

# **INFLATION TARGETING UNDER IMPERFECT CREDIBILITY: LESSONS FROM INDONESIAN EXPERIENCE<sup>1</sup>**

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## **Abstract**

*This paper tries to assess the role of credibility in the implementation of inflation targeting framework in Indonesia. It illustrates how credibility may play an important role in the evolution of the Indonesian monetary policy. Understanding the degree of credibility would be beneficial for Bank Indonesia (BI) to understand how to adjust policy instrument to achieve a long-term inflation target. Scaled from zero (purely not credible) to one (perfect credibility), our quantitative measurements found that credibility index for Indonesian monetary policy converge to around 0.5. Refer to projection and simulation results in this paper, the study shows expectation inflation of economic agents is strongly influenced by monetary policy credibility. The more credible the monetary policy, the faster inflation expectation would anchor to its target. In addition, high credibility also increase the efficiency of the monetary policy transmission since the disinflation cost represented by sacrifice ratio is lower. Under imperfect credibility the central bank prefer to attain its inflation target gradually, and if the credibility stock is doubled, then achieving its long-term inflation target required a lot shorter time (approximately 0.4 periods than the baseline).*

**Keywords:** Disinflation, Monetary Policy, Imperfect Credibility, Sacrifice Ratio.

JEL Classification: E31, E52, E58, E61

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[http://www.bsp.gov.ph/events/2010/cbmmw/downloads/papers/2010\\_CBMMW\\_01\\_paper.pdf](http://www.bsp.gov.ph/events/2010/cbmmw/downloads/papers/2010_CBMMW_01_paper.pdf).

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## I. INTRODUCTION

Law No.23 of 1999 mandates a single objective to Bank Indonesia (BI) to achieve and to maintain the stability of Rupiah. Inflation Targeting Framework (ITF) is currently BI's monetary policy framework. ITF is characterized by setting an inflation target, announcing to public, and pursue its target as the primary goal of monetary policy. Numerically, low and stable long-term inflation is commonly referred to 3% in order to be competitive with other countries.

ITF could reflect as the framework of forward looking monetary policy, focused on inflation, and inflation expectations of economic agents. Important features of the ITF are commitment to pursue inflation as a primary goal of monetary policy, announcement of inflation target (including monetary policy measures), and accountability (Mishkin, 2000). The framework provides a nominal anchor for the economic agents in forming their inflation expectations and predicting monetary policy.

The most important point in which monetary policy could affect inflation is that when the economic agents anchor their inflation expectations to the central bank's target. If economic agents' expectations remain high, the disinflation process would last longer and require greater cost in the form of output loss (Clarida, Gali and Gertler, 1999). A central bank who can manage inflation expectations will gain an effective monetary policy, hence a credible monetary policy (Blinder, 1999).

Several studies indicate that monetary policy credibility problem may arise because of the uncertainty of economic agents about the preferences of monetary authorities. Although the monetary authorities announce the target of inflation, it may not credible when the preferences of central banks to reduce inflation is weak (Geraats, 2001; Kozicki and Tinsley, 2003). Economic agents try to interpret preferences based on the monetary authorities of monetary policy actions and performance of inflation and further renew their expectations. King (1996) stressed that transparency would encourage the learning process so that the inflation expectations of economic agents would anchor to the inflation target more quickly.

There are some significant attention associated with disinflation strategy in achieving low and stable inflation, namely: (i) the cost of disinflation related to the trade off of output - inflation (output loss), and (ii) the length of disinflation. Numerous studies show that the disinflation strategy is highly influenced by the credibility of monetary policy. If monetary policy is not fully credible (imperfect credibility), the learning process of economic agents is very slow. This in turn, will affect the formation of inflation expectations and the actual inflation will converge slowly to the target. Consequently, it would dampen on policy rates and other macro variables (GDP, exchange rate, etc).

In order to answer several questions related to the impact of monetary policy credibility on the dynamics of main macroeconomic variables, particularly in achieving the inflation target, the study aimed to develop a model namely ARIMBI (Aggregate Rational Inflation - Targeting Model for Bank Indonesia), which is equipped with credibility features. Specifically, the research objectives are (i) measuring the degree of credibility of monetary policy in Indonesia; (ii) studying the dynamics of the credibility of monetary policy in Indonesia and its impact on the dynamics of key macroeconomic variables (inflation, GDP, exchange rates, interest policy rates), and (iii) conducting simulations to obtain how big the cost of disinflation and how fast the process of disinflation to inflation target over medium term and long term in Indonesia with knowledge of the degree of credibility of monetary policy.

The next session of this paper explains the background of development models and the credibility of monetary policy. Methodology and the model, which describes model structure and transmission mechanism with imperfect credibility and equations in the model will be presented on session 3, while session 4 presents results of simulations and projections. Conclusions and policy implications will close this paper.

## II. THEORY

### 2.1. Central Bank Credibility

Blinder (1999) defines credibility as a "words matching deeds". Compatibility between words and actions is what actually the core of the credibility became. A central bank is considered to be credible if they truly run their monetary policy to achieve the stated target. That definition is similar to Svensson (1999) who showed that a credible monetary policy is reflected in the close relationship between inflation targets with economic agent expectation.

Given the nature of unobservable, the level of credibility is generally ranged from 0 (not credible) to 1 (perfectly credible).

Valentin and Rozalia (2008) offer a method of measuring the credibility of monetary policy as follows:

$$ICI_{adjusted} = \begin{cases} 1 - \frac{|\pi^e - \pi^{tar}|}{\pi^{tar}} & , if |\pi^e - \pi^{tar}| < \pi^{tar} \\ 0 & , if |\pi^e - \pi^{tar}| > \pi^{tar} \end{cases} \quad (1)$$

With  $\pi^e$  is an inflation expectation of the economic agents (private sector) and  $\pi^{tar}$  is the central bank inflation target. For illustration, when the inflation expectations perfectly match the target ( $\pi^e = \pi^{tar}$ ), then the index gained credibility will be 1 (or perfect credibility). Conversely, if inflation expectations are twice the inflation target or more, then the credibility index would be valued at 0 or (no credibility). It is worth to mention that, this approach imposes "symmetric punishment".

As an alternative measurement of the credibility of monetary policy, Cecchetti and Krause (2002) formulates as follows:

$$IC = \begin{cases} 1 & \text{if } \pi^e \leq \pi^{tar} \\ 1 - \frac{1}{0.2 - \pi^{tar}} (\pi^e - \pi^{tar}) & \text{if } \pi^{tar} < \pi^e < 20\% \\ 0 & \text{if } \pi^e \geq 20\% \end{cases} \quad (2)$$

With  $\pi^e$  is inflation expectations of economic agents (private sector) and  $\pi^{target}$  is the central bank's inflation target. Referring to the formula above, when inflation expectations equal or exceed the upper bound of 20%, then the credibility index would be 0 (not credible). Unlike previous measures, Cecchetti and Krause (2002) does not impose symmetric punishment and anywhere the inflation expectations are lower than the target, then the monetary authority is considered to be perfectly credible.

Within the framework of this ITF, credibility becomes crucial particularly for central banks in developing countries, which are not usually independent from the interests of the government or political establishment. This credibility could be built also through communication and transparency to the public. Through these efforts, the public trust to the central bank would increase and in turn inflation expectations in the community could anchor on inflation targets. Achieving low and stable inflation is a prerequisite for good macroeconomic developments. Central banks have substantial flexibility in conducting monetary policy (e.g. consider economic growth, stable exchange rate, the existing business cycle, boom, asset price), but their main responsible is attaining medium-long term inflation target. Thus, the ITF framework is often described as "constrained discretion" (Bernanke and Mishkin, 1997). Constraint is manifested through high transparency and accountability of central banks, in order to build the credibility of monetary policies on disinflation process and to reduce time-inconsistency problem.

On this paper, we internalize the central bank credibility into the macroeconomic model. In general, the structure of macroeconomic models is built to capture the real economy containing the interaction of various economic variables. Basically there are two main objectives of

macroeconomic modeling, namely economic projections and policy impact analysis (policy simulation).

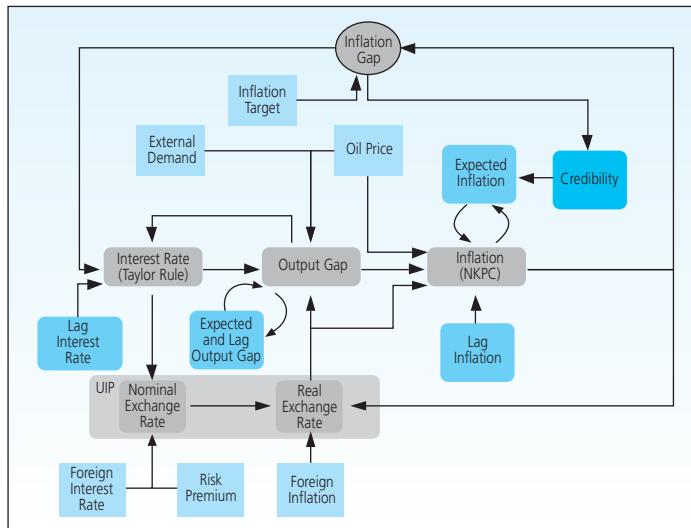
Refers to the practice of modeling done by the various central banks who hold the ITF, a reliable macroeconomic model should : (i) be able to reflect the characteristics of economic structure and to produce a comprehensive analysis of the main determinants of inflation, (ii) represents the monetary policy transmission mechanism; (iii) be equipped with a policy rule, suppose the interest rate, Taylor rule, and put the inflation target and an explicit expectation formation mechanism therein, (iv) theoretically consistent, and (v) have a well-defined steady state and produce projections/ analysis that are consistent with theory.

