy

Transmission of monetary policy merged since the separation of the monetary authority from fiscal authorities. Monetary authorities evolved in line with the development of central bank from circulation bank (issuing paper money or fiat money), which marked by the establishment of Bank of England (BOE) in 1694 (Capie, 1994). Because of its inflationary paper money (since it has no intrinsic value) then the task of central bank increased, including setting the money supply to control the value of currency or inflation. This is not necessary when the money has intrinsic value, like the gold Dinar and silver Dirham during Islamic caliphate. The last Khilafah Islamiyah, the Ottoman dynasty in Turkey, collapsed in 1924 (Islahi, 2004).

In conventional economic domination with its central bank and fiat money, Islamic economics grow in Muslim-majority countries within the system of paper money and central banks. Therefore, Islamic monetary system with its policies and transmission processes also grew. A pioneer of the theory of contemporary Islamic monetary economics is Muhammad Umer Chapra in his book “Towards a Just Monetary System (1985)”.
The setting of contemporary Islamic financial institutions are not much different from the setting of conventional financial institutions, hence the Islamic monetary policy instruments are also similar with the instruments of the conventional one. Since both systems have similar and also different instruments, the Islamic monetary policy transmission can be similar or different from the conventional one. Chapra (1985) did not discuss specifically the issue of Islamic monetary policy transmission. Further development of Islamic monetary theory also does not mention it; including pass-through or its channels (see Siddiqui, 2007).

However, few empirical studies a rise to see the Islamic monetary policy transmission characteristics. Sukmana and Kassim (2010) was an initial attempt to determine the transmission of monetary policy through financing channel to economic growth in Malaysian Islamic banking system, which is simply defined as follows:

\[ IPI = f(IF, ID, ONIGHT) \]  
\[ IPI = f(IFIN, IDEP, PUAS, SBIS) \]  
\[ CPI = f(IFIN, IDEP, PUAS, SBIS) \]  
\[ IPI = f(nIFIN, nCCR, iIFIN, iCCR, nIDEP, nCDEP, iDEP, iCDEP, SBIS, SBI) \]
where \( IPI \) is industrial production index, \( nFIN \) is total Islamic bank financing, \( nCCRD \) is total conventional bank credit, \( nDEP \) is financing or funds from an Islamic third part, \( nCDEP \) is total financing or funds from a conventional bank, \( iIDEP \) is Islamic banking deposits yield, \( iCDEP \) is conventional banking deposits yield, \( SBIS \) is the yields of Syariah Certificates of Bank of Indonesia, and \( SBI \) is the yields of Certificates of Bank Indonesia.

The conventional interest rate pass-through model (Egerti, 2006) was modified to formulate the Islamic pass-through rate policy model. Equation (1) is modified as follows:

\[
ibr_{n,t} = \gamma_0 + \gamma imr_{n,t}
\]  

(10)

Where \( ibr \) is funding or financing yield set by Islamic banks, \( \gamma_0 \) is mark-up and \( imr \) is the marginal cost price, substituted with market return.

For equation to estimate, we refer Bde Bondt (2002), with the following modification:

\[
\Deltaibr_{n,t} = \eta_n + \alpha \Delta imr_t - \beta (ibr_{n,t-1} - \gamma imr_{t-1}) + \epsilon_{n,t}
\]

(11)

Where \( \alpha \) is pass-through parameter for one period, and \( \beta \) is the speed of pass-through adjustment.

The first step is to calculate the residual of Equation 10 (\( ibr_{n,t-1} - \gamma imr_{t-1} \)). The second step is use the residual (\( ibr_{n,t-1} - \gamma imr_{t-1} \)), then estimate Equation 11.

III. METHODOLOGY

This paper uses quantitative approach to analyze monetary policy in a dual financial system; conventional and Islamic. Empirical model that is built refers to the conceptual framework as illustrated in Figure 4.

Dual monetary policy in Indonesia used multiple monetary policy instruments, namely Certificate of Bank of Indonesia or SBI-based interest rates for conventional system, and Islamic SBI or SBIS-based fee for Islamic banking, which are still referring to the SBI rate. SBI interest rate and SBIS fee are policy rates. Policy rates will affect the funding and the bank financing through the interbank money market both in conventional and Islamic banking, then will affect the cost of fund channeling. Expansion of credit and financing will finally affect the level of output and inflation.
3.1. Data and Variables

The data used in this study is monthly time series data during the period of January 2003 to September 2009, obtained from SEKI, DSM, and DPbS Bank Indonesia.

To answer the first research question, we use the following data:

1. \( SBI_t \) : Conventional policy rate, a 1-month SBI obtained from DSM-BI.
2. \( SBIS_t \) : Islamic policy rate, using the SWBI bonus and SBIS fee (since April 2008), obtained from Statistics of Islamic Banking and DSM-BI.
3. \( PUAB_t \) : Conventional interbank money market rate, obtained from the DSM-BI.
4. \( PUAS_t \) : Islamic interbank money market, obtained from the DSM-BI.
5. \( INT_t \) : Loan (working capital) interest of conventional banks, obtained from the DSM-BI.
6. \( PLS_t \) : The rate of profit and loss sharing for financing (Musharaka + Mudharabah) in Islamic bank, obtained from the Directorate of Islamic Banking BI.
7. \( LOAN_t \) : Total value of conventional bank loan, obtained from the Indonesian Banking Statistics BI.
8. \( FINC_t \) : Total financing of Islamic banks, obtained from Islamic Banking Statistics BI.
9. \( IHK_t \) : Inflation rate obtained from SEKI BI.
3.2. Estimation Techniques

This study will use several estimation techniques, namely Granger Causality and Vector Auto regression (VAR)/Vector Error Correction Model (VECM), Standard Error Correction Model with two-steps, and descriptive analysis.

To answer the first research question (identify the dual monetary policy transmission channel in Indonesia, both through the conventional and Islamic system, and also their link), we use the Granger Causality technique. Causality relationships among the variables are based on the following conceptual framework:

To answer the second research question, we can use the Vector AutoRegression (VAR). In the presence of cointegration, we will use the Vector Error Correction Model (VECM).

