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THE OPTIMAL INSTRUMENT RULE OF INDONESIAN MONETARY POLICY[1]

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ABSTRACT

Since 1999, according to Law No. 23/1999, Bank Indonesia (BI – the Indonesian Central Bank) set inflation targeting as the goal of its monetary policy. At the time, BI set monetary aggregate M1 as its operational instrument. However, as BI considers M1 to be increasingly difficult to control, it has changed its operational instrument to the nominal interest rate. The changes are stipulated in Law No.3/2004. This paper discusses the optimal value of interest rate as the operational instrument of Indonesian monetary policy, known as the optimal instrument rule. An instrument rule is defined as a single mathematical expression indicating the value of interest rate (as a policy instrument) the Central Bank should set. Previous examples of instrument rules are the well-known Taylor rule and McCallum rule. The instrument rule in this paper is constructed by applying a mathematical model which is then tested empirically by using an econometric method. The period of estimation for the policy instrument in the model is the quarterly monetary data from 1993 to 2006.

Key words: Optimal rule, nominal interest rate, inflation targeting.

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Fields: Monetary and Financial Policy

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1. Introduction

In setting its monetary policy instrument, every central bank has guidelines on macroeconomic targets it would like to achieve. In the case of Indonesia, according to Law No. 3 Year 2004, the role of Bank Indonesia, the Republic of Indonesia's central bank, is to achieve and maintain the stability of the value of the rupiah, the Indonesian currency. The stability of the value of the rupiah meant by the law is the stability of the rupiah's value in respect of goods and services, as well as foreign exchange. The rupiah's stability in respect of goods and services is measured by the inflation rate, while its stability towards foreign exchange is measured by the exchange rate. Moreover, Bank Indonesia faces a difficult choice between pressing the inflation rate and stimulating economic growth. A growing economy is usually followed by increases in aggregate demand, pushing up the prices of goods and services. However, Bank Indonesia does not have to press the inflation rate to its lowest level. There is an optimal rule of inflation rate that supports output growth in the economy. Therefore, besides targeting the inflation rate, Bank Indonesia must also consider output growth in setting the correct policy.

In keeping the stability of price of goods and services and output growth, many countries currently apply an *inflation targeting framework*. The framework requires the central bank to set a quantitative target. In addition, the framework also requires the central bank to be independent in setting up the direction of macroeconomic variables and their magnitude, as well as choosing and creating a policy instrument. Meanwhile, an optimal policy instrument requires consideration of which monetary variable should be applied as an instrument, the interest rate or the money supply.

How to choose an instrument for monetary policy has been widely discussed in the literature. In the 20th century, many rules arose regarding the choice of policy instrument and magnitude setting. Literature regarding the choice of an optimal monetary policy instrument started with Poole (1970). Following Poole, McCallum (1987, 1988, 1993) set a rule to determine an optimal money supply level to achieve a target output growth. In addition, Taylor (1993) set a rule to determine an optimal nominal interest rate in order to respond to inflation rates, the expected rate of inflation and output gap. A more sophisticated model in choosing an optimal policy instrument is introduced by Guender (2003). Next, the author of this paper discusses how the Guender rule is superior to the rules of Taylor and McCallum.

Both the Taylor and McCallum rules assume that the chosen instrument, whether interest rate or money supply, and the set target, whether the inflation target or the nominal GDP target, already fit the country's economic conditions. Neither rule takes into account the economic conditions of a country in suggesting a policy instrument and targeting a macroeconomic variable in determining the parameter. In reality, by not taking into account a country's economic conditions, choosing a policy instrument and targeting macroeconomic variables could lead to a monetary policy being ineffective in stimulating the economy, due to the incompatibility of the chosen instrument and the set target with the country's economic conditions.[2]

Both Taylor's (1993) and McCallum's (1987, 1988, 1993) models applied a predetermined value of parameter. As a result, by applying the Taylor rule to two countries with the same actual inflation and inflation target, the model will predict the same optimal interest rate, although the underlying macroeconomic conditions for both countries are different. In the case of Guender's optimal rule, parameters applied in the model are not predetermined but endogenously estimated, so that the model will better represent a country's underlying macroeconomic condition. In this way, the Guender rule is better than Taylor's or McCallum's.

In this paper, we develop a model constructed by Guender (2003). The Guender model discusses the structure of an economy and choosing an optimal interest rate that becomes the monetary policy instrument. The model we develop in this paper differs from the Guender model in that we explicitly explain the exchange rate behavior. After that, we estimate the model empirically by using Indonesian quarterly macroeconomic data from the first quarter of 1993 to the first quarter of 2006. In that period, there were two structural changes in Indonesian monetary policy. First, in 1999 Bank Indonesia set inflation targeting as its goal. Second, in 2004 Bank Indonesia changed its operational instrument from the monetary aggregate (M1) to the nominal interest rate. In this study, we do not take into account these structural changes, nor do hypothesis testing for both structural changes. Therefore, the finding of optimal interest rate in this paper holds generally for every episode of Indonesian monetary policy.

For clarification, the optimal interest rate holds in both inflation targeting, and monetary targeting eras. In the inflation targeting era, the central bank set in advance the inflation target they would like to achieve. In the monetary targeting era, the optimal interest rate rule is still relevant, assuming there is a specific inflation rate the central bank would like to achieve with the money supply target. This assumption is supported by the findings of Razzak (2001).