## **2.2. The Model**

In practice, there is usually a tradeoff between accuracy projection resulting from the econometric model and the medium-long term policy simulation obtained from the Dynamic Stochastic General Equilibrium DSGE model, the economic model used for policy simulation based on micro-economic foundations, with dynamic path and general equilibrium framework and with a stochastic shock. Projections generated from Econometric models and the direction is not necessarily commensurate with the simulation results issued by the DSGE model. Short-term projections based on the goodness of fit is good from the econometric model, not necessarily aligned with the DSGE model simulation results. Based on its trade-offs, starting 2008 BI developed a model that combines the advantages of econometric models (Bayesian Econometric estimation method adopted) and DSGE (New Keynesian macroeconomic model), therefore useful both for projection and policy simulation.

ARIMBI with Imperfect Credibility could be classified as a semi-structural model which derived from a simple DSGE model. The equation used in the model is ad-hoc basis, in the sense of not purely derived from standard equations as DSGE model. Technically, ARIMBI is a small scale model of a quarterly macroeconomic model adopted from GPM (Global Projection Model) IMF with an additional feature of monetary policy credibility. However, because Indonesia does not have a good unemployment data, then the unemployment rate equation is not implemented. This model contains interactions of several main macroeconomic variables, namely output, inflation, short term interest rate, exchange rates and monetary policy credibility. In addition there are also several other variables and the equation of identity that complements the model.

Relationships between variables in ARIMBI with Imperfect Credibility are described in the following diagram:



**Diagram 1.**  
**Model Structure of ARIMBI with Imperfect Credibility**

The figure above shows that there are four primary behavioral equations in the model, namely the inflation equation New Keynesian Phillips Curve (NKPC), the output gap, uncovered interest rate parity (UIP) and the Taylor rule. Inflation is influenced by forward and backward looking inflation itself, the output gap, changes in oil prices and real exchange rate. Output gap is affected by the backward and forward looking variable itself, the real interest rate, real exchange rates and external demand (captured by the US GDP). Taylor Rule equation for determining the nominal policy interest rate is influenced by the real interest rate, deviations of inflation from target and output gap. While UIP, which is a deviation between the expectations of the exchange rate, interest rate differentials are influenced by both domestic and foreign (rest of the world).

One important assumption on the model, the attainment of inflation targets with minimum cost is strongly influenced by the credibility of monetary policy. There are two ways to capture the dynamics of the credibility of monetary policy in a model, either by letting this credibility variable to be exogenous or endogenous. By modeling credibility of monetary policy to be exogenous, we assumes that the credibility of monetary policy follow the auto regressive AR(1). On the other hand, by modeling the credibility of monetary policy as endogenous, we assume that the credibility of monetary policy follows the nature of stock and will increase or decrease in accordance with the past performance of the central bank on achieving his target. In this case the greater the credibility of monetary policy the closer the inflation expectation to the target, hence the sooner the actual inflation anchored to the target.

The above model is represented on simultaneous equations. Technically, the rend variable is denoted by using alphabet letters with symbols line or bar on top, while the gap is denoted by using alphabet letters with symbols hat or cap on it. Variable annual rate year on year (oy) is represented by four digits after the variable name, while the annual rate of quarterly (quarterly annualized) denoted four scoreless after the variable name, for example yoy CPI inflation is denoted by  $\pi_{t+1}^{CPI}$ . For the growth variable is generally denoted by the letter  $d$  in front of a variable, e.g. GDP growth yoy denoted by  $dy_{t+1}$ .

Gap is the difference between variable and its potential value. The variable  $y$  is defined as 100 multiplied by the log of real GDP,  $y_{\bar{y}}$  as 100 multiplied by the log of output potential and  $y_{\hat{y}}$  as the output gap in percentage units, which  $\hat{y} = y - \bar{y}$ . The annual rate of quarterly inflation ( $\pi_t^{CPI}$ ) is defined as 400 times the first difference of log CPI. While inflation yoy ( $\pi_{t+1}^{CPI}$ ) is defined as 100 multiplied by the difference between inflation at this quarter and its previous four quarters. Several other important variables,  $i$  is nominal interest rate,  $r$  is real interest rate,  $s$  is nominal exchange rate Rupiah per U.S. Dollar and  $z$  is the log real exchange rate Rupiah compared to the U.S. Dollar.

### 2.2.1 Main Equation

Equations (3) to (13) are main behavioral equations which describe transmission mechanism in the model.

$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t+1} - \beta_3 \hat{r}_t + \beta_4 \hat{y}_t^* + \beta_5 \hat{z}_t - \beta_6 (\hat{\pi}_t^{RPOIL} - \bar{d}z_t) + e_t^{\hat{y}} \quad (3)$$

Equation (3) is a behavioral equation for the output against the value of its lag and lead (a measure of backward and forward-looking), real interest rate gap, the real exchange rate gap, output gap in other countries, inflation in the real world oil prices and disturbance terms.

Equation (4) is a New Keynesian Phillips Curve equation to determine the level of inflation, where inflation in the equation is described by past and future inflation, output gap, real exchange rate, inflation and the real world oil prices to inflation disturbance term. The output gap is the variable that links the real side of economy with the inflation rate. Besides the inflation rate is also influenced by changes in the Indonesian real exchange rate (Rupiah) against the U.S. bilaterally.

$$\pi_t^{CPI} = \lambda_1 \pi_{t-1}^{CPI} + (1 - \lambda_1) E_t \pi_{t+1}^{CPI} + \lambda_2 \hat{y}_t + \lambda_3 \hat{z}_t + \lambda_4 (\pi_t^{RPOIL} - \bar{d}z_t) + e_t^{\pi^{CPI}} \quad (4)$$

$$i_t = \gamma_1 i_{t-1} + (1 - \gamma_1) (\bar{r}_t + \pi_{t+1}^{TAR} + \gamma_2 (\pi 4_{t+4}^{CPI} - \pi_{t+4}^{TAR}) + \gamma_3 \hat{y}_t) + e_t^i \quad (5)$$

Equation (5) above is the Taylor rule equation used to determine the nominal value of short-term interest rates, in this case could be interpreted as the policy rate to Indonesia (BI Rate). The value of the interest rate is defined as a function of its lagged value (is a smoothing device for capturing short-term rate changes) and the central bank response to changes in the deviation of output gap between the expectations of inflation with target inflation. In other words, Bank Indonesia seeks to achieve long-term equilibrium interest rate (which is the sum of the equilibrium real interest rates and one quarter ahead expectation inflation), where interest rates could also be adjusted in response to a deviation from expectation year-on-year inflation rate fourth quarter would come from the inflation target,  $\pi 4_{t+4}^{CPI} - \pi_{t+4}^{TAR}$ , and against the current output gap. This equation also has disturbance term to accommodate the adjustment of nominal interest rates if the results generated by the above equation are not appropriate.

$$i_t - i_t^{US} = 4(E_t S_{t+1} - S_t) + prem_t + e_t^s \quad (6)$$

Equation (6) above is the equation of uncovered interest parity (UIP), which is expected depreciation ( $E_t S_{t+1} - S_t$ ) equals the nominal interest rate differential with the U.S and Indonesia. This calculation also includes the balance of risk premium  $prem_t$ , whereby if interest rate of Indonesia is higher than US, there was one of two possibilities that could happen, or a combination of the two possibilities, namely whether the exchange rate of nominal Indonesia against the U.S. would experience a depreciation in the period Next ( $E_t S_{t+1}$  higher than  $S_t$ ), or the nominal interest rate balance between Indonesia and the U.S. is different because of the risk premium. In addition, there was disturbance term  $e_t^s$ .

To calculate the expected exchange rate of the nominal, conducted by weighted between the exchange rate of nominal forward that would happen with the assumption that expectations are perfect foresight,  $S_{t+1}$ , with its variable lag,  $S_{t-1}$ , which was added to twice the trends of exchange par of each quarter,  $2(\bar{d}z_t + \pi_t^{TAR} - \pi^{CPI\_US\_SS}) / 4$  because the nominal exchange rate variable has a trend.

$$E_t S_{t+1} = \sigma S_{t+1} + (1 - \sigma) (S_{t-1} + 2(\bar{d}z_t + \pi_t^{TAR} - \pi^{CPI\_US\_SS}) / 4) \quad (7)$$

### **2.2.2 World Oil Price Equation**

World oil price data is the price of oil that comes from Minas (USD / barrel). Incorporating world oil prices into model, we need a few steps. Assuming that US inflation from the world representing the real world oil price levels could be calculated with the equation:

$$P_t^{RPOIL\_US} = P_t^{OIL\_US} - \pi_t^{CPI\_US} \quad (8)$$

Then the filtering process is carried out by separate variables for trends and gaps in the real world oil price levels

$$P_t^{RPOIL\_US} = \bar{P}_t^{RPOIL\_US} + \hat{P}_t^{RPOIL\_US} \quad (9)$$

It is assumed that the growth trend of real world oil price is zero, so

$$\bar{P}_t^{RPOIL\_US} = \bar{P}_{t-1}^{RPOIL\_US} + e_t^{\bar{P}RPOIL\_US} \quad (10)$$

While in the real world oil price gap is modeled by an AR (1)

$$\hat{P}_t^{RPOIL\_US} = (1 - \rho \hat{P}_{t-1}^{RPOIL\_US}) \hat{P}_{t-1}^{RPOIL\_US} + e_t^{\hat{P}RPOIL\_US} \quad (11)$$

Calculation of real world oil price inflation is

$$\pi_t^{RPOIL\_US} = 4 (P_t^{RPOIL\_US} - P_{t-1}^{RPOIL\_US}) \quad (12)$$

Hence, the real world oil price inflation is converted from units of (USD / barrel) in local currency,

$$\pi_t^{RPOIL} = \pi_t^{RPOIL\_US} + dz_t \quad (13)$$

### **2.2.3 Equation Variable Trends / Potential**

For potential output variables, the shock is assumed to occur only in growth rate of potential output. This shock causes a persistent deviation between potential output growth to value growth in the long-run steady-state it.

$$\bar{dy}_t = \rho_{\bar{dy}} \bar{dy}_{t-1} + (1 - \rho_{\bar{dy}}) \bar{dy}^{ss} + e_t^{\bar{dy}} \quad (14)$$

Equation (14) states that the growth of potential output, in the long term equal to the value growth of steady-state is, but could deviate from the growth of its steady-state depending on the value of error, whether the negative / positive. Furthermore, it would return to the

steady-state growth gradually, with a speed in accordance its parameter values, whereby the greater the value the faster potential output leads to the steady-state.