VAR is a system of \( n \) equation, with \( n \) endogenous variables. Each endogenous variable is explained by its own lag, current value of other endogenous variable, and the lag of other endogenous variables. Therefore, in the context of modern econometrics, VAR is considered as a multivariate time-series that treat all variable endogenously since there is no certainty if the variable is actually exogenous, and is fully rely on the data to explain. Sims (1980) argues that if there is a true simultaneity among a number of variables, then the variables must be treated equally and there should be no a priori distinction between endogenous and exogenous variables. Enders (2004) formulated the simple first-order bivariate system as follows:

\[
y_t = b_{10} - b_{12} z_t + \gamma_{11} y_{t-1} + \gamma_{12} z_{t-1} + \varepsilon_{yt}
\]  

(12)

\[
z_t = b_{20} - b_{21} y_t + \gamma_{21} y_{t-1} + \gamma_{22} z_{t-1} + \varepsilon_{zt}
\]

(13)
Assuming that $y_t$ and $z_t$ is stationary, $\varepsilon_y$ and $\varepsilon_z$ are white noise disturbances with standard deviation $\sigma_y$ and $\sigma_z$, while $\varepsilon_y$ and $\varepsilon_z$ are white noise and uncorrelated disturbance. Meanwhile, we can write the standard form of the primitive model above as follows.

\[
y_t = a_{t0} + a_{t1}y_{t-1} + a_{t2}z_{t-1} + \epsilon_{yt} \tag{14}
\]

\[
z_t = a_{z0} + a_{z1}y_{t-1} + a_{z2}z_{t-1} + \epsilon_{zt} \tag{15}
\]

$\epsilon_{yt}$ and $\epsilon_{zt}$ are the combination of $\varepsilon_y$ and $\varepsilon_z$. The primitive form is called the structural VAR, and the standard form is called VAR. Detail explanation on transforming the primitive to standard forms is available in Enders(2004). The general VAR model can be presented as:

\[
x_t = \mu_t + \sum_{i=1}^{k} A_i x_{t-i} + \epsilon_t \tag{16}
\]

$x_t$ is the ($n \times 1$) vector of endogenous variable; $\mu_t$ is the vector of exogenous variable, including intercept and trend; $A_i$ is ($n \times n$) coefficient matrix; and $\epsilon_t$ is the residual vector. In a simple bivariate system of $y_t$ and $z_t$, the variable $y_t$ is influenced by the present and past value of $z_t$, while $z_t$ is influenced by the present and the past value of $y_t$.

To overcome the shortcoming of first-differenced VAR and to regain long-run relationships between variables, we can use Vector Error Correction Model (VECM), as long as these variables are co-integrated. Inserting the original equation in level into the new equations, we have:

\[
\Delta y_t = b_{10} + b_{11}\Delta y_{t-1} + b_{12}\Delta z_{t-1} - \lambda(y_{t-1} - a_{t0} - a_{11}y_{t-2} - a_{12}z_{t-2}) + \epsilon_{yt} \tag{17}
\]

\[
\Delta z_t = b_{20} + b_{21}\Delta y_{t-1} + b_{22}\Delta z_{t-1} - \lambda(z_{t-1} - a_{z0} - a_{z1}y_{t-2} - a_{z2}z_{t-2}) + \epsilon_{zt} \tag{18}
\]

$a$ is the long-run coefficient, $b$ is the short-run coefficient, $\lambda$ is the error correction parameter, and the term in parentheses indicate co-integration between variables $y$ and $z$.

General VECM model can be presented as follows (Achsani et al, 2005):

\[
\Delta x_{t-1} = \mu_t + \Pi x_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \epsilon_t \tag{19}
\]

$\Pi$ and $\Gamma$ is the function of $A_i$. The matrix $\Pi$ can be decomposed into two matrices with dimensions ($n \times r$); $\Pi = \lambda \beta^*$, where $\lambda$ is the adjustment matrix and $\beta$ is the co-integration vector, whereas $r$ is the co-integration rank.
The procedure of VAR analysis is presented Diagram 3. Once the basic data is ready, we transform them into the natural logarithm (ln) to obtain consistent and valid results, except for interest rates and profit sharing return. The first test is the unit root test, to determine if the data is stationary or containing trend. If they are stationary at level, we use VAR directly. VAR level can estimate long-run relationships among variables. If data are not stationary at level, we take the first difference and test if they are stationary. If the data in first difference is stationary, we proceed to test for co-integration among variables. Without co-integration, we can only apply the VAR at first difference, representing the short-run relationships among variables. Without cointegration, the innovation accounting would not be meaningful for the long-run relationship among variables.

With the presence of co-integration, we can apply the VECM model on data level to obtain the long-run relationships among variables. VECM can estimate the short and the long-run relationships among variables. Within this condition, the innovation accounting for the VAR level and VECM will be meaningful for long-run relationships.

Referring the conceptual framework above, the second issue in this paper will be analyzed by using general VAR model, as in Equation 18. The two models of the dual monetary transmission policy are output models and inflation model.
We use impulse response function to analysis the response of endogenous variables on other variables shock in the model. Decomposition variance analysis was also conducted to see the relative contribution of variable in explaining the variability of certain variables. Data of IHK, FINC, and LOAN are transformed into the natural logarithm (ln) to obtain valid and consistent results.

IV. RESULTS AND ANALYSIS

The stationary test show only IPI, FINC, and PUAB are stationary at level, while the remaining variables are stationary on the first difference. These second test is to determine the optimal lag. The first step is determining maximum lag of stable VAR system, where the criterion is stable if all roots have a modulus smaller than one and are located within circle unit (Lutkepohl, 1991). The results show the modulus range of 5 for model Output (IPI) and 6 for the inflation model (CPI); both are located within the unit circle.

The second step is to determine the optimal lag; the shortest lag of Hannan-Quinnon Criterion (HQ) or the Schwarz Information Criterion (SC). The results showed the optimal of one lag for both output and inflation model.

We apply trace statistics for co-integration test to determine the number of cointegrating equations that explain the long-run relationship. The results show that the Output model has six cointegrated equations, while the Inflation model has four cointegrated equations at critical value of 5%.

4.1. Granger Causality

Granger Causality results for conventional monetary policy transmission channel with Output (IPI) as the final target, indicates a continuity of interest rate channel, from SBI rate to interbank rate (PUAB) and INT, from PUAB to INT and OUTPUT, from INT to the LOAN and back to the SBI and PUAB, and also from LOAN to OUTPUT, then from OUTPUT back to LOAN. In general, the rise in SBI rate increases interest rates and lowers the LOAN and OUTPUT.
On conventional monetary policy transmission with Output (IPI) as final target, there is no continuity of yield channel from SBIS margin to OUTPUT. SBIS can only affect the financial markets to PUAS. Meanwhile, the PLS affect FINANCING and OUTPUT, and FINANCING affected OUTPUT and PUAS. In general, the SBIS yield only increased the PUAS yield, while the PLS yield increase FINANCING and OUTPUT.