[2] In technical terms, the determination of an unbiased, optimal monetary policy instrument holds specifically for each country, as each country has special characteristics in its economy. It depends on the magnitude of macroeconomic parameters and the economic fluctuation. Meanwhile, the economic fluctuation is represented by the *variances of structural disturbance*, affecting the magnitude of macroeconomic variables.

Razzak concludes that both the Taylor rule (for inflation targeting) and the McCallum rule (for monetary targeting) will recommend similar policy.

The limitation of this research is that we do not separate the policy eras, between the monetary targeting and inflation targeting eras. A further study might include the application of the model in the two different eras of monetary policy in Indonesia, and the connection between them.

The main results obtained in the paper are as follows: (i) Although interest rate determination policy has a different direction to the inflation rate, the changes of focus of the central bank, whether the central bank is more concerned with inflation stability or output stability, should not have a significant impact on the policy interest rate. Therefore, it is time for the central bank to pay more attention to output growth, since it has only a small impact on interest rate decrease. (ii) The gap between actual inflation and the inflation target contributes 32% of nominal interest rate increase. It means that if the gap widens by 1%, the central bank is supposed to increase the optimal interest rate by 32 basis points. We find that an increase in Bank Indonesia's nominal interest rate, as a short-term policy instrument, is usually of lower value than the optimal interest rate generated by the instrument rule from our research. In addition, Bank Indonesia must be able to choose the right timing to increase the nominal interest rate, in order not to stimulate the inflation rate, but to control inflation. (iii) The inflation target set by Bank Indonesia is too low, making it difficult for the bank to achieve. Therefore, the set inflation target needs more evaluation, and the inflation target needs to be announced more often, by looking at the actual economic conditions, forward or backward.

2. Literature Review

There are some rules of monetary policy applied in many countries, among them the well-known Taylor rule and McCallum rule. On one hand, the Taylor rule (Taylor, 1993) has become very popular in recent years. The rule represents an automatic response of interest rate as a monetary policy instrument to any deviation of the inflation rate from a desired target value and to the deviation of real GDP from its potential (output gap). On the other hand, the McCallum rule (McCallum, 1987,1988,1993) is a money base-nominal GDP targeting rule which is also an adaptive policy formula, but with a different policy instrument and a different underlying theory of transmission mechanism. The chosen policy instrument is the monetary base, instead of the interest rate.

The Taylor Rule can be expressed as follows:

$$R_t = \bar{r} + \Delta p_t^a + 0.5\left(\Delta p_t^a - \pi^*\right) + 0.5\tilde{y}_t \qquad (1)$$

Here R_t is the short term nominal interest rate that the central bank uses as its instrument or "operating target". $\bar{r}$ is the long-run average real rate of interest. Δp_t^a is an average of recent inflation rates (or a forecast value), and π^* is the central bank's target inflation rate. Finally $\tilde{y}_t$ is the measure of the output gap, the percentage difference between actual and capacity output values. The rule suggests that monetary policy should be tightened (by increase) when inflation exceeds its target value and/or output exceeds capacity.

The Taylor rule is applied to measure an interest rate for monetary policy in several countries, including Indonesia. Afandi (2004) applied the Taylor Rule to determine the optimal interest rate for Indonesia, divided in three different periods: (1) the pre crisis period (March 1993 to June 1997); (2) the post crisis period (July 1997 to September 2003); and (3) the central bank independence period (May 1999 to September 2003). The study reflected the poor performance of output growth in the aftermath of the crisis. Moreover, the study estimated a modified Taylor rule that fits the Indonesian economy for each period. One of the conclusions from Afandi is that the central bank set a higher interest rate policy to stabilize domestic inflation, compared to the interest rate that is predicted by the Taylor rule.

Another study on the Taylor rule was conducted by Saville (2004), who researched the South African economy. Saville (2004) compared the optimal interest rate predicted based on the Taylor rule and the rule made by the South African Reserve Bank (SARB) for the South African economy. The findings suggest that the stance of SARB is appropriate in terms of current interest rate policy. The key lending rate set by SARB is apparently not "too high" given South Africa's current economic conditions. If the interest rate is assessed on the basis of the Taylor Rule, then it would appear that SARB is generally less active in adjusting rates than the rule suggests. The instrument (repo) rate moves in a far tighter band than the equilibrium Taylor rule rate. SARB's monetary policy stance is more restrictive than the Taylor rule suggests.

The rule proposed by McCallum can be expressed as follows:

$$\Delta b_t = \Delta x^* - \Delta v_t^a + 0.5\left(\Delta x^* - \Delta x_{t-1}\right) \tag{2}$$

Here Δb_t is the change in the log of the adjusted monetary base, i.e. the growth rate of the base between period t−1 and t. The term Δx^* is the target growth rate for nominal GDP, Δx_t being the change in the log of nominal GDP. Δx^* is specified as $\pi^* + \Delta y^*$, where Δy^* is the long-run average of growth of real GDP. Δv_t^a is the average growth of base velocity over the previous 16 quarters, $v_t = x_t - b_t$ being the log of base velocity. Razzak (2001) stated that many researchers suggest that the McCallum money-base targeting rule has undesirable stabilization properties. This type of rules dominates the Taylor rule when it is difficult to accurately assess the state of the economy in real time. By contrast, the Taylor rule appears to dominate if one assumes artificially low degrees of uncertainty. Razzak (2001) then tested whether the Taylor rule is really different from the McCallum rule by modifying the McCallum rule. Model-based evaluation of the two rules' stabilization properties indicate that the modified McCallum rule is similar to the Taylor rule. The key to this result is the degree of interest rate smoothing applied to the policy rule.