For the target variables of inflation, risk premium and real interest rates of U.S. trends, it is assumed that the dynamics using the same relationship with potential output variables in the equation above.

$$\pi_t^{TAR} = \rho_{\pi}^{TAR} \pi_{t-1}^{TAR} + (1 - \rho_{\pi}^{TAR}) \pi^{TAR\_SS} + e_t^{\pi^{TAR}} \quad (15)$$

$$prem_t = \rho_{prem} prem_{t-1} + (1 - \rho_{prem}) prem^{ss} + e_t^{prem} \quad (16)$$

$$\bar{r}_t^{US} = \rho_{\bar{r}}^{US} \bar{r}_{t-1}^{US} + (1 - \rho_{\bar{r}}^{US}) \bar{r}^{US\_SS} + e_t^{\bar{r}^{US}} \quad (17)$$

While for the variable trend of real interest rates and trend real exchange rate depreciation, are assumed to follow UIP relationship or

$$\bar{r}_t = r^{US\_SS} + dz^{ss} + prem^{ss} \quad (18)$$

$$\overline{dz}_t = \bar{r}_t - \bar{r}_t^{US} - prem_t \quad (19)$$

#### 2.2.4 Identity Equation

Identity equation is divided into three parts, namely the equation for calculating an annualized quarterly growth year on year and, as in the following equation:

$$\pi_t^{CPI} = 4 (P_t^{CPI} - P_{t-1}^{CPI}) \quad (20)$$

$$\pi_t^{CPIUS} = 4 (P_t^{CPIUS} - P_{t-1}^{CPIUS}) \quad (21)$$

$$\pi 4_t^{CPI} = (P_t^{CPI} - P_{t-4}^{CPI}) \quad (22)$$

$$\overline{dy}_t = 4 (\bar{y}_t - \bar{y}_{t-1}) \quad (23)$$

$$\overline{dz}_t = 4 (\bar{z}_t - \bar{z}_{t-1}) \quad (24)$$

$$dy_t = 4 (y_t - y_{t-1}) \quad (25)$$

$$dy4_t = (y_t - y_{t-4}) \quad (26)$$

$$dz_t = 4 (z_t - z_{t-1}) \quad (27)$$

$$dz4_t = (z_t - z_{t-4}) \quad (28)$$

$$ds_t = 4 (s_t - s_{t-1}) \quad (29)$$

Or equation that represents the identity of filtering process to separate the trends and gaps between variables, such as the following equation:

$$y_t = \bar{y}_t + \hat{y}_t \quad (30)$$

$$z_t = \bar{z}_t + \hat{z}_t \quad (31)$$

$$r_t = \bar{r}_t + \hat{r}_t \quad (32)$$

And the last is the equation of identity that reflects the relationship that comes from such a simple economic theory: equations (32) and (33) that define the real interest rate as the difference between the nominal interest rate and CPI inflation expectations at a subsequent quarter.

$$r_t = i_t - \pi_{t+1}^{CPI} \quad (33)$$

$$r_t^{US} = i_t^{US} - \pi_{t+1}^{CPI-US} \quad (34)$$

Equation (34), which defines the relationship real exchange rate,  $z_t$  at the rate of nominal,  $s_t$ , which is defined as the Indonesian currency (Rupiah) is compared to the U.S. Dollar, are added to the CPI ( $P_t^{CPI-US}$ ) in the United States, less the CPI, Indonesia ( $P_t^{CPI}$ ). If there is an increase in the value  $z_t$ , meaning that the real depreciation in Indonesia has occurred against the U.S. dollar.

$$z_t = (s_t + P_t^{CPI-US}) - P_t^{CPI} \quad (35)$$

## **2.2.5 Equation Rest of The World**

With the assumption that the Indonesian economy is relatively small open economy equations Rest of the World was modeled by an AR (1)

$$\hat{y}_t^* = \rho_{\hat{y}}^* y_{t-1} + e_t^{\hat{y}*} \quad (36)$$

$$i_t^{US} = \rho_i^{US} i_{t-1}^{US} + (1 - \rho_i^{US})(\bar{r}_t^{US} + \pi^{CPI-US}_{SS}) + e_t^{iUS} \quad (37)$$

$$\pi_t^{CPI-US} = \rho_{\pi}^{CPI-US} \pi_{t-1}^{CPI-US} + (1 - \rho_{\pi}^{CPI-US}) \pi^{CPI-US}_{SS} + e_t^{\pi^{CPI-US}} \quad (38)$$

## 2.2.6 Credibility Equations

New features in this model are credibility variables. Credibility variables used in this model is  $1 - INCRED_t$ , so variables that are explicitly used are variable  $INCRED_t$  or a variable that represents how credible is the central bank. Variable  $INCRED_{t\text{worth}}$  one (1) meaning the central bank has no credibility at all; otherwise if  $INCRED_t$  value 0 then the central bank has full credibility.

In principle, adding credibility done by changing the inflation expectations variable  $\pi_{t+1}^{CPI}$  perfect foresight previously assumed to be variable inflation expectations, contain elements of penalties depending on the credibility of central banks, or in the equation is written as

$$E_t \pi_{t+1}^{CPI} = \pi_{t+1}^{CPI} + cpiplus INCRED_t \quad (39)$$

Where as previously described, the parameters *cpiplus* illustrates how much additional maximum inflation is added to the variable inflation expectations if the central bank has no credibility. For example, if the central bank has no credibility at all mean that the variable  $INCRED_t$  valuable one and the value *cpiplus* 0.5, then the expectations of inflation worth 0.5% higher than inflation expectations that are Perfect Foresight.

In this paper, we modeled two types of credibility, namely exogenous and endogenous. ARIMBI with exogenous credibility is modeled with a simple way is to model the variable  $INCRED_t$  into the AR (1) toward the value of steady state is zero, or in other words assumed credibility would be increased from time to time to the credibility of management (full credible).

$$INCRED_t = \rho_{INCRED} INCRED_{t-1} + e_t^{INCRED} \quad (40)$$

While for the model with endogenous credibility is modeled by adding the past performance of the attainment of inflation to its target into the equation above

$$INCRED_t = \rho_{INCRED} INCRED_{t-1} + (1 - \rho_{INCRED}) \alpha (\pi 4_{t-1}^{CPI} - \pi_{t-1}^{TAR}) + e_t^{INCRED} \quad (41)$$

In endogenous approach, we try to incorporate credibility which does not always increase from time to time, but depending on his past performance.

### III. METHODOLOGY

There are eight variables, namely real GDP, CPI inflation, short-term interest rate, exchange rate, U.S. inflation, Fedfund rate, U.S. GDP and world oil prices (Minas). Before the filtering process to separate the variables and its gap and trend, firstly, observed variables are removed from its seasonal effects by employing X12 US Census Bureau. Filtering process generally uses the HP filter method with some adjustment to the level and trend growth in the variable. The data used is since 2000Q1 to 2009Q4. Indonesia does not use long historical data for several reasons, among them is that before 1997 Indonesia implemented fixed exchange rate regime and there is a significant jump in the data due to economic crisis in the late 90s period.