For inflation models, i.e. the monetary policy transmission channel with Inflation (CPI) as the ultimate target, the Granger causality for the conventional system show a continuity of
interest rate from SBI to PUAB and INT, from PUAB to INT, from INT to LOAN and INFLATION and back again to SBI and PUAB. After that, INFLATION affected SBI. In general the rise in SB increases interest rate, lowers the LOAN and increase INFLATION.

On the other hand, for the Islamic monetary policy transmission in Inflation model (CPI), the Granger Causality indicated the discontinuity continuous from SBIS yield to inflation. SBIS only affects the yield of PUAS Islamic financial market. Meanwhile, PLS affect FINANCING then FINANCING affects PUAS. In contrast, PUAS, PLS and FINANCING were affected by INFLATION.
In general, the increase of SBIS yield only increase the PUAS yield, while INFLATION lowered the PLS and increase FINANCING.

From the Granger test results above, the conventional monetary policy transmission channel is continuous to OUTPUT, especially loan, because conventional loans are parts of the real sector activities. On the other hand, in Islamic monetary policy transmission channel, the financial sector (SBIS and PUAS) are separated from the real sector (PLS and FINANCING), and only real sector link to OUTPUT. Worth to note, in conventional side, the increase of SBI reduces the output, since funds are absorbed into the financial sector rather than to the real sector.

In inflation models, the channel of conventional monetary policy transmission is continuous to inflation, while Islamic channel is not. This is possible since the conventional interest-based economy has two dichotomous markets (financial and real sector markets), where the financial market is inflationary. On the other hand, the Islamic one is non-interest-based and focuses on real sector, hence non-inflationary. Therefore, the interest rate (representing the price in the conventional financial sector) affects inflation, while the SBIS (not representing the price in real sector and financial sector) does not affect inflation. When the Islamic system still use SWBI with wadiah akad, the SBIS represent the price in Islamic real sector, and when it use SBIS with ju’alah akad, (profit sharing, which is comparable to the one-month SBI), SBIS more represent the price of conventional financial sector.

The conventional system affect the Islamic system mainly on loan, since the monetary and financial system in Indonesia is still dominated (97.4%) by conventional systems, and the real sector is related to credit, not the interest rates. On the other hand, Islamic sides affect the conventional side more from the financing yields (PLS), since it is basically a real sector. Meanwhile, conventional loan interest rates (INT) did not affect the Islamic side since INT is the price of money in the financial sector, which is depends on many variables.

Generally, conventional monetary policy transmission is in line with the theory, while the transmission channel of Islamic monetary policy cannot be clearly identified. However, Islamic instruments using profit and loss sharing, such as mudharabah and musharakah in PLS financing, positively affect the OUTPUT and inflation.

4.2. Impulse Response Function

The results of Impulse Response Function (IRF) for the dual monetary policy transmission output models show that all conventional variables, namely credit (LOAN), interest (INT), interbank money market (Interbank) and the policy rate (SBI), permanently lower the output. On the other hand, all the variables of the Islamic Policy Rate, namely financing (FINC), profit sharing (PLS), Islamic interbank money market (PUAS) and Islamic Policy Rate (SBIS), have positive impact in terms of increasing output permanently.
The effect of the conventional variables shock towards the output decline and stable after 16-21 periods, while the influence of the Islamic Policy Rate shock towards output decline and stable more quickly after 11-16 periods. Interest rates on conventional systems give the largest negative impact on the output, while Islamic financing (FINC) has the largest positive impact on the output.

For the inflation model (CPI), Impulse Response Function shows that except SBI rate, all conventional variables including the volume of loan (LOAN), interest (INT), and the interbank money market (PUAB), give inflationary impact on inflation permanently. On the other side, all Islamic variables including financing (FINC), profit and loss sharing (PLS), Islamic interbank money market (PUAB) and Islamic policy rate (SBIS), shows a positive impact in terms of reduce the inflation permanently.
The effect of conventional variables shock to inflation decline and stable after 8-21 period, while the influence of Islamic variables shock on inflation decline slightly faster and stable after 9-19 periods. Among conventional variables, the loan interest rate (INT) have the largest negative impact (triggering) on inflation, while the Islamic profit and loss sharing (PLS) have the largest positive impact (reduce) on inflation.

The same result applies for conventional loans (LOAN) and Islamic financing (FINC). Since the credit is influenced by its interest rates, while the financing is affected by its profit sharing, then the loan has a negative impact on inflation and output, while Islamic financing had a positive impact on inflation and output. This pattern also applies for the conventional interbank rate (PUAB) and Islamic interbank yield (PUAS). Since PUAB rate as the reference of conventional banking interest rate give negative impact on inflation and output. On the other hand PUAS positively affect to the inflation and output.

Furthermore, the Islamic monetary policy (SBIS) also showed similar behavior with other Islamic variables; reducing inflation and encouraging the output.

Meanwhile, the effects of shock (increase) in SBI may affect (retain) inflation, but at the same time, it also have a negative impact on output. SBI influence on inflation is the premise of conventional economics to use the SBI as the main monetary instrument in controlling inflation. However, it should be noted that the negative influence of the other three conventional variables (PUAB, and LOAN INTEREST) is much larger than the positive effect of SBI on inflation.

The impact of interest rates and inflation are in accordance with the results of empirical studies by Ascarya (2009a and 2009b), where the interest rate is one of the causes of inflation, while profit sharing does not trigger the inflation. The impact of the interest rate and profit sharing towards output was in accordance with Ryandono (2006) and Ascarya et.al. (2007), where the interest rates gave negative impact to output or economic growth, while the profit sharing gave a positive impact to output or economic growth. When the interest rate increased, investment would decrease, so that the output would decrease as well. Meanwhile, when the profit sharing increased, the investment would increase, so that the output would increase as well.

4.3. Forecast Error Variance Decomposition

For the model of dual monetary policy transmission channel with the final output (IPI) as the target, the Forecast Error Variance Decomposition (FEVD) indicates that the conventional variables with largest negative contribution (inhibitory) on output includes the interest rate (18:13%), SBI(5:02%), Interbank (4:57%) and LOAN(3:57%). On the other hand, the Islamic variable sturned out to be a positive contributor on driving the output, though still small, like the FINC (1.12%) and PLS (0.36%).
For the dual monetary policy transmission with the ultimate goal of inflation (CPI models), the Forecast Error Variance Decomposition (FEVD) shows that the conventional variables with the largest negative contribution or triggering inflation, are interest (25.23%), credit volume or LOAN (19.43%) and the Interbank Money Market (1.87%), except SBI which contribute positively (inhibitors) on inflation by 1.52%. Meanwhile, Islamic variables are a positive contributor in terms of an inhibitor of Inflation, although still small, such as PLS (4.63%) and the FINC (1.31%).