However, Koivu, et. al. (2008) found that the McCallum rule could be a useful tool for analyzing the monetary policy stance and for providing information about inflationary pressures in the Chinese economy. They found that the actual Chinese money supply, measured by monetary base, has been very close to the rule-based values during the estimation period (1994–2006).

Guender (2003) constructed a monetary policy instrument using a structural model explaining the economic behavior of a country. The Guender model generated an optimal instrument rule of monetary policy for countries adopting the *inflation targeting* policy. The rule is derived from a simple macroeconomic model in order to find a parameter gauging the optimal policy. Having reached the parameter, we are able to estimate an optimal interest rate policy.

Next are equations applied in the Guender model. Equation (3) and (4) indicate the main behavior of the economy together with the central bank monetary policy. Equation (5) indicates the objective function that the central bank would like to achieve, and equation (6) indicates the optimal solution of the central bank's goal. These equations are written as follows:

$$y_t = -\beta r_t + E_t y_{t+1} + v_t \quad (3)$$

$$\beta > 0 \, , \; v_t \approx N(0, \sigma_v^2)$$

Equation (3), representing the IS relation, explains that the *output gap* will increase at the same moment as the increase of the expected output gap for the next period, and will go down in response to the increase in real interest rate.

$$\pi_t = E_t \pi_{t+1} + a y_t + u_t \quad (4)$$

$$a > 0 \, , \; u_t \approx N(0, \sigma_u^2)$$

Equation (4), representing a Forward-looking Phillips Curve, explains that the current inflation rate is the positive function of the next period's expected inflation and the output gap.

$$r_t = \bar{r} + \lambda\left(\pi_t - \pi^T\right) \tag{5}$$

Equation (5) represents the instrument rule, where variable r_t is the real interest rate that the central bank should achieve in running the monetary policy. Variable $\bar{r}$ is the nominal interest rate target, λ is the policy parameter, achieved by deriving the central bank objective function. Variable λ indicates how quickly the central bank adjusts its monetary policy until the inflation target is reached.

$$\text{Min } L = V(y_t) + \mu V(\pi_t) \tag{6}$$

After that, equation (6), the central bank's objective function, is the sum of two variables, the variance of the output gap and the variance of the inflation. The central bank chooses a parameter μ indicating its concern, whether the central bank is more concerned with the variability of the output gap or inflation. Parameter μ is an exogenous variable determined by *judgment*.

$$\lambda^* = \frac{a}{\beta}\left[\mu + \left(1 + \mu a^2\right)\frac{\sigma_v^2}{\sigma_u^2}\right] \tag{7}$$

Finally, equation (7) is the solution of equation (6). The parameter λ^* depends on the source of economic uncertainty (the variability of output gap and inflation) and also on the preference of the policy maker in running monetary policy. By substituting equation (7) to equation (5), we will obtain the optimal nominal interest rate.

In order to implement the model on the Indonesian economy and the way Bank Indonesia set its optimal interest rate, we need to estimate equation (3) and (4) in the model. The Guender model offers freedom to do empirical testing to gain the following optimal parameter: β (a coefficient relating the interest rate and output gap), a (a coefficient relating inflation and output gap), the stochastic disturbance variance of each equation, and the central bank preference parameter μ.

3. The Model

The goal of this research is to develop the Guender model until we achieve an optimal nominal interest rate for Bank Indonesia's target of operation. The model that we applied has several characteristics. First, the instrument used as an intermediate target is the nominal interest rate, leaving no room for debate whether money supply or interest rate be used as the chosen instrument. Second, the model is constructed only for countries applying an *inflation targeting* policy. Finally, the model assumes that economic agents are *forward-looking* in forming their expectation, applying rational expectations. However, the Guender model assumes a closed economy, so the model has not explicitly included exchange rate fluctuation. The exchange rate fluctuation is our improvement over the Guender model.

The model characteristics follow current world economic conditions, where many countries' central banks apply the inflation targeting policy and set the nominal interest rate as the intermediate target. Meanwhile, the rational expectation theory is also a modern theory in explaining how people form their expectations, leaving the adaptive expectation theory behind. In explaining the central bank characteristics, besides output and inflation stabilization, exchange rate stabilization could also be another main focus of central bank policy.

The model applied in this research is to compile equations (3) to (5) in a system of equations and after that we add the following equation (8):

$$e_t = E_t e_{t+1} - \gamma\left(r_t - r_t^*\right) + w_t \tag{8}$$

Variable e_t is the real exchange rate as a function of the difference between real domestic interest rate (r) and foreign interest rate (r^*).

We take the first order condition of the central bank objective function in equation (6) to get a parameter determining the optimal interest rate. By following the flow of the model, we can determine whether the actual Bank Indonesia interest rate policy (called the "BI Rate") is higher or lower than, or close to, the estimated optimal value.