Behavioral parameters are a parameter that would determine the dynamics of the model towards long-term equilibrium or steady state. Behavioral parameters in ARIMBI model using parameter calibration approach based on parameters in other model BISMA constructed by Bank Indonesia and some other studies both from domestic and abroad that have similar characteristics with the Indonesian economy. The following baseline parameters used in ARIMBI:

**Table 1.**  
**Behavior Parameters**

No	Parameter	Description	Value
1	beta1	Backward Looking Param on Output Gap Eq.	0.8
2	beta2	Forward Looking Param on Output Gap Eq.	0.1
3	beta3	Real Interest Rate Param on Output Gap Eq.	0.15
4	beta4	External Demand Param on Output Gap Eq.	0.15
5	beta5	Real Exch. Rate Param on Output Gap Eq.	0.01
6	beta6	World Oil Price Param on Output Gap Eq.	0.01
7	lambda1	Backward Looking Param on Inflation Eq.	0.5
8	lambda2	Output Gap Param on Inflation Eq.	0.05
9	lambda3	Real Exch. Rate Param on Inflation Eq.	0.02
10	lambda4	World Oil Price Param on Inflation Eq.	0.01
11	gamma1	Smoothing Param on Taylor Rule	0.8
12	gamma2	Inflation Gap Param on Taylor Rule	1.575
13	gamma3	Output Gap Param on Taylor Rule.	0.5
14	sigma	Forward Looking Param on Output Gap Eq.	0.95
15	rho_pietar	AR(1) param on Inflation Target Eq.	0.8
16	rho_incred	Smoothing param on Incredibility Eq.	0.9
17	alpha*	Past Performace Param on Incredibility Eq.	0.1
18	rho_ygap_star	AR(1) param on Foreign Output Gap Eq.	0.8
19	rho_i_us	AR(1) param on Foreign Interest Rate Eq.	0.8
20	rho_dcpi_us	AR(1) param on Foreign Inflation Eq.	0.8
21	rho_dybar	AR(1) param on Output Trend Eq.	0.8
22	rho_prem	AR(1) param on Risk Premium Eq.	0.8
23	rho_rbar_us	AR(1) param on Foreign Real Int Rate Trend Eq.	0.8
24	rho_rpoilgap_us	AR(1) param on Foreign Inflation Eq.	0.8

\* Endogenous Credibility Model only

In addition to behavioral parameters, there are steady state parameters that must be included. This parameter reflects a state in the long term that would be aimed. The magnitude of this parameter is obtained based on historical average consideration of existing and vision coupled with the Indonesian government that would be aimed for the long term. Here is some of the steady state parameters included in the model:

**Table 2.**  
**Steady State Parameters**

No	Parameter	Description	Value (%)
1	growth_ss	Pertumbuhan PDB	7
2	r_us_ss	US Real Interest Rate	0.5
3	dz_ss	Real Exchange Rate Dep	-1.5
4	prem_ss	Risk Premium	2.5
5	pietar_ss	Inflation	3
6	dcp�_us_ss	US Inflation	2
7	cpiplus	Maximum Punishment on Inflation	0.5

Assuming a steady state value as mentioned above, it implies that the steady state real interest rate is 1.5%, the nominal interest rate is 4.5%, U.S. nominal interest rate is 2.5% and the nominal exchange rate appreciation is -0.5%. In other words, in a steady state, Rupiah (Indonesian currency) would be appreciated by 0.5%. *Cpiplus* parameter is a new feature in this model that illustrates maximum addition to inflation expectations if the central bank has no credibility. Further discussion would be described in next section.

In development and employing ARIMBI with Imperfect Credibility, we need to know the value of central bank credibility on current conditions as an initial value. From the perspective of forecasting, the credibility value is entered as the initial value at the time where the data the actual date was available. For example, when going to perform forecasting begins 2009Q2, then the credibility indices have been measured would be the initial value in 2009Q1.

Index measurement credibility of Bank Indonesia would be proceeding in two approaches, Valentin and Rozalia (VR, 2008) and Cecchetti and Krause (CK, 2002). Inflation target data is used for annual data 2002-2009 at both the target-setting by the BI as well as by the Government with input from the central bank. As for the inflation expectations used three data namely: Business Survey (Survey SKDU BI), Consensus Forecast (CF) and Actual Inflation. Therefore, we would obtain six BI credibility indexes as the results. Previous research (Harmanta, 2009) using Bayesian estimation of DSGE models of small open with the data period 2000-2008 produces

an index figure of 0.4. Generally it is believed that the current monetary policy credibility of Bank Indonesia is not completely perfect (imperfect credibility). But in the long term, coupled with the communication / transparency / consistency of Bank Indonesia, the credibility of monetary policy is believed to be increased slowly and surely.

Several important assumptions and conditions in simulation and forecasting for aggregate macroeconomic variables in the study are as follows:

- Long-term inflation target to be achieved with the implementation of the ITF in Indonesia amounted to 3% + 1% (see e.g. Monetary Policy Report of Bank Indonesia).
- Medium term inflation target in Indonesia is up to 2014-2015 with 4.0% (plus minus 1%), in line with the economic recovery process in order to achieve economic growth of about 7.0 % - 7.5% in the year 2014-2015 as targeted by government.
- In line with the measurement of the credibility of monetary policy as mentioned earlier (based on the measurement method in the style of Cecchetti and Krause (2002), SKDU Survey results and some results of previous studies (Harmanta, 2009), the initial value of the credibility of monetary policy is about 0.5.
- To see the impact of monetary policy credibility of the dynamics of macroeconomic variables, especially in the medium term inflation target length with minimal cost, there are three scenarios the credibility of monetary policy, namely: (i) the credibility of the baseline with the initial value of 0.5, (ii) less credible with initial value of 0.1, and (iii) is more credible with the initial value of 0.9.
- Disinflation strategy for achieving low and stable inflation: (i) the long disinflation of the time required to reach the target medium-and long-term inflation, and (ii) the cost of disinflation: Sacrifice Ratio, that is the output loss that occurred for each decline in inflation by 1%.

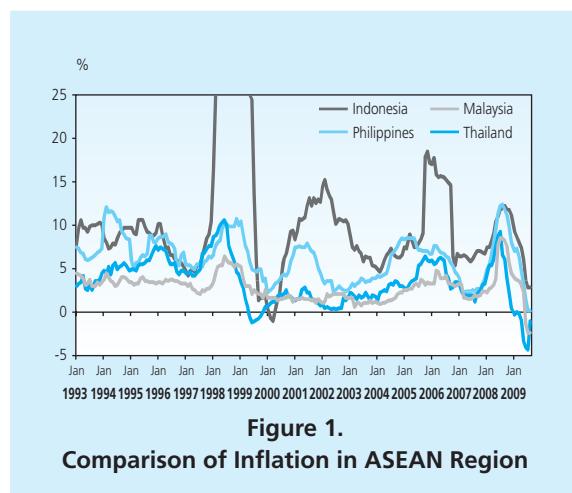
## **IV. RESULTS AND ANALYSIS**

### **4.1. Inflation Behavior and Expectation in Indonesia**

In the last two decades, Indonesian inflation is high as well as its volatility. By removing the crisis period, average inflation is around 8.5%. After eliminating the effect of structural shocks, inflation in Indonesia reached 7.9%. The core inflation tends to decline around 7.4% after the implementation of the ITF (Table 3), however, inflation in Indonesia is relatively higher than Thailand, Malaysia, Singapore or the Philippines, see Figure 1.

**Table 3.**  
**Inflation Disaggregation in Indonesia**

Period	CPI	Core	VF	Adm	CPI Deviation Std.
Pre Crisis (1992.01 - 1997.12)	8.08	8.50	9.13	6.91	1.92
Pre ITF (2000.01 - 2005.06)	7.94	7.69	4.47	14.96	4.34
Post ITF (2005.07 - 2009.08)	9.75	7.41	14.18	13.33	4.35
Total (excl. krisis)	8.47	7.93	8.84	11.44	3.40



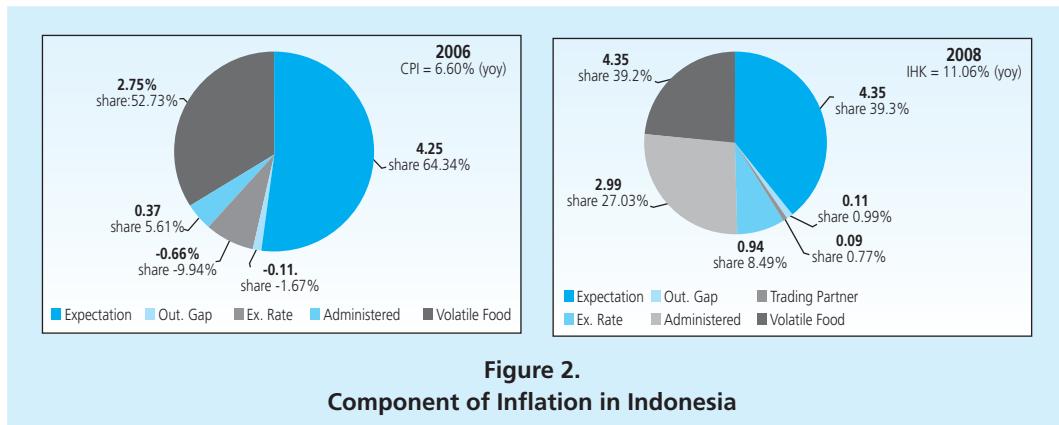
The phenomenon of high inflation, even after eliminating the structural shocks indicates the hypothesis of high inflation persistence. Among others, Alamsjah (2008) conform the existence of this high inflation persistence in Indonesia, where the disaggregated inflation persistence for the good and services category is 0.8 and 0.9 correspondingly<sup>3</sup>. The degree of inflation persistence decrease as shown by Yanuarti (2007).

The high persistence of inflation in Indonesia was influenced by inflation expectations<sup>4</sup>. Some studies in Indonesia in recent years also demonstrate the importance of inflation expectations on inflation forming<sup>5</sup>. Therefore, inflation expectations must be considered in formulating monetary policy in order to achieve the inflation target.