The results indicate that, overall, the conventional variables are inhibitors, while Islamic variables are driving force for the economic growth. In aggregate, these conventional variables contributed negatively to economic growth by 31.29%, while the Islamic variables contributed positively to economic growth by 1.62%.
Meanwhile, in order to achieve price stability or inflation, the conventional variables generally trigger inflation, while the Islamic variables contain it, except for SBI (conventional), which contribute 1.52% in containing inflation. For inflation targeting, totally generally, the contribution of conventional variables on triggering inflation is 46.53%, while the Islamic variables contain inflation with contribution of 6.21%.

The above results generally show that the conventional variables (mainly financial sector variables) naturally lead to inflation and restrain economic growth, while the variables of the Islamic Policy Rate (mainly real sector variables) naturally do not trigger inflation, while encouraging economic growth.

The behavior of SBI in restraining the inflation accord the conventional practice of monetary policy, but fuels inflation through an increase in lending rates and hampering economic growth.

V. CONCLUSION

This empirical paper provides some important findings. First, based on the test Granger Causality, overall, the flow of conventional monetary policy transmission are in accordance with the theory, while the Islamic monetary policy transmission cannot be clearly identified and is disconnected at PUAS. However, Islamic instruments that uses a contract of profit and loss sharing, such as mudaraba and musharaka in PLS financing, positively affect the real sector’s output and does not effect to inflation.

Second, based on the IRF result, the whole shocks from SBI, Interbank, interest rates and credit (conventional) affect negatively and permanently the inflation and economic growth (except SBI to inflation), and indicates of speculative behavior. On the other hand, the shock of SBIS, PUAS, Islamic profit sharing and financing shows permanent and positive impact on inflation and economic growth, without indication of speculative behavior.

Third, referring to the variance decomposition result, the overall conventional variables, which are primarily financial sector variables, naturally play the role in triggering inflation and slowing the growth. An exception is for SBI (conventional), which contribute 1.52% in keeping inflation. The role of SBI in detaining inflation during monetary contraction are in accordance with conventional practice of monetary policy over the years, but fueling inflation through an increase in lending rates and lowered economic growth. On the other hand, the Islamic variables which are mainly real sector variables, naturally contributed to contain inflation and to stimulate economic growth.

These three findings lead to the empirical conclusion that monetary policy to reduce inflation with Islamic patterns is more effective than conventional patterns. These conclusions provide some logical implications, (i) in the dual monetary system, an alternative approach to
monetary policy, can be conducted using a quantitative approach that is not contrary to the conventional and Islamic Policy Rates. This is in line with the proposed strategy of Choudhury (1997), Ascarya, et al. (2007) and Ascarya and Shakti (2008); (ii) pricing approach can still be used, but using Real Rate of Return as a policy rate, so it can be applicable to conventional and Islamic policies. It is also in line with Ryandono (2006), Ascarya, et al. (2007), Ascarya, et al. (2008), Ascarya (2009), and Ascarya and Yumanita (2009), so that monetary policy is not only to control inflation, but also to eradicate inflation; (iii) in line with points (i) and (ii), then SBIS should use sharing profit contract (or musharakah mudharabah), rather than fee-based (ju’alah), to give better effects on macroeconomic stability and inflation reduction.
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This paper analyzes the contribution of capital and labor on sectoral performance in Indonesia. Using stochastic frontier production function, this paper found the aggregate share of capital and labor is 0.20 and 0.34 respectively; representing the dominance of labor. The highest three technical efficiency is Mining sector (88.65%), Manufacture (70.47%) and Financial (65.93%), while the lowest one is Electric, Gas and Water (25.38%).

Keywords: efficiency, stochastic frontier, productivity, Indonesia.

JEL Classification: D24, J24, O18
I. INTRODUCTION

The growth of Gross Domestic Product (GDP) is one of domestic economic development indicator. GDP can be viewed from three approaches; expenditure, sectoral, and income. The Central Bureau of Statistics (BPS) has actually calculated the GDP; unfortunately they publish GDP growth only from the expenditure and sectoral sides. There are nine sectors which contribute to GDP growth, namely Agriculture, Mining, Manufacturing, Electricity Gas and Water, Construction, Trade Hotel and Restaurant, Transportation and Telecommunications, Finance, and Other services.

On income approach, Tjahyono (2007) analyzed the impact of the quality and the efficiency of input factors on output, both in national and regional level. He concluded the technology adoption is equal across regions and the technical efficiency (TE) is time varying in Indonesia. However, these studies neither explained specifically the sectoral efficiency in regional level, nor the dynamics of regional efficiency across periods. It is necessary to know which sectors in each region have the highest growth over the years. On the other hand, we should identify the sector with low efficiency; hence need regional policy to support their development.

From sectoral approach, the regional economic structure can be distinguished into two; the region with similar sectoral economic structure with the national economy, and the region with high dependency on particular sectors (e.g. Mining and Agriculture). The changes in regional economic growth that affect the national economic growth, depends on the performance of each sector in the region, particularly their major sector. In addition, the change of economic growth, will affect the economic cycle both in regional and national.

This information is vital for local government to determine their priority to achieve the economic resilience on their region. Considering the purpose of development is to achieve sustainable economic growth, therefore it is necessary to identify the sectoral dynamics to formulate the right targeted regional policy.

This study will also beneficial for investors and bank industry. Investors can decide their investment target by looking at the sectoral efficiency and its dynamics. Investors will certainly prioritize investment in the most efficient sector. From the banking side, this study will assist the sectoral allocation of the loan. A more efficient sector will absolutely be a priority for the bank.

The first purpose of this study is to analyze the input factors that encourage the growth of national economy. Second is to measure the sectoral efficiency at national and regional level. Third is to analyze if there are changes in the sectoral efficiency over time. Fourth is to provide policy recommendations for local government to maintain resilience and to obtain the sustainable regional economic growth.
The second part of the paper reviews the theory and the literature study on sectoral efficiency. The next part will review the methodology, econometric models, and data. In the fourth section, we present the estimation result and analysis. The fifth part provides conclusions and suggestions, and closes the presentation.

II. THEORY

Frontier analysis refers to the Solow-Swan model, which is based on the concept of Cobb-Douglas production function. Solow-Swan\textsuperscript{2} model is widely referred in exogenous growth theory; one of the approaches to the theory of long-run economic growth.