In short, we write down the system of equations as follows:

1. $y_t = -\beta r_t + E_t y_{t+1} - b\left(E_t e_{t+1} - e_t\right) + v_t$ ➔ *IS Relation*
2. $\pi_t = E_t \pi_{t+1} + a y_t + u_t$ ➔ *Forward Looking Phillips Curve*
3. $r_t = \bar{r} + \lambda\left(\pi_t - \pi^T\right)$ ➔ *Instrument Rule*
4. $e_t = E_t e_{t+1} - \gamma\left(r_t - r_t^*\right) + w_t$ ➔ *Interest Rate Parity Condition*

The purpose of the system of equations is to find the optimal solution value for parameter λ. Having gained the estimated value of parameter λ and the estimated value of other coefficients, we will gain the estimated value of the optimal central bank interest rate.

An estimation problem with a forward-looking model is the difference of time period between a dependent variable and the equation's error term. The existence of time period differences causes estimation bias on variance of errors. In fact, variance of errors is the main component to gain the estimated instrument rule. To overcome the time period difference problem, Rudd & Whelan (2005) express the following forward looking equation:

$$\pi_t = \omega^f E_t \pi_{t+1} + \omega^b \pi_{t-1} + \gamma x_t \tag{9}$$

in terms of:

$$\pi_t = \omega^f \pi_{t+1} + \omega^b \pi_{t-1} + \gamma x_t + \varepsilon_{t+1} \tag{10}$$

Which are: π_{t+1} (the actual inflation at time t+1), ε_{t+1}: (the error of expectation), x_t: (the output gap or unemployment rate).

According to the theory of rational expectations, the error term at equation (10) cannot be determined at time *t*, so that the coefficient ω^f can be estimated consistently by using the same variable at time period t or before, as a coefficient for π_{t+1}. We estimate the coefficient ω^f using the following method:

First, we do a *backward-looking* estimation to gain estimated values of $\hat{\pi}_{t+1}$ towards the following equation:

$$\hat{\pi}_{t+1} = \hat{\delta}_1 \pi_{t-1} + \hat{\delta}_2 x_t + \hat{\delta}_3 z_t \tag{11}$$

In equation (11), variable z_t is other unknown variables stimulating inflation.

Second, we use the estimated values of $\hat{\pi}_{t+1}$ on the second stage regression between the current inflation π_t as the independent variable towards the expected future inflation (approximated by $\hat{\pi}_{t+1}$), the lag of inflation rate π_{t-1} and the driving variable x_t, reaching the next regression equation:

$$\pi_t = \omega^f \hat{\pi}_{t+1} + \omega^b \pi_{t-1} + \gamma x_t + \varepsilon_t \tag{12}$$

We estimate the Forward Looking Phillips Curve by using the two-stage regression method. We use the same method to estimate equations (3), (4) and (8).

4. Solving The Model

The model is solved by using a post-putative solution for the three endogenous variables:

$$y_t = \phi_{10} + \phi_{11} v_t + \phi_{12} u_t + \phi_{13} w_t \tag{13}$$

$$\pi_t = \phi_{20} + \phi_{21} v_t + \phi_{22} u_t + \phi_{23} w_t \tag{14}$$

$$e_t = \phi_{30} + \phi_{31} v_t + \phi_{32} u_t + \phi_{33} w_t \tag{15}$$

Readers may find the mathematical derivation for the optimal solution in Appendix 1. The solution of equation (6) is the parameter λ, derived mathematically by the following steps:

(i) Substitute one equation to another to get the reduced form for output, inflation and exchange rate.

(ii) Determine the coefficient of error term and the intercept of each reduced form equation of output, inflation and exchange rate.

(iii) Create the equation of output variance and inflation variance by using the reduced form equation.

(iv) Take the first order equation for equation (6) from the equation of output variance and inflation variance created in the previous step.

(v) Generate the optimal value of parameter λ, whose value depends on other parameters in the structural equation. The other parameters are: the source of uncertainty in the economy (output gap variability and inflation variability) and the preference of the policy maker.

(vi) Substitute the optimal parameter λ into equation (5) to get the value of optimal nominal interest rate.

Having included the interest rate parity equation, the solution for the objective function is:

$$\underset{\lambda}{Minimize}\; L = \frac{1}{\left(1 + \lambda a(\beta + b\gamma)\right)^2}\left[\left(1 + \mu a^2\right)\sigma_v^2 + \left(\mu + \lambda^2 (\beta + b\gamma)^2\right)\sigma_u^2 + \left(b^2 + \mu a^2 b^2\right)\sigma_w^2\right] \tag{16}$$

The solution for the first order condition of equation (16) is the optimal value of the following instrument rule parameter:

$$\lambda^* = \frac{a}{\beta + b\gamma}\left\{\mu + \left(1 + \mu a^2\right)\left[\frac{\sigma_v^2}{\sigma_u^2} + b^2\frac{\sigma_w^2}{\sigma_u^2}\right]\right\} \tag{17}$$

Readers may see how equation (17) differs from equation (7). Equation (17) explicitly includes the variance of errors of the exchange rate (σ_w^2), derived from the interest rate parity equation. Equation (17) states that the optimal monetary policy is not only affected by the fluctuation of output and inflation, by also by exchange rate fluctuation.

We apply the constructed model to explain the behavior of the Indonesian economy and the way Bank Indonesia should set the optimal interest rate. In that case, we need to estimate equations (3), (4) and (8) empirically. The parameters to be estimated from the three equations are: β (a coefficient relating interest rate and output gap), a (a coefficient relating inflation and output gap), γ (a coefficient relating exchange rate and domestic and international interest rate parity), the variance of stochastic disturbance for each equation, and the central bank preference parameter μ. A necessary condition for the estimated model is that it has a forward-looking explanatory variable.