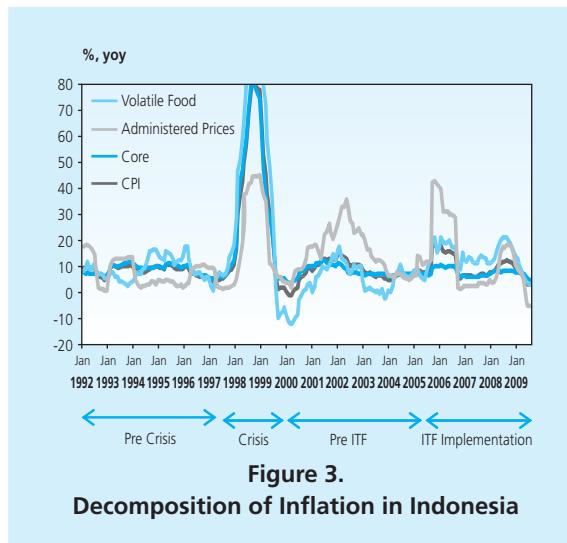
3 The inflation persistence was estimated by employing an autoregressive univariate model. By adopting the formula of Gujarati (2003) contained in the Alamsyah (2008), the persistence of inflation from 0.8 to 0.9 means that if there is a surprise then 50% of those surprises would be absorbed within a period of 4-9 months and the rest would be absorbed as inflation trip back to the normal average length of term. Long computation time required to absorb 50% shocks using a formula calculating the mean lag  $j/(1-j)$ , with  $j$  is the degree of persistence.

4 Hutaibarat (2005) also found that inflation expectations of economic agents in the period 1999-2004 was dominated on inflation formation than the output gap, administered prices, supply shocks, and exchange rates.

5 A study by Chatib Basri, Damayanti and Sutisna (2002) from LPEM - UI indicates that the major source of Indonesian inflation is expected inflation, followed by exchange rate depreciation, and money supply.



In the transition period and the implementation of ITF since 2000-2009, the actual inflation rate is more often out of target range. It was mainly due to large shocks in the domestic economy, both in terms of food supply and distribution (volatile food) and pricing policies set by the government (administered prices). Unfortunately, core inflation is also often higher than the CPI inflation target.



Besides the problems mentioned above, the high inflation in Indonesia is also sourced from external influence, including exchange rate pass through effect and world commodity prices. Additionally, the inevitable fact is that quite dominant of phenomenon shocks that spread through the follow-up expectations which in turn would core inflation. For example, inflationary pressures in 2005 and 2008 were originating from the external shocks coming

from the increase in global commodity prices of both energy and food commodities. The increase in world oil prices has prompted the government to raise fuel prices by an average of up to 28.7%. In addition to providing a direct impact on inflation, the impact of this second round effect would also contributed to push the inflation rate. In general, in almost a decade, the deviation between actual inflation and target due to good fundamentals as well as non-fundamental shocks are closely associated with supply side management. Given the monetary policy tools are more suitable to solve the problem on the demand side, the supply side problems requires coordination between institutions including Bank Indonesia and the government and its related agencies.

With the above facts, the work brings to the decline in inflation (disinflation) is not an easy task. Characteristics of inflation that tend to persistent bring consequence the slow process of disinflation. One of the researches (Alamsyah, 2008) showed that persistence is caused primarily by the formation of inflation expectations which mostly in backward looking manner. This occurs due to fairly large proportion of producers who do not adjust their price and maintain price to the previous<sup>6</sup>. The Survey of Price Formation Mechanism (in 2000 and 2003) confirmed the relative reluctance of price changes in producer level. The survey showed that price is less flexible and company rarely made changes in its price (only 1-2 times a year).

This backward looking manner in forming of inflation expectation is also indicated in other regular surveys, both metric (stating level) and non-metric (only direction). BI's Inflation expectations surveys cover a range of respondents: consumer level (Survey of Consumer-BI), traders (Retail Sales Survey-BI), enterprises (Business Survey-BI) and economists (Market Perception Survey-BI and Consensus Forecast (CF)). In general, these surveys confirm a correlation of expectation with its lag actual inflation. For example, in CF, inflation expectations move in line with actual inflation. In addition, backward-looking nature is also demonstrated through empirical observations, in which the average of last six month of actual inflation has a significant explanatory power on inflation expectations (Bank Indonesia, 2008).

On the other hand, forward-looking is seems indicated in spite of in very short term. This is partly visible from inflation expectations on Survey of Consumer for three months periods that have a high correlation with actual inflation at  $t+1$  and  $t+2$ . Regression testing with the involvement of other macroeconomic variables also showed that inflation expectations three months on Survey of Consumer has explanatory power of ahead core inflation projection in

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<sup>6</sup> In the formation of inflation within the framework of NKPC equation (the New Keynesian Phillips Curve), it is assumed that the firm faces a monopolistic competition market structure so there are companies that could determine the price (price setting) because it has little monopoly power. However, most companies still keep its price by indexation to a price before (backward looking). With this assumption, we would get the hybrid NKPC, in which inflation expectations would be influenced by the backward looking and forward looking and the output gap (as a proxy of marginal cost).

very short term i.e. 2-3 months. This indicates that inflation expectations from surveys have been able to act as an indicator of inflationary pressure despite the very short term.

In general, though backward looking behavior is quite dominant in the inflation formation in Indonesia, this tends to decline in period after Asian Crisis (1997). Conversely, Alamsyah (2008) found that forward looking behavior tends to increase in the period after the crisis. As backward looking behavior is declining, degree of inflation persistence seems declining. From groups of commodities perspective, the decline of inflation persistence mainly occurred in clothing goods and imported goods as the increasingly competitive market structure. Hence, decreasing the degree of inflation persistence would bolster the growing role of monetary policy to control inflation.

## **4.2. Inflation Persistence, Credibility Issue, and Disinflation Process**

### **4.2.1. Inflation Persistence and Policy Credibility**

The high persistence of inflation in the midst of current economic conditions facing pressure from both external and domestic causes of disinflation efforts towards low and stable inflation in the medium-long term have a very serious challenge. It should be noted also that the ability of central banks in controlling inflation is not on overall CPI inflation, but only limited to core inflation (core inflation) that are influenced mainly by fundamental factors, namely the output gap, exchange rates, particularly on prices of imported goods (imported inflation), and inflation expectations. Meanwhile, other components such as volatile food and administered prices as part of the CPI inflation rate are not a central bank domain. Thus, the rate of low and stable inflation could not be achieved solely through the monetary policy of Bank Indonesia, but also determined by fiscal and other economic policies pursued by the Government. In addition to reducing the exchange rate pass through effect into inflation, it is necessary to also support policies to keep exchange rate volatility not too large.

As noted earlier, core inflation contributes to CPI inflation more dominant than volatile food and administered. In this case, core inflation is more influenced by inflation expectations that occurred in the community compared to the output gap and exchange rates. To that end, the inflation target and monetary policy measures and monetary instruments used to achieve it should be communicated effectively to public to influence and shape inflation expectations.

Hence, credibility of monetary policy is essential to achieve a central bank's goal, namely low and stable inflation. Within ITF, if economic agents believed that monetary policy would be capable or credible in achieving its inflation target, the inflation expectations of economic agents would soon anchored to the inflation target so that actual inflation would also be

anchored on the inflation target. This would further reduce inflation persistence. More credible monetary policy, adjustment process of economic agents on anchoring inflation expectations with the target would be quick, and vice versa. As a common indicator, deviation between inflation expectations and actual inflation towards the inflation target is employed to indicate the credibility<sup>7</sup>.

Due to high persistence of inflation, rapid process on disinflation would be very expensive as it requires tight interest rates that could cause a huge of output loss. Consequently, to achieve the objectives of monetary policy and minimizes the loss of social welfare then the monetary authority tends to make gradual disinflation. If the decline in actual inflation that occurred is not significant then inflation expectations of economic agents would adjust only marginally to the inflation target. Moreover, economic agent would rely on backward looking behavior which increases the persistence of inflation.

Observations on Indonesia economy shows that the credibility of monetary policy in Indonesia is relatively low, and it contributes to the persistence of high inflation (Harmanta, 2009). However, in line with the implementation of the ITF, the credibility of monetary policy has improved. This is reflected by increasing of Kalman Gain<sup>8</sup> parameter from around 0.2 in the period before implementation of the ITF (July 2005) to approximately 0.4 in the period after ITF implementation. It may be argued that with the increased credibility of monetary policy after the ITF, inflation tends to be influenced by the behavior of forward looking economic agents. As a consequence, declining inflation persistence would lead inflationary expectation to the target due to monetary authority<sup>9</sup>.

This is consistent with the observation of Orphanides and Williams (2007). Their study indicates that the formation of inflation expectations experienced by pointing at the target inflation as the main target of monetary policy in the era of the ITF would facilitate the learning process of economic agents better than non-ITF era with multiple objectives. This process would cause inflation expectations of economic agents become more forward looking and anchored

<sup>7</sup> Erceg and Levin (2003) showed that the low credibility of monetary policy of the US in 1980-1985 led to the persistence of high inflation and high cost (sacrifice ratio). An important implication of these findings is that the persistence of inflation is not an inherent characteristic of an economy but diversity associated with the credibility of monetary policy. It is shown that the persistence of inflation would be lower if monetary policy is credible, and otherwise create a high persistence of inflation when monetary policy is not fully credible (imperfect credibility) because economic agents have not fully believe in the inflation target in the future (forward looking).

<sup>8</sup> Technically, the Kalman Gain parameter captures a projection by economic agencies on an inflation target of monetary authorities in the Taylor rule equation through the derivation of Kalman filter. Kalman gain parameter reflects the learning process of economic agents about the target inflation so that monetary authorities could be used as a measure of the degree of credibility of monetary policy. The faster of learning process by economic agents about the inflation target of monetary authorities then the higher degree of credibility of monetary policy. Kalman Gain value is between 0 and 1, where it is getting closer to a more credible monetary policy.

<sup>9</sup> The behavior of economic agents that are more forward looking in inflation formation during the period of ITF implementation is in line with the findings due to Solikin (2004), Yanuarti (2007), and Alamsyah (2008).

to inflation target. The results are also consistent with Siregar and Goo (2008) which showed that inflation inertia in Indonesia has decreased for both non-tradable goods and tradable goods in the period of implementation of the ITF as compared to the period before implementation of the ITF.