Solow-Swan model\textsuperscript{2} has been adopted by many economists and continuously developed by some experts such as Mankiw-Romer Model-Weil (MRW Model) who internalize human capital into the model. Bernanke and Guyanak also developed a MRW models by presenting learning by doing through the balance growth path. In addition, Barro-Mankiw-Sala I Martin (2001) also contributed by introducing the role of financial market in stimulating the economic growth. These models are using the assumption that the growth of technological progress is exogenous; hence they are included on exogenous growth category.

2.1. Solow-Swan Model and Measurement of Efficiency

Solow-Swan model basically reflects a closed economy. This closed economy produces one type of goods using labor and capital stock as the input factors. Solow-Swan model is a combination of neoclassical supply-side and Keynesian demand-side, in which technological progress and saving rate are assumed to be exogenous. In addition, government is excluded, leaving only the household and corporate sectors. In the corporate sector, there are several companies with similar technology. The prices of production factors are more flexible to ensure full utilization, while the output price is constant.

Cobb-Douglas production function expressed that the output is affected by the input, in which the capital stock and labor are the main components. Therefore, the Solow-Swan Model also focuses on the capital stock and labor as the input factors plus technological factor.

Nevertheless, the Solow-Swan models cannot present the level of efficiency in the use of input factors. Farrell (1957) classifies efficiency into two categories, technical efficiency (TE) and allocative efficiency (AE). Technical efficiency (TE) measures the maximum output one can obtain using available input, whereas the allocative efficiency (AE) measure the efficiency by using input in an optimal proportions and available input price.

\textsuperscript{2} Mankiw, N. Gregory, David Romer, and David N. Weil, “A Contribution to the Empirics of Economic Growth”, Quarterly Journal of Economics, 1956
Furthermore, we can use parametric and non-parametric data to estimate the fully efficient production function. Data Envelopment Analysis (DEA) is a measurement method that uses non-parametric data, while the Stochastic Frontier method is a measurement method that uses parametric data, developed among others by Aigner, Lovell, and Schmidt (1977).

2.2. Stochastic Frontier Model

Stochastic frontier model was not only developed by Aigner, Lovell and Schmidt (1977), but also by Meeusen and Van den Broeck (1977), Cornwell, Schmidt and Sickles (1990), and Kumbhakar (1990). Basically, stochastic frontier illustrates maximum output that can be generated from the input factors. Actual output will be exactly on the frontier line, when the input factors are used efficiently. Otherwise, the actual output will be inside the frontier. The greater difference between the frontier and the actual, the more inefficient the input factor utilization.

The gap can be narrowed or widened over time. These changes can be caused by the increasing of efficiency in input usage or the frontier shifting due to the technological improvement. Hence, there are three factors that influence output: the efficiency change of input factors usage, the changes in technology, and the changes in input factors.

The basic model of this approach is Solow-Swan based on the Cobb-Douglas production function with stock of capital and labor as the input. Cobb-Douglas production function can be expressed as:

\[ Y_{it} = A_i K_{it}^{\beta_{1i}} L_{it}^{\beta_{2i}} \]  

Where \( Y_{it} \) is the output of the province \( i \) at period \( t \), \( K_{it} \) expresses province capital stock, \( L_{it} \) expresses province labor, \( A_i \) expresses technological progress, \( \beta_{1i} \) expresses output elasticity to capital, and \( \beta_{2i} \) expresses output elasticity to labor.

On Equation (1), we add two types of composite error: one-sided non-negative error term that measures the inefficiency in input factors usage (various factors under firm’s control) and two-sided error term that measures all factors beyond the firm’s control. Aigner, Lovell, Schmidt (1977) developed Stochastic frontier function model which significantly contributed to econometric model and estimated the technical efficiency of firm or economic sector. Stochastic frontier includes two random components, one of them is the technical inefficiency and the other is a random error. Furthermore, Schmidt and Sickles (1984) developed a model of stochastic frontier production function with panel data as presented below:

\[ y_{it} = \alpha + X_{it} \beta + v_{it} - u_{it} \]
Analysis of Sectoral Efficiency and the Response of Regional Policy

Where $\alpha_1 = \alpha - u_{it}$

Equation (3) is a standard form on panel data literatures, and $\beta$ can be estimated with standard methods, such as GLS (Generalized Least Square) or Haussmann and Taylor instrumental variables estimator. We can also estimate using the MLE (Maximum Likelihood Estimator) with assumption of particular distribution for one side error $u_{it}$ in equation (2).

Schmidt and Sickles applied panel model above on airline sample data during 1970-1977 (prior deregulation) under assumption of Cobb-Douglas technology. Schmidt and Sickles used and compare the GLS and MLE method (assuming half normal distribution for the firm effects). They also use Wu-Haussmann specification error and test the null hypothesis: firm-specific effects are not correlated with its regressor.

The advantage of using panel data is we can choose whether to use a particular distribution assumption for $v$ and $u$ or use the assumption that technical inefficiency is not correlated with the input. This assumption is testable. Nevertheless, the major benefits come primarily from the assumption that firm effects are constant over time.

Several studies use aggregated data, hence does not necessarily work on individual firms data. Senhadji (2000) among others measured the total factor productivity (TFP) in several countries using the Solow model and compare TFP between developing and developed countries. Koop, Osiewalski, and Steel (1997) applied stochastic frontier model using Bayesian analysis to decompose the output growth into input change, technological change and efficiency change in developing countries.

III. METHODOLOGY

This study uses quantitative method in measuring the efficiency of Indonesia’s economy. There are two different methods to apply, first, the stochastic frontier model with panel data, to analyze the effect of input factor on sectoral growth based on the Cobb-Douglas production function and to analyze the efficiency levels. Empirically we use special software FRONTIER program 4.1 developed by Coelli (1996). This program use FORTRAN language to insert mathematical specification into the stochastic frontier models.

For frontier analysis, we use the data of Gross Domestic Product, real Gross Regional Domestic Product, capital stock, and labor. The frequency of the data is annual, covering periods of 1985 to 2009, providing us 25 years in total. In addition, the cross section
identifier is nine sectors of the economy (Table 1). In total, the number of sample data is 225.