5. The Empirical Evidence

To determine the optimal interest rate, we start by estimating three structural equations, equation (3), equation (4) and equation (8). The best model we estimate is the one making the parameters of the three equations statistically significant. In this case, the values of R^2 do not become the main consideration, since we do not apply the model to do forecasting. The values of estimated coefficient and t-statistics is presented in Table 1. We do a two-stage regression for each equation. At the first stage, we estimate the expected value of each dependent variable, then use the forecasted expected value at the first stage as the proxy for the expected value at the second stage. Rudd and Whelan (2005) apply a two-stage regression to avoid the model misspecification problem.

We apply a logarithm transformation for each variable in the structural equation to make the value of estimated variance homogenous and no longer dependent on the unit of data. The *Forward Looking Phillips Curve* equation is estimated using logarithmic CPI variable instead of inflation data, in order to generate a variance of error homogenous among equations. The estimated parameter value of equations (3), (4), and (8) above is as follows:

Table 1 Estimated Values of Equations (3), (4) and (8)

Coefficient	Estimated value	t-statistic	*R-squared*
a :	0.0185	2.198	*0.385*
b :	0.2725	1.738	*0.209*
β :	0.1002	3.351	*0.209*
γ :	*−0.0353*	*−3.196*	*0.161*

Although the values of R^2 are low, it doesn't imply that there is no significant relationship among output, policy interest rate and exchange rate. The relationship is still significant as long as the t-statistic is significant for each coefficient. The values of R^2 are low because we have not applied additional independent variables in the model. Independent variables applied for estimation were only those available in the initial structural model.

The three estimated structural equations can be formulated as:

$$y_t = -0.1002 * r_t + E_t y_{t+1} - 0.2725 * \left(E_t e_{t+1} - e_t\right) + v_t \quad (18)$$

$$\pi_t = E_t \pi_{t+1} + 0.0185 * y_t + u_t \quad (19)$$

$$e_t = E_t e_{t+1} + 0.0353 * \left(r_t - r_t^*\right) + w_t \quad (20)$$

We use the sum squared residual (SSE) from each equation to estimate variance of error term of each structural equation, following the definition: variance of error term = *SSE / (T−M)*. Variable T = the amount of observation and M = the amount of estimated parameter. The estimated values of the three variances of error are:

σ_v^2 : 0.9937

σ_u^2 : 0.3403

σ_w^2 : 0.8312

Next, we substitute the values of estimated parameters and the value of variances of error to get the value of λ^* in equation (17), equal to 0.318. Therefore, we conclude that the instrument rule as guideline for Indonesian monetary policy based on 1993–2006 data is:

$$r_t = \bar{r} + 0.318 * \left(\pi_t - \pi^T\right) \quad (18)$$

Equation (18) shows that there is a roughly 32% deviation of the difference between inflation target and actual inflation, for the optimal interest rate from the long run interest rate. The higher the difference between inflation target and actual inflation, the wider the gap between the long run interest rate and the optimal interest rate that Bank Indonesia aims to achieve.

As an example, in May 2008, Bank Indonesia set BI rate at 8.25%, an increase of 25 basis points from the previous period, 8%. If we follow the instrument rule we generate in equation (18), and assume that the inflation target and the output growth target have the same value, with the inflation target as much as 6.5%, BI should set the interest rate at 8.78% instead of 8.25%.

Table 2 Several Values of Interest Rate and Inflation Based on the Instrument Rule

Variable	Optimal Value	Actual Value
Optimal interest rate	8.78	8.25
Inflation target	6.50	8.10
Actual inflation (yoy)	–	8.96
Previous period interest rate	–	8.00

Source: Bank Indonesia and estimation result

The instrument rule performed in equation (18) emphasizes the importance of achieving the inflation target. The instrument rule provides room for the actual inflation to be 0.8% higher than the inflation target, assuming the current Bank Indonesia interest rate policy to be optimal. By that assumption, the increase of 25 basis points in the interest rate taken by Bank Indonesia may only decrease the inflation rate to 8.10%, not to its target level; i.e. 5.5±1%.

Our next discussion will be based on two simulations. First, a simulation that explains the importance of the central bank focussing on its goal, whether the goal is output stability or inflation stability. Second, a historical review comparing the BI rate set so far with the optimal interest rate generated by the instrument rule in equation (18).

The focus of the central bank is shown by the parameter μ in the objective function $L = V(y_t) + \mu V(\pi_t)$. The value $\mu = 1$ shows that the central bank sets the same weight on output stability and inflation stability. The higher the value of parameter μ, the more attentive the central bank is towards inflation stability. The simulation on many values of parameter μ and λ resulted in a linear function between the two parameters, as shown in Figure 1:

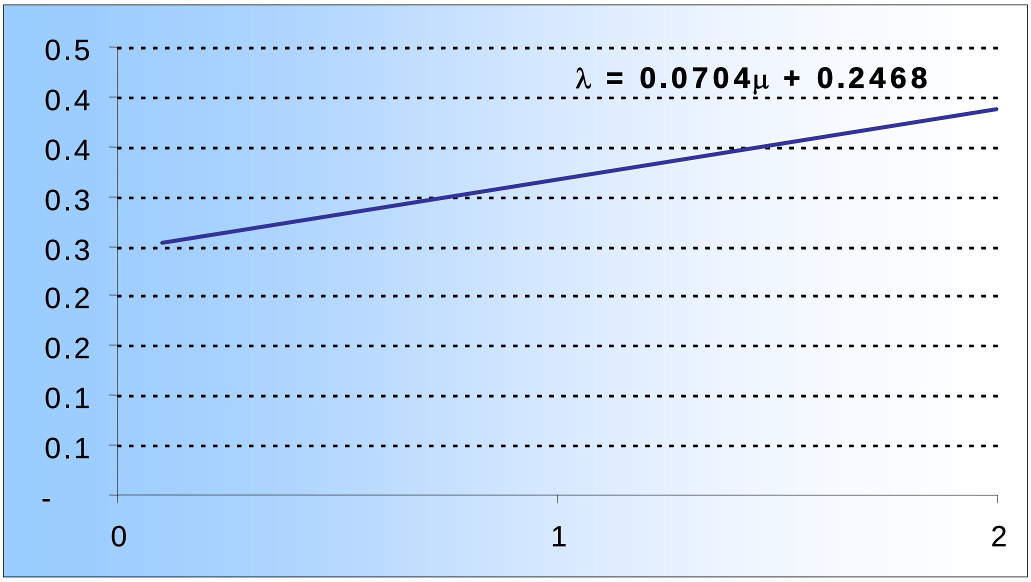

Figure 1 The Linear Function of Parameter μ toward Parameter λ

Notes:
μ = a parameter indicating the focus of a central bank on controlling inflation. A higher value of the parameter indicates that the central bank prefers controlling inflation to promoting economic growth.
λ = a parameter indicating the effect of the gap between actual inflation with target inflation on the difference between optimal and actual interest rate.

Figure 1 shows that the greater the focus of the central bank on inflation stability, the larger the role of differential proportion of inflation target and actual inflation on optimal interest rate. It means that to achieve its inflation target, Bank Indonesia must set a higher BI rate. The implication is that, should Bank Indonesia set its inflation target too low, it will have a heavier burden in paying the interest on Certificates of Bank Indonesia (Sertifikat Bank Indonesia-SBI), the central bank securities instrument for open market operations.

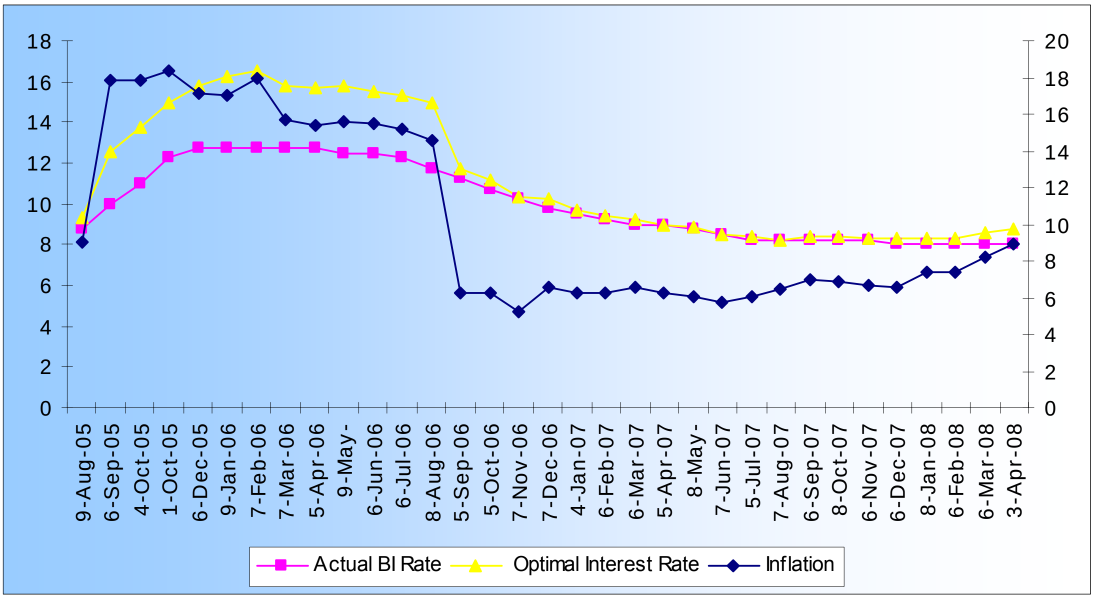

Figure 2: The Simulation of Inflation, BI Rate and Optimal Interest Rate Based on 6.5% Inflation Target y-o-y Period August 9, 2005 – April 3, 2008

Source: www.bi.go.id

Figure 2 shows a simulation between the BI rate, optimal interest rate and actual inflation since Bank Indonesia announced the BI rate for the first time (August 9, 2005) up to date (April 3, 2008). There are two assumptions regarding how the figure is made. First, we assume that Bank Indonesia set the same weight between output growth and inflation rate ($\mu = 1$). Second, they set target inflation at 6.5%. We may see from Figure 2 that the higher inflation rate, the wider the gap between BI rate and optimal interest rate.

The mathematical relation between parameter λ and parameter μ as shown in Figure 1 can also be implemented to measure the concern of the central bank BI towards its achievement in targeting inflation. One way that we implement this by simulation based on the parameter μ. As we infer, a value of μ between 0 and 1 indicates that the central bank is more concerned with output growth than inflation rate. A value of parameter μ greater than 1 shows that the central bank is concerned more with inflation rate than output growth. Table 3, below, illustrates the simulation of several values of parameter μ and the differences between actual BI rate and estimated optimal interest rate.