**Table 4.**  
**Actual, Expectation, Inflation Target & Monetary Policy Credibility**

Year	Actual CPI (1)	Inflation Expectation (2)	CPI Target (3)	Mistake (1) - (3)	Surprise (2) - (1)	Anchoring (2) - (3)	Credibility*)
2000	9.35	10.61	6.00	3.35	1.26	4.61	<b>24</b>
2001	12.55	14.29	7.25	5.30	1.74	7.04	<b>21</b>
2002	10.03	12.12	9.50	0.53	2.09	2.62	<b>26</b>
2003	5.06	8.04	9.00	-3.94	2.98	-0.96	<b>46</b>
2004	6.40	7.38	5.50	0.90	0.98	1.88	<b>42</b>
2005	17.10	9.75	6.00	11.10	-7.35	3.75	<b>32</b>
<b>2006</b>	<b>6.60</b>	<b>9.20</b>	<b>8.00</b>	-1.40	2.60	1.20	<b>23</b>
2007	6.60	7.47	6.00	0.60	0.87	1.47	<b>47</b>
<b>2008</b>	<b>11.06</b>	<b>7.75</b>	<b>5.00</b>	6.06	-3.31	2.75	<b>37</b>
<b>2009</b>	<b>2.78</b>	<b>4.90</b>	<b>4.50</b>	-1.72	2.12	0.40	<b>51</b>

\*) Credibility: the percentage of respondents whose inflation expectations coincide the monetary authority target (Business Survey - BI, processed)

Meanwhile, Business Survey – BI (SKDU) with 2000 companies as respondent showed that 51% of the number of companies anchored their inflation expectations to the target at the end of 2009. This number has increased significantly compared to around 24% in the early implementation of the ITF. If the results of the survey could be used as one of proxy for the degree of credibility of monetary policy, the credibility of monetary policy has increased from approximately 0.24 to 0.51 in line with a consistent implementation of the ITF, see Table 4.

#### **4.2.2. Monetary Policy Credibility and Disinflation Process**

Theoretically, the ITF aims to achieve a low and stable inflation<sup>10</sup>. In this regard, although there has been no agreement on how much the inflation target, in the long term target level of inflation in developing and developed countries amounted to 2% - 3% (Roger and Stone, 2005). However, for developing countries, including Indonesia, inflation is quite far from this desired level of long-term inflation. Average inflation for developing countries when implementing the ITF is above 13% (double digit), which is higher than developed countries which amounted around 4% (Fraga et al., 2004). Obviously, this would lead to difference

<sup>10</sup>Experience in several countries ITF showed that the inflation target set has the characteristics: (i) quite low, (ii) have a low inflation volatility, (iii) is quite challenging to achieve by the bank central, and (iv) could be achieved with a minimum loss of output.

disinflation strategy in an ITF era. In this case, most developing countries set an inflation target in short term time horizon, usually early in the implementation of annual targets in order to build the ITF and increase the credibility of monetary policy.

Empirically based on the experience of many countries, they have several strategies to reduce inflation to low and stable level. In general, developed countries that have a low inflation level, (i.e. single digit) are aggressively pursuing a strategy of disinflation directly to level-term inflation of about 2.0% - 3.0%. While developing countries have a fairly high level of inflation (i.e. double digit) usually use gradual disinflation strategy with short-term inflation target with speed decrease of about 0.8% per year before converging to the level of long-term inflation around 2.0% - 3.0% (Roger and Stone, 2005)<sup>11</sup>.

Observations for the Indonesian case show that the disinflation process conducted by monetary authorities would decline economic growth, showing that monetary policy is not credible (Harmanta, 2009)<sup>12</sup>. In this case, the learning process to reduce the economic agent's inflation target is slow. These causes the expectations of economic agents converge slowly and gradually to the target of inflation<sup>13</sup>. During the period of transition and implementation of the ITF - 2000 – 2008, the speed of disinflation in Indonesia was approximately -0.5% per year, slightly lower than average disinflation rates of developing countries amounted to -0.7% per year (Roger and Stone, 2005).

If monetary policy is too aggressive for make disinflation in a short time then it would lead to high costs of disinflation in the form higher output loss and sacrifice ratio. In the context of small open economy, rapid reduction of inflation in imperfect credibility situation would provide very high pressure to the appreciation of the exchange rate thus exacerbating the trade off inflation - output<sup>14</sup>. In addition, the strategy of gradual disinflation in Indonesia is desirable

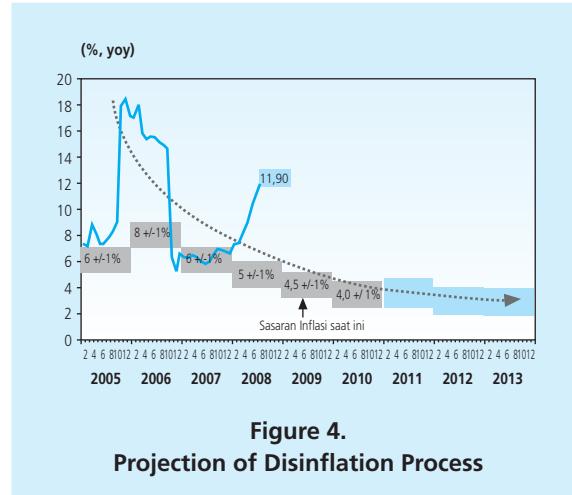
<sup>11</sup> Some researchers showed that the strategy is strongly influenced by the credibility of disinflation policy central bank monetary. Developed countries are considered more credible monetary policy tends implementing an aggressive strategy of disinflation because monetary policy is able to guide inflation expectations of economic agents and actual inflation to its target quickly. Hence, interest rate response would be optimal and would not cause a large loss of output. While developing countries are considered less credible, the strategy of disinflation is likely to apply gradually as monetary policy has not been able to guide fully inflation expectations so that response rates could not optimal and may cause large loss of output.

<sup>12</sup> As shown by Ball (1994), disinflation could be done without sacrificial fee (costless) significantly during inflation expectations are rational pure inflation (purely rational expectation) and monetary policy is fully credible (perfect credibility).

<sup>13</sup> In such a situation is not fully credible monetary policy so that inflation expectations principals actual inflation and slow economic convergence of the inflation target, the monetary authority considers that rapid disinflation would require a response of interest rates so large that they could disinflation raises the cost of very expensive form of output loss is very high. Consequently, to run a monetary policy that minimizes the loss of social welfare then the central bank pursuing a strategy of gradual disinflation. Observing economic agents dynamics of the monetary policy pursued by looking at actual inflation compared inflation target. By looking at the decline in inflation that is not too large to provide new information a little so that inflation expectations of economic agents would adjust only marginally against the central bank inflation target.

<sup>14</sup> When monetary policy is not fully credible, the slow decline of interest rates would possibly generate a larger output loss. Monetary policy that seems likely to tight would affect the behavior of economic agents in doing so thus consumption is slow down. Furthermore, it affects the production side then finally the output would not be increase. In overall, this mechanism is reflected in the Sacrifice Ratio.

considering that inflation level sometimes reached double digits, moderate degree of persistence, and the backward looking behavior of the agent.



**Figure 4.**  
**Projection of Disinflation Process**

Cukierman (2005) showed that the stabilization of inflation from double digits to mid-long term inflation require gradual disinflation. Experience from some countries, such as Chile, also showed that the process of disinflation to the level of low and stable inflation within the framework of ITF requires less than 36 quarters or nearly 9 years (Schmidt-Hebbel and Werner, 2002). In fact, apart from Indonesia, there are still some developing countries that implement ITF but still in disinflation process such as the Philippines since 2002, Colombia since 1999, Romania since 2005, and Turkey since 2006 (Roger, 2009).

### 4.3. Initial Credibility Index

As already mentioned above, the index measuring the credibility of monetary policy is conducted using, VR2008 and CK 2002. Especially for the measurement of CK in 2002 made adjustments over the previous limit of very loose 20% to 15%. It is with consideration of Indonesia which is a developing country so that the business environment is relatively more uncertain compared to developed countries. Based on historical data of Indonesia, the highest CPI (yoy) in Indonesia are 17.11% in 2005 and has never reached 20%.

Using expectations data (Survey SKDU BI, Consensus Forecast and Actual Inflation), we obtain measurement results for BI Credibility Index BI as follows:

**Table 4.**  
**Initial Credibility Index**

No	Data for Expectation	Credibility Index (VR 2008)	Credibility Index (CK 2002)
1	Survey SKD - BI	0.604	0.664
2	Consensus Forecast	0.789	0.841
3	Actual Inflation	0.581	0.740

Table 4 shows that the use of inflation expectations data and how different measurement indices would provide vary results, ranging from 0.581 till 0.841. The measurement results showed that the credibility of monetary policy in Indonesia during the period 2000 - 2009 has not completely perfect (imperfect credibility). Based on the results of these measurements and taking into account other previous results (among others : Harmanta (2009) who found 41% and 51% number of companies that inflation expectations anchored to the target), then for the next section we use conservative number 0.50 as the initial value of credibility.

#### **4.4. Simulation Results of Exogenous Credibility**

The simulation results and projections of macro variables with some degree of exogenous credibility are presented in the figure 5.