We refer to the Solow-Swan model with the basic Cobb-Douglas production function. Recall Equation (1), the function to estimate is \( Y_{it} = A_i K_{it}^{\beta_{1,i}} L_{it}^{\beta_{2,i}} \). Where \( Y_{it} \) is GDP or real regional GDP of province \( i \) to time \( t \); \( K_{it} \) is capital stock of province \( i \) to time \( t \); \( L_{it} \) is labor of province \( i \) to time \( t \); \( A_i \) is similar to \( A e^{\xi_t} \), where \( \xi \) measures the rate of technical progress; \( \beta_{1,i} \) is the level of output elasticity to capital; and \( \beta_{2,i} \) the level of output elasticity to labor.

We apply this model on several provinces, including North Sumatera, South Sumatera, West Java, Central Java, East Java, Bali, South Kalimantan, and South Sulawesi.

**IV. RESULTS AND ANALYSIS**

**4.1. Sectoral Economic Profile in Regional and National Level**

The GDP growth is contributed by nine sectors. Four major sectors with the total contribution of 68.2% are Manufacturing, Trade Hotel and Restaurant, Agriculture, and Mining sector with the individual share of 27.8%, 15.5%, 14.5%, and 10.4% respectively. With this significant contribution, the movement of total GDP growth will depends mainly on these four sectors.

The regional economic growth contributes variously to national growth. Some regional growths coincide with the national growth, and some are even higher than the national level. However, there are regions with lower growth than the national. The different growth between regional and national may arise from different sectoral economic structure. This occur in Riau,
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NAD, East Kalimantan and Jakarta, where the economy of these regions rely on specific sectors, such as Mining for Riau, Aceh, and East Kalimantan, and financial sector for Jakarta. Nationally, the contribution of these sectors is minor relative to other sectors. Figure 2 to Figure 5 describe the sectoral contribution in the region.³

³ Region consists of several provinces, Sumatera (all provinces in Sumatra, Riau Islands, and Bangka Belitung); JABALNUSTRA (the provinces on Java Island, Bali, Nusa Tenggara except DKI Jakarta) Jakarta, and KALI_SULAMPUA (all provinces in Kalimantan island, Sulawesi, Maluku and Papua)
Among all sectors, the majority of labor in Indonesia (the average from 2000-2009) is absorbed in agricultural sector (43%), Sector Trade, Hotel and Restaurant (20%), and Service (12%). See below.

### Table 2. Sectoral Labor Absorption (in percent)

<table>
<thead>
<tr>
<th>Sector</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>45.28</td>
<td>43.77</td>
<td>44.34</td>
<td>46.38</td>
<td>43.33</td>
<td>43.97</td>
<td>42.05</td>
<td>41.24</td>
<td>40.30</td>
<td>39.68</td>
</tr>
<tr>
<td>Construction</td>
<td>3.89</td>
<td>4.23</td>
<td>4.66</td>
<td>4.37</td>
<td>4.84</td>
<td>4.86</td>
<td>4.92</td>
<td>5.26</td>
<td>5.30</td>
<td>5.24</td>
</tr>
<tr>
<td>Trade, Hotel and</td>
<td></td>
<td></td>
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<tr>
<td>Transport and</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telecommunication</td>
<td>5.07</td>
<td>4.90</td>
<td>5.10</td>
<td>5.32</td>
<td>5.85</td>
<td>6.02</td>
<td>5.93</td>
<td>5.96</td>
<td>6.03</td>
<td>5.84</td>
</tr>
<tr>
<td>Finance</td>
<td>0.98</td>
<td>1.24</td>
<td>1.08</td>
<td>1.41</td>
<td>1.20</td>
<td>1.22</td>
<td>1.41</td>
<td>1.40</td>
<td>1.42</td>
<td>1.42</td>
</tr>
<tr>
<td>Other*</td>
<td>0.58</td>
<td>1.20</td>
<td>0.88</td>
<td>0.95</td>
<td>1.35</td>
<td>1.17</td>
<td>1.21</td>
<td>1.17</td>
<td>1.24</td>
<td>1.33</td>
</tr>
</tbody>
</table>

Source: Sakernas, BPS
Note: *) Other sector includes Mining, Electric, Gas and Water.
4.2. Indonesian Economic Policy and the Impact of World Shock on Sectoral Developments

Sectoral developments in Indonesia cannot be separated from the economic policy during the regime of Orde Baru and the dynamics of the external economy. The economic policy of Orde Baru is based on the trilogy of development; a dynamic national stability, high economic development, and equitable distribution of development and its results. The implementation of development at that time was divided into five-year development patterns or so-called Five-Year Development (Pelita) which began in 1969 (Bappenas, 1969 - 1998).

On the other hand, the dynamics of world economy also affected the sectoral development in Indonesia. The oil boom in 1970s and the US recession in 1980 bring significant impact on exports and imports performance of oil-gas and non-oil-gas. Changes in import-export performance trigger sectoral fluctuations, including Mining and Manufacturing (textile, wood products). Meanwhile, the economic crisis in 1997-1998 reduced the performance of almost all sectors.

In the next section we present the analysis of stochastic frontier models and the sectoral efficiency both at national and regional level.
Table 3.  
Indonesia’s Economic Policy

<table>
<thead>
<tr>
<th>PELITA</th>
<th>TARGET</th>
<th>POLICY</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (1969-1974)</td>
<td>The central point of development is Agriculture (food production), supported by clothing, infrastructure, and other sectors to support Agriculture.</td>
<td>Focus on policies to boost rice production (agricultural intensification) and infrastructure improvements, as well as the ease of investment</td>
</tr>
<tr>
<td>II (1974-1979)</td>
<td>Availability of food, clothing, housing, and infrastructure</td>
<td>Continuity of agricultural intensification and extensification, ease on Mining investment</td>
</tr>
<tr>
<td>III (1979 – 1984)</td>
<td>Focus on equity (world economic recession, 1980)</td>
<td>the policies for Industrial development</td>
</tr>
<tr>
<td>VI (1994-1998)</td>
<td>Food self-sufficiency and industrial development</td>
<td>-</td>
</tr>
<tr>
<td>RPJM</td>
<td>-</td>
<td>The era of low cost carrier in air transport</td>
</tr>
</tbody>
</table>

Figure 7.  
Event Analysis
4.3. **Analysis of Stochastic Frontier**

By using panel data, we will outline the aggregate elasticity of input factor, while the level of efficiency will be analyzed on sectoral level. Generally, the level of sectoral efficiency changes over time or time varying, with an increasing trend.