Table 3: The Simulation of Parameter μ

Parameter (μ) Value	Interpretations of Parameter μ	Differences between actual interest rate and optimal interest rate (%)
0.50	The central bank is more concerned with output growth than inflation rate	−1.09
1.00	The central bank accords output growth and inflation rate the same weight	−1.23
2.00	The central bank is more concerned with inflation rate than output growth	−1.49

Source: Author's calculation

Readers may see in Table 3 that when the central bank is more concerned with output growth than inflation rate, the actual interest rate is lower than the estimated optimal interest rate. It also shows that although the central bank is more concerned with output growth than inflation rate, the actual interest rate is still too low relative to the estimated optimal interest rate, as shown in the third column of Table 3. The inflation target set at 6.5% is still to difficult to achieve by using the current BI rate. BI should have held the BI rate at that higher level for a certain long period until the inflation target was achieved, after that reducing the BI rate gradually.

Bank Indonesia still has another alternative in order to achieve the target inflation, by making corrections to its set inflation target. However, this alternative would reduce the credibility of BI if they changed the inflation target too often. More frequent announcements to public regarding how BI achieves its set inflation target, and other explanation, such as why the target is not achieved, is necessary.

6. Conclusion

The step taken by Bank Indonesia to set an inflation-targeting policy framework – following the worldwide monetary policy – is correct. However, in the case of Indonesia, Bank Indonesia does not have an instrument rule as guideline for policy implementation yet. The purpose of this paper is to construct a monetary policy rule for Indonesia, developed from the Guender optimal rule (2003) and from the empirical estimation of the model. Several conclusions from the empirical estimation result follow.

First, the policy-based interest rate has a different direction to the inflation rate. However, the changes of focus of the central bank's policy, whether concerned more with inflation stability or output stability, have neither large nor significant impact on the changes of the interest rate policy (BI rate in this case). Therefore, it is time for Bank Indonesia to be more concerned with the growth of output, since it has only a small impact on the decrease of the interest rate.

Second, the gap between actual inflation and inflation target contributes as much as 32% to the increase in interest rate. As the gap increases by 1%, the optimal interest rate Bank Indonesia should set increases by 32 basis points (0.32%). The increase of BI rate as a short-term policy instrument is mostly lower than the optimal interest rate generated by our research's instrument rule. In addition, Bank Indonesia needs to time increases in the interest rate well, and be concerned about increasing the higher long-run interest rate that is valid in the longer term.

Finally, the inflation target set by Bank Indonesia is relatively too low, making it difficult to achieve. Bank Indonesia therefore needs to hold the BI rate at that higher level for a certain long period until the inflation target is achieved, after that reducing the BI rate gradually. BI also needs more regular announcements of the value of its inflation target, how that value is reached, and other explanations, such as why the target has not been achieved.

REFERENCES

Affandi, Yoga. 2004. "Estimating Policy Rule in Post Crisis Indonesia," Faculty of Economics and Politics, St Edmund's College, University of Cambridge – Cambridge CB03 0BN, United Kingdom and Bank Indonesia – Jakarta 10010, Indonesia.

Beechey, Meredith, Nargis Bharucha, Adam Cagliarini, David Gruen and Christopher Thompson. 2000. "A Small Model of the Australian Macroeconomy", Economic Research Department. Reserves Bank of Australia. Research Discussion Paper.

Debelle, Guy, and Jenny Wilkinson. 2002. "Inflation Targeting and The Inflation Process: Some Lessons from an Open Economy", Economic Research Department. Reserves Bank of Australia. Research Discussion Paper.

Guender, Alfred V. 2003. "Optimal Monetary Policy under Inflation Targeting Based on an Instrument Rule", *Economic Letters*.78 (2003) 55–58.

Koivu, Tuuli, Aaron Mehrotra and Riika Nuutilainen. 2008. "McCallum rule and Chinese monetary policy", Bofit Discussion Papers 15 (2008).

Leitemo, Kai and Ulf Soderstrom. 2005. "Robust Monetary Policy in A Small Open Economy", Bank of Finland Discussion Papers 20.

Majardi Fajar. 2004. "Pembentukan Model Makroekonomi Skala Kecil (SSMX)", Bagian Studi Sektor Rill. Direktorat Riset Ekonomi dan Kebijakan Moneter. Bank Indonesia.

McCallum, Bennett T. 2002. "Alternative Monetary Policy Rules: A Comparison with Historical Settings for the United States, the United Kingdom, and Japan." Carnegie Mellon University and Federal Reserve Bank of Richmond.

Poole, William. 1970. "The Optimal Choice of Monetary Policy Instruments in A Simple Macro Model", *Quarterly Journal of Economics* 84, 192–216.

Razzak, W A. 2001. "Is Taylor rule really different from the McCallum rule?" Discussion Paper Series No. 07. Reserve Bank of New Zealand.

Rudd, Jeremy and Karl Whelan. 2005. "New Test of The New-Keynesian Phillips Curve", *Journal of Monetary Economics*. 52(2005) 1167–1181.

Saville, Adrian. 2005. "Are Interest Rates Too High? Taylor's Rule versus SARB's rules", A Research note on economic policy. Cannon asset managers.

Taylor, John. 1993. "Discretion Versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy*, Vol. 39 (November), pp.195–214.