Based on the graph above shows that the baseline scenario with the assumption that monetary policy credibility of the initial value of 0.5 and considering the existence of inflationary pressures began Quarter-10 (Q-10) is approaching the upper limit of the inflation target in line with the global and domestic economic recovery, interest rates (the optimum Taylor rule based on the endogenous ARIMBI) needs to be raised start on Q-8 and then could be lowered gradually began Q-12. On one hand, the path of inflation is likely anchoring to 4.0% + 1% in Q-24. On the other hand, path of interest rates would provide economic growth about 5.5% to 6.4% in next few quarters before going to achieve economic growth around 7.0 - 7.5% in Q-24. In line with the path of interest rate and the trajectory of inflation and GDP, exchange rates will slightly appreciate than start stay steadily on Rp. 9300-9750 / USD in medium and long term.

In the less credible scenario with the initial assumption of lower credibility value to 0.1, the path of inflation is higher than the baseline in which inflation in Q-9 to Q-12 would approach the upper limit of the target. Hence, inflation start in Q-13 would pass through the upper limit of the inflation target. Considering the existence of a higher inflation pressure compared to baseline, central bank should increase interest rates higher than the baseline to achieve medium-term inflation target of 4% (plus minus 1%) in Q-24. Path to higher interest rates would lead

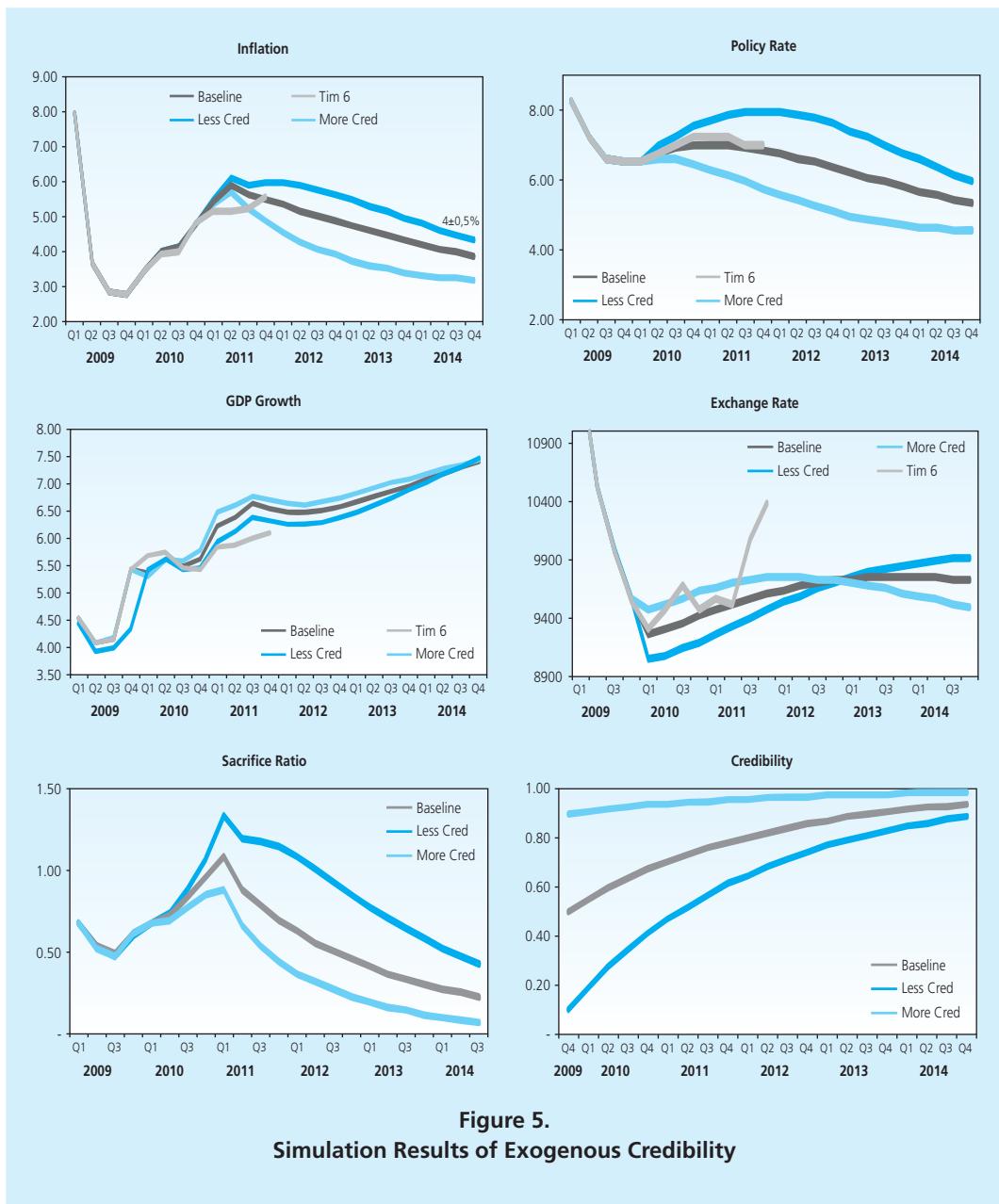


Figure 5.  
Simulation Results of Exogenous Credibility

to lower economic growth compared to the baseline to about 5.5% to 6.2 % in up to Q-12. In overall cost of disinflation, the scenario is less credible monetary policy would cause the Sacrifice Ratio (output loss that occurred for the decline in inflation of 1%) higher than baseline. In the medium term - long or less credible scenario also causes the trajectory is more weaken the exchange rate compared to baseline.

On the more credible scenario assuming higher initial credibility value to 0.9, the path of inflation is lower than the baseline in which inflation moved closer to the midpoint or lower limit of the inflation target. Consider the trajectory of inflation is lower than the baseline and has been anchored relative to the inflation target, the current interest rate could be maintained until Q7, before it could be lowered gradually. Path to lower interest rates would lead to higher economic growth compared to the baseline to about 5 – 6 % in next few quarters. From cost of disinflation perspective, the scenario of a more credible monetary policy would cause the Sacrifice Ratio (output loss that occurred for the decline in inflation of 1%) is lower than the baseline. In the medium - long more credible scenario would cause the trajectory which has further strengthened the exchange rate compared to baseline.

#### **4.5. Simulation Results of Endogenous Credibility**

In the baseline scenario with the initial assumption of 0.5 and consider the credibility of inflation pressure from Q-10 which approximates the upper limit of the inflation target, interest rates (optimum based on the Taylor rule in ARIMBI endogenous) needs to be raised gradually since Q-6 and then could be lowered gradually began Q-11. With this interest rate path, consequently, the path of inflation targets is likely to be achieved towards 4.0% in medium term. This interest rate path would also bolster the economic growth around 5.5% to 6.2% in next few quarters before going to achieve economic growth steadily around 7.0% - 7.5%. In line with the path of interest rate and the trajectory of inflation and GDP, exchange rates would stronger (appreciation) around Rp. 9150-9550/ USD.

In the less credible scenario, the initial assumption of credibility is 0.1. Trajectory of inflation is higher than the baseline in which inflation in the year 2011 would approach the upper limit of the inflation target. Considering the existence of a higher inflation pressure compared to baseline, central bank should increase interest rates higher than the baseline to achieve the inflation target term medium for 4%. Indeed, path to higher interest rates would lead to lower economic growth compared to the baseline. In cost of disinflation perspective, less credible scenario would cause Sacrifice Ratio (output loss that occurred for the decline in inflation of 1%) higher than baseline. In the medium-long term, less credible scenario also causes the trajectory is more to weaken the exchange rate compared to baseline.

On the more credible scenario, we impose initial assumption for credibility is 0.9. Trajectory of inflation is lower than the baseline in which inflation moved closer to the midpoint or lower limit of the inflation target. Considering the lower inflation trajectory than the baseline and has been anchored relative to the inflation target, the current interest rate could be