4.3.1. **Input Factor Analysis at National Level**

This study emphasizes the role of input factors on producing the output, without analyzing their quality. This is consistent with the Neo Classic theory, which considers only the accumulation of input factor (capital stock and labor). The empirical results of Stochastic Frontier with Maximum Likelihood Estimator (MLE) method is:

\[
\log Y = 3.43 + 0.20 \log K + 0.34 \log L \\
(0.28)^{**} \quad (0.03)^{**} \quad (0.04)^{**}
\]

\[
\sigma^2 = 0.10, \quad \hat{\gamma} = 0.97, \quad \hat{\mu} = 0.47, \quad \hat{\eta} = 0.02
\]

Log (likelihood) = 309.37

The above is a result from panel data regression with nine economic sectors during 1985-2009. Nationally, the elasticity of capital and labor are 0.20 and 0.34 respectively, with a fairly high significance level (\(*\)). These are consistent with Tjahjono and Anugrah (2006) that the role of labor is greater than the capital stock for Indonesian economy.

The labor elasticity of 0.34 indicates a 1% increase of labor will increase the output by 0.34%. Meanwhile, an increase of 1 unit of capital will increase output by 0.2 units, which mean to increase 1 unit of output require 5 additional units of capital. On the other hand, the Incremental Capital Output Ratio (ICOR) during 2008-2009 is 4-5, which represents the needs of 4-5 additional units of capital to increase the output by 1 unit.

4.3.2. **Regional Input Factor Analysis**

The results of regional input factor analysis are presented in Table 5.1. Depends on the characteristic of regional economy, the proportion of capital stock and labor factor varies across region.
From the empirical test results above, the capital and the labor elasticity of output is positive for all regions. The positive sign of parameter $\eta$ indicates the technical efficiency will increase over time. It also indicates an increasing efficiency level of production input over the observation period.

The results for East Java and South Sulawesi are similar with the national result, where the contribution of labor is dominant over the capital stock. However, in contrast to the national results, in West Java, Central Java, Denpasar, North Sumatera, South Sumatera and South Kalimantan, the capital stock contributes more than the labor.

Possible reason is the contribution of capital intensive sectors on these regions. In West Java, the contribution of Manufacturing is high\(^4\), while in South Kalimantan\(^5\) the Mining sector

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\(^4\) Analysis of Efficiency Levels and Sectoral Business Cycle in West Java.
\(^5\) Analysis of Efficiency Levels and Sectoral Business Cycle in South Kalimantan.
dominates. In South Sumatera, the highest sectoral contribution is Mining, Manufacturing, and Electricity, Gas and Water.

4.3.3. Sectoral Efficiency Analysis in National Level

Battese and Coelli (1992) stated that if the parameter $\hat{\eta}$ is positive, the technical efficiency will increase over time, likewise, the technical efficiency will decrease when $\eta$ is negative. On national level, the estimated $\hat{\eta}$ is 0.02, which indicates an increase of sectoral efficiency during the period of observation.

In agricultural, the average level of efficiency is 53.08% with an increasing trend for the last 25 years (See Figure 8). The improvement in agricultural sector and the use of more efficient labor contribute to this increasing technical efficiency.

In Mining sector, the average level of efficiency is 88.65% during 1985-2009 (See Figure 9). This is the highest among all sectors. This high technical efficiency is possibly explained with the usage of more efficient Mining equipment, which is included in capital stock.

The growing Manufacturing sector in Indonesia also records an increase of efficiency level. On average, the efficiency level of Manufacturing is 70.47% in the last 25 years. This is the second highest after Mining sector. Possible explanation for this fairly high efficiency is the higher skills of the labor; hence more efficient, and the use of more efficient equipment.

Meanwhile, the Electricity, Gas and Water record the average level of technical efficiency by 25.38%, which is the lowest among sectors during 1985-2009. Though increases over

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6 Analysis of Efficiency Levels and Sectoral Business Cycle in South Sumatera.
time, the low efficiency level of this sector is possibly caused by the less efficient of its production equipment.

The average level of technical efficiency on Construction also increases over time. The technical efficiency in this sector is averagely 55.17% for the last 25 years. The efficiency increase in this sector is relatively higher as illustrated with steeper line in Figure 12.

Trading, Hotels and Restaurants records 58.50% of efficiency level for the same period; similar with the Construction sector. The efficiency level in this sector is also changing over time with a positive trend. The more efficient the labor, the higher the technical efficiency of this sector.
The efficiency level of Transport and Telecommunication changes over time with a positive trend. However, the average efficiency level is quite low, 43.40% during 1985-2009. The use of inefficient supporting equipment on Transport is possible reason for its low efficiency.

In financial sector, the average level of efficiency during the period 1985-2009 is 65.93%. Several financial policies including banking policy of Pakto 1988 increase the performance of this sector. In addition, the labor of this sector tends to be more efficient. Over time, the efficiency of Financial sector also increases.

Service sector also records a change in technical efficiency over time, with a positive trend. However, the average level of efficiency for this sector is low, 43.99%, for the last 25 years. Considering its changes rate, the technical efficiency of this sector increases rapidly, as indicated by steeper line in Figure 16.
## 4.3.4. Analysis of Sectoral Efficiency at Regional Level

The value of technical efficiency for each sector in each region is presented in Table 5 below.

<table>
<thead>
<tr>
<th>Sector</th>
<th>National</th>
<th>Jabar</th>
<th>Jateng</th>
<th>Jatim</th>
<th>Bali</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>53%</td>
<td>76%</td>
<td>77%</td>
<td>44%</td>
<td>0,1%</td>
</tr>
<tr>
<td>Mining</td>
<td>89%</td>
<td>95%</td>
<td>94%</td>
<td>45%</td>
<td>0,01%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>70%</td>
<td>67%</td>
<td>81%</td>
<td>44%</td>
<td>0,05%</td>
</tr>
<tr>
<td>Electricity, Gas and Water</td>
<td>25%</td>
<td>4%</td>
<td>17%</td>
<td>57%</td>
<td>0,00%</td>
</tr>
<tr>
<td>Construction</td>
<td>55%</td>
<td>45%</td>
<td>88%</td>
<td>23%</td>
<td>0,03%</td>
</tr>
<tr>
<td>Trade, Hotel and Restaurant</td>
<td>58%</td>
<td>56%</td>
<td>69%</td>
<td>54%</td>
<td>0,1%</td>
</tr>
<tr>
<td>Transport and Telecommunication</td>
<td>43%</td>
<td>16%</td>
<td>39%</td>
<td>21%</td>
<td>0,04%</td>
</tr>
<tr>
<td>Finance</td>
<td>66%</td>
<td>12%</td>
<td>77%</td>
<td>9%</td>
<td>0,03%</td>
</tr>
<tr>
<td>Services</td>
<td>44%</td>
<td>13%</td>
<td>28%</td>
<td>12%</td>
<td>0,05%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sector</th>
<th>Sumut</th>
<th>Sumsel</th>
<th>Sulsel</th>
<th>Kalsel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>76%</td>
<td>13%</td>
<td>64%</td>
<td>8%</td>
</tr>
<tr>
<td>Mining</td>
<td>96%</td>
<td>32%</td>
<td>50%</td>
<td>5%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>67%</td>
<td>14%</td>
<td>62%</td>
<td>4%</td>
</tr>
<tr>
<td>Electricity, Gas and Water</td>
<td>6%</td>
<td>0,5%</td>
<td>200%</td>
<td>4%</td>
</tr>
<tr>
<td>Construction</td>
<td>89%</td>
<td>8%</td>
<td>100%</td>
<td>3%</td>
</tr>
<tr>
<td>Trade, Hotel and Restaurant</td>
<td>58%</td>
<td>9%</td>
<td>88%</td>
<td>2%</td>
</tr>
<tr>
<td>Transport and Telecommunication</td>
<td>29%</td>
<td>3%</td>
<td>100%</td>
<td>2%</td>
</tr>
<tr>
<td>Finance</td>
<td>28%</td>
<td>5%</td>
<td>133%</td>
<td>1%</td>
</tr>
<tr>
<td>Services</td>
<td>15%</td>
<td>5%</td>
<td>5%</td>
<td>0,3%</td>
</tr>
</tbody>
</table>