APPENDIX 1

Substitute Phillips Curve eq(4) to instrument rule eq (5)

(A1) $$r_t = \bar{r} + \lambda\left(E_t\pi_{t+1} + ay_t + u_t - \pi^T\right)$$

Substitute eq (A1) to IS Relation eq (3)

(A2) $$y_t = -\beta\left(\bar{r} + \lambda\left(E_t\pi_{t+1} + ay_t + u_t - \pi^T\right)\right) + E_t y_{t+1} - b\left(E_t e_{t+1} - e_t\right) + v_t$$

Substitute eq (8) to eq (A2)

(A3) $$y_t = -\beta\left(\bar{r} + \lambda\left(E_t\pi_{t+1} + ay_t + u_t - \pi^T\right)\right) + E_t y_{t+1} - b\left(\gamma\left(r_t - r_t^*\right) - w_t\right) + v_t$$

Substitute eq (A1) to eq (A3)

(A4) $$\begin{aligned} y_t = &-\beta\left(\bar{r} + \lambda\left(E_t\pi_{t+1} + ay_t + u_t - \pi^T\right)\right) + E_t y_{t+1} \\ &- b\left(\gamma\left(\bar{r} + \lambda\left(E_t\pi_{t+1} + ay_t + u_t - \pi^T\right) - r_t^*\right) - w_t\right) + v_t \end{aligned}$$

Reduced Form IS Relation

(A5) $$\begin{aligned} y_t\left(1 + \lambda a\left(\beta + b\gamma\right)\right) = &-\beta\left(\bar{r} + \lambda\left(E_t\pi_{t+1} + u_t - \pi^T\right)\right) + E_t y_{t+1} \\ &- b\left(\gamma\left(\bar{r} + \lambda\left(E_t\pi_{t+1} + u_t - \pi^T\right) - r_t^*\right) - w_t\right) + v_t \end{aligned}$$

Putative Solutions for endogenous variables:

(A6) $$y_t = \phi_{10} + \phi_{11}v_t + \phi_{12}u_t + \phi_{13}w_t$$

(A7) $$\pi_t = \phi_{20} + \phi_{21}v_t + \phi_{22}u_t + \phi_{23}w_t$$

(A8) $$e_t = \phi_{30} + \phi_{31}v_t + \phi_{32}u_t + \phi_{33}w_t$$

The Expected Values

(A9) $$E_t y_{t+1} = \phi_{10}$$

(A10) $$E_t\pi_{t+1} = \phi_{20}$$

(A11) $$E_t e_{t+1} = \phi_{30}$$

Solution for parameters in eq (26)

(A12) $$\phi_{10} = 0$$

(A13) $$\phi_{11} = \frac{1}{1+\lambda a(\beta + b\gamma)}$$

(A14) $$\phi_{12} = \frac{-\lambda(\beta + b\gamma)}{1+\lambda a(\beta + b\gamma)}$$

(A15) $$\phi_{13} = \frac{b}{1+\lambda a(\beta + b\gamma)}$$

Substitute eq (21) to eq (4)

(A16) $$e_t = E_t e_{t+1} - \gamma\left(\bar{r} + \lambda\left(E_t \pi_{t+1} + a y_t + u_t - \pi^T\right) - r_t^*\right) + w_t$$

Substitute eq (26) and the expected values to eq (29)

(A17) $$e_t = \phi_{30} - \gamma\left(\bar{r} + \lambda\left(E_t \pi_{t+1} + a(\phi_{10} + \phi_{11} v_t + \phi_{12} u_t + \phi_{13} w_t) + u_t - \pi^T\right) - r_t^*\right) + w_t$$

Solution for parameters in eq (28)

(A18) $$\phi_{31} = \frac{-\gamma\lambda a}{1+\lambda a(\beta + b\gamma)}$$

(A19) $$\phi_{32} = \frac{-\gamma\lambda}{1+\lambda a(\beta + b\gamma)}$$

(A20) $$\phi_{33} = 1 - \frac{\lambda a b\gamma}{1+\lambda a(\beta + b\gamma)}$$

Substitute eq (26) and the expected values to eq (2)

(A21) $$\pi_t = \phi_{20} + a(\phi_{10} + \phi_{11} v_t + \phi_{12} u_t + \phi_{13} w_t) + u_t$$

Solution for parameters in equation eq (27)

(A22) $$\phi_{21} = \frac{a}{1+\lambda a(\beta + b\gamma)}$$

(A23) $$\phi_{22} = \frac{1}{1+\lambda a(\beta + b\gamma)}$$

(A24) $$\phi_{21} = \frac{ab}{1+\lambda a(\beta + b\gamma)}$$

The objective function is:

$$\text{(A25)}\quad \underset{\lambda}{Minimize}\ L = \frac{1}{\left(1+\lambda a(\beta + b\gamma)\right)^2}\left[\left(1+\mu a^2\right)\sigma_v^2 + \left(\mu + \lambda^2(\beta + b\gamma)^2\right)\sigma_u^2 + \left(b^2 + \mu a^2 b^2\right)\sigma_w^2\right]$$

The policy maker is assumed to set the parameter value that minimizes the *loss function*. The parameter optimal value of the instrument rule is:

$$\text{(A26)}\quad \lambda^* = \frac{a}{\beta + b\gamma}\left\{\mu + \left(1+\mu a^2\right)\left[\frac{\sigma_v^2}{\sigma_u^2} + b^2\frac{\sigma_w^2}{\sigma_u^2}\right]\right\}$$