Generally, the largest efficiency level is for Mining sector in national level as well as in some regions. West Java, Central Java, and North Sumatra record efficiency level above 90%. This indicates the use of input (capital and labor) to produce output in this sector has been optimal relative to other sectors.

Electricity, Gas, and Water records the lowest level of efficiency, nationally and in several region including West Java, Central Java, North Sumatra, and South Sumatra. Possible explanation is the over use of capital stockin producing inadequate output. East Java and South Sulawesi are the opposite cases where the EGW sector record the largest technical
V. CONCLUSION

Since the regime of Orde Baru, the government has been trying to encourage the sectoral growth as a part of the overall economic development. Some fundamental policies have improved the sectoral performance, including intensification and extensification policy, which has increased the growth on Agricultural sector, especially food which contribute 60%. In financial sector, the enactment of Pakto 1988 and its continuous policy package had raised the financial sector performance, originated from banking. In Manufacturing, the policy, which focuses on the clothes availability and supported by industrial regulation, particularly on investment, has increased the TPT performance.

This paper provides two important findings. First, with additional information on the technical efficiency of input, the stochastic frontier model is better than the Solow-Swan model. The estimated shares of capital stock and labor are 0.20 and 0.34 respectively. This indicates the labor dominates of the use of capital stock in Indonesia’s economy.

Second, all sectors experienced an increase of technical efficiency during period of 1985-2009. The Mining sector on average has the highest technical efficiency (88.65%), followed by Manufacturing sector (70.47%) and Financial sector (65.93%). While the Electricity, Gas, and Water recorded the lowest average efficiency by 25.38%, for the last 25 years.

These two findings require the government role to raise the level of efficiency especially in some sectors with low efficiency such as Electricity, Gas, and Water. Since the government dominate this sector, it is important to provide incentives for the state owned company to increase their efficiency.

This research calls for further research by examining the quality of input factor for each sector, such as human capital and the term structure of the capital. In addition, it is also important to include the sectoral Total Factor Productivity (TFP).
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APPENDIX: SPENCER CURVE

Spencer Moving Average is generally used as a data smoothing process, to display the underlying pattern (signal) while reducing the random fluctuation (noise). Spencer (1904) proposed a method to remove trends from time series data by using moving average line. Spencer formulated 15 periods moving average, with negative weight for the end of period. The Spencer Curve is particularly calculated based on the 5x5x4x4 moving average, which is the 4 periods moving average of original data is processed using 4 periods moving average, then 5 periods moving average and finally another 5 periods moving average by assigning weights of -3/4, 3/4, 1, 3/4, and -3/4.

The following steps show how the Spencer Curve is formed:
1. Determine 4 periods moving average. The general form is as follows:

\[ MA_{4i} = \frac{1}{4} (x_{i} + x_{i+1} + x_{i+2} + x_{i+3}) \]

2. Determine the 4 periods moving average using \( MA_{4} \) data. The general form is as follows:

\[ MA_{4-4i} = \frac{1}{4} (MA_{4i} + MA_{4i+1} + MA_{4i+2} + MA_{4i+3}) \]

Or:

\[ MA_{4-4i} = \frac{1}{4} (x_{i} + 2x_{i+1} + 3x_{i+2} + 4x_{i+3} + 3x_{i+4} + 2x_{i+5} + x_{i+6}) \]

Where \( MA_{4-4} \) is the moving average for 4 periods from \( MA_{4} \) data.

3. Determining the 5 periods Moving Average using \( MA_{4-4} \) data. The general form is as follows:
MA5_4_4_i = ( MA4_4_i + MA4_4_{i+1} + MA4_4_{i+2} + MA4_4_{i+3} + MA4_4_{i+4} ) / 5

Or:

MA5_4_4_i = ( x_i + 3x_{i+1} + 6x_{i+2} + 10x_{i+3} + 13x_{i+4} + 14x_{i+5} + 13x_{i+6} + 10x_{i+7} + 6x_{i+8} + 3x_{i+9} + x_{i+10} ) / 80

Where MA5-4-4_i is the moving average for 4 periods from MA4_i data

4. Determining the 5 periods Moving Average using MA5_4_4 weighted data.

The general form is as follows:

MA_Spencer_i = (-3/4) MA5_4_4_i + (3/4) MA5_4_4_{i+1} + (3/4) MA5_4_4_{i+2} + (3/4) MA5_4_4_{i+3} + (3/4) MA5_4_4_{i+4}

Or:

MA_Spencer_i = (-3/320) x_i + (-6/320) x_{i+1} + (-5/320) x_{i+2} + (3/320) x_{i+3} + (21/320) x_{i+4} + (46/320) x_{i+5} + (67/320) x_{i+6} + (74/320) x_{i+7} + (67/320) x_{i+8} + (46/320) x_{i+9} + (21/320) x_{i+10} + (3/320) x_{i+11} + (-5/320) x_{i+12} + (-6/320) x_{i+13} + (-13/320) x_{i+14}

The graph below shows the weighting in smoothing process on Spencer Moving Average method.
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   - Methodology (quantitative methodology is preferred)
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