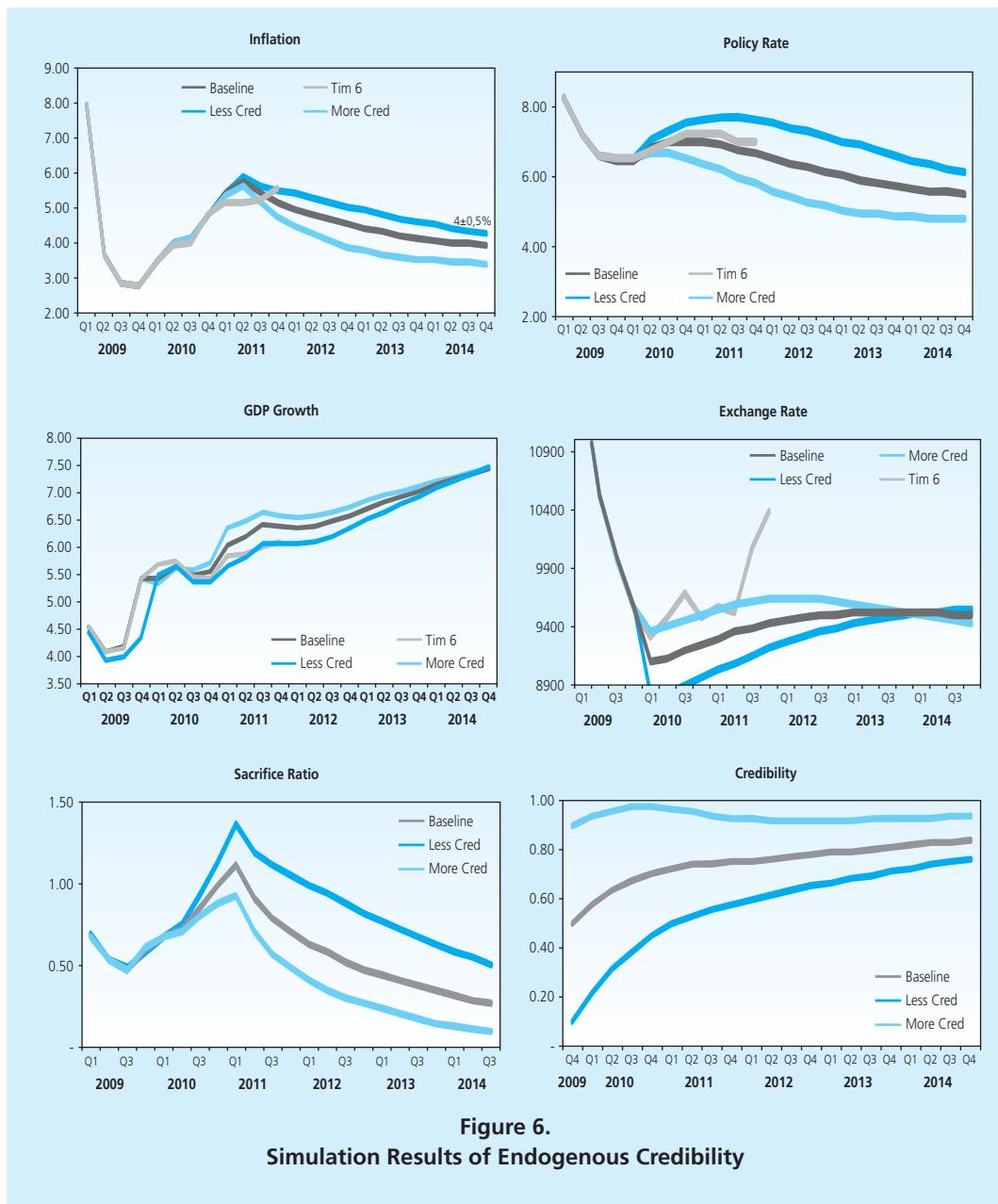
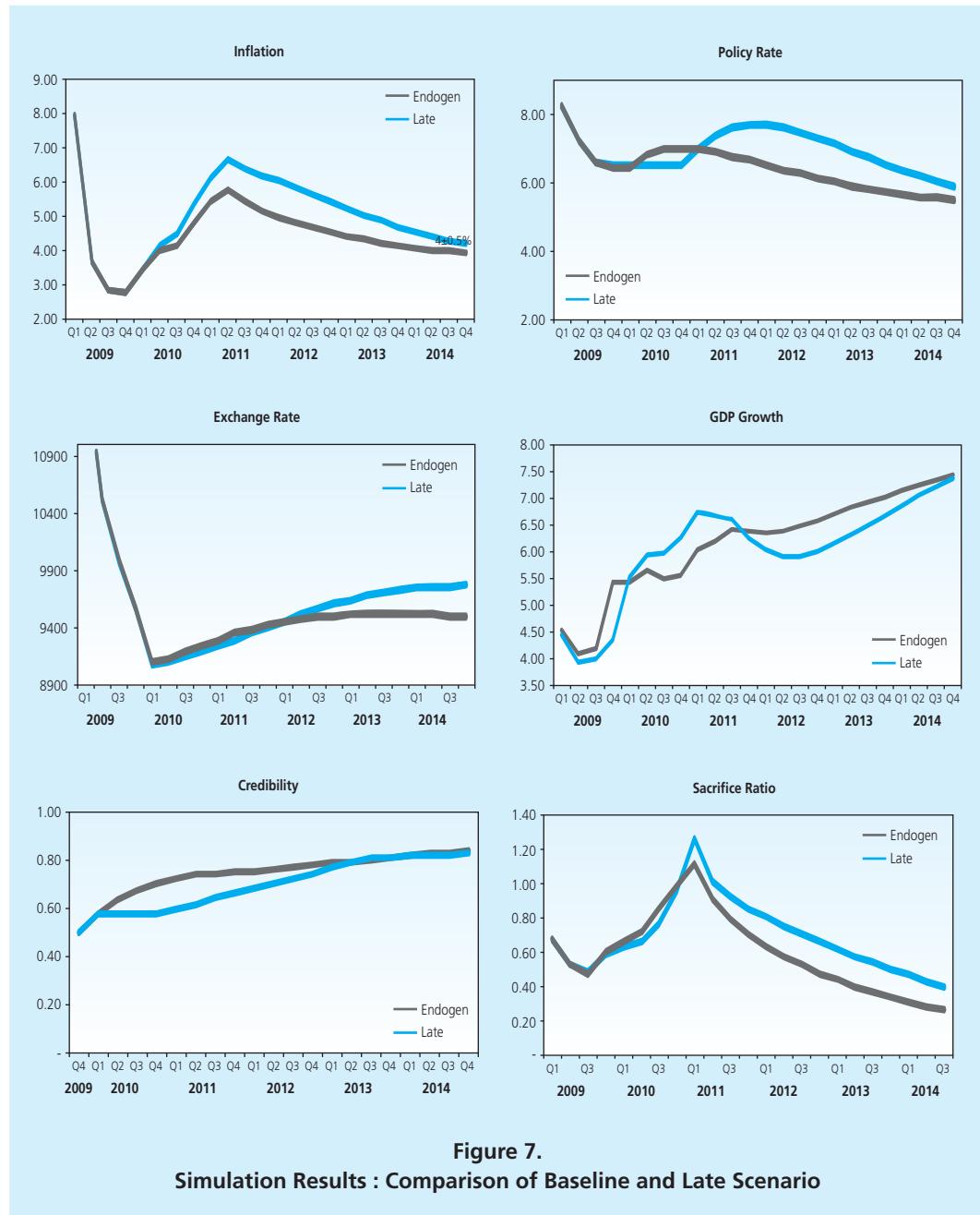


Figure 6.  
Simulation Results of Endogenous Credibility

maintained up to Q-7, before it could be lowered gradually. Obviously, path to lower interest rates would lead also to higher economic growth compared to the baseline (around 5.5 % to 6.5% in next few quarters). From cost of disinflation perspective, the more credible scenario would cause lower Sacrifice Ratio (output loss that occurred for the decline in inflation of 1%) than the baseline. In the medium-long term, the more credible scenario would cause strengthened the exchange rate compared to baseline.

#### 4.6. Simulation Results : Comparison of Baseline and Late Scenario

To see whether the timing of interest rate policy response affect the dynamics of key macroeconomic variables, we simulate a late response rate (Scenario late) compared to baseline (optimum response rates), as shown in the figure below.



In the late scenario, with the assumption that monetary policy credibility of the initial value equal to the baseline of 0.5, delay in the hike of policy response rate would cause the trajectory of inflation is higher than the baseline. As we could see from Graph 4.3, inflation near the upper limit of the inflation target in up to next eight quarters and pass the upper limit of the inflation target start Q-9. In order achieving medium-term inflation target (4% in Q-24) and considering the inflation trajectory is higher than the baseline, interest rates need to be raised higher than the baseline before it could be reduced gradually since Q-16. These higher interest rates path would affect medium-term economic growth which is lower than the baseline. In term of cost of disinflation, the late scenario would yield higher Sacrifice ratio (output loss that occurred for the decline in inflation of 1%) than the baseline, especially in the medium term. In the medium-long term, the slow response of monetary policy would lead to a better path to weaken the exchange rate compared to baseline.

Based on the simulation results above, this study shows that the delay in the response rate would cause higher inflation path and could even exceed the inflation target. Consequently, bringing down inflation back to the target required very high interest rates. Obviously, this in turn would impact on slowing economic growth. Trade off inflation and higher output has an impact on the increasing Sacrifice ratio thus for every effort to decrease inflation requires a higher output loss. Implications of these findings, Bank Indonesia need to maintain consistency in responding to inflation pressures in a timely manner with an optimum amount of interest. Hence, delay in response of monetary policy would affect the higher cost of disinflation.

#### **4.7. Periods for Disinflation Process**

Related to focus on the length of disinflation, simulation and projection length of disinflation towards medium-term target (4%) and long-term target (3%) are described in Table 5.

Table 5 shows that the length of disinflation to anchor to medium-term inflation target is strongly influenced by the degree of monetary policy credibility. The scenario with the initial baseline value of 0.5 monetary policy credibility, either exogenous or endogenous, takes less than 19 quarters to reach an inflation of 4% in medium term. If the initial value of credibility decreased to 0.1, then the process of disinflation to 4% as medium term target requires a longer period which is 25 quarters (exogenous) or 31 quarters (endogenous). Conversely, if the initial value increased to 0.9, then process of disinflation to medium term requires only a shorter time period, 11 quarters (exogenous) or 25 quarters (endogenous). Similarly, disinflation to 3%

**Table 5.**  
**Periods for Disinflation Process**

Credibility Type	Periods for Disinflation Process	
	Medium Term ( 4 % )	Long Term ( 3 % )
<b>Exogenous</b>		
Initial cred = 0,1	25 quarters	48 quarters
Initial cred = 0,5	19 quarters	40 quarters
Initial cred = 0,9	11 quarters	24 quarters
<b>Endogenous</b>		
Initial cred = 0,1	31 quarters	64 quarters
Initial cred = 0,5	19 quarters	56 quarters
Initial cred = 0,9	11 quarters	22 quarters

as long term target requires a shorter time of 22-24 quarter if the credibility of the initial value of 0.9. In less credible situation (index is set to 0.1), it takes longer time to 48 quarters (exogenous) or 64 quarter (endogenous) to achieve 3% inflation. In baseline credibility index (0.5), it takes 40 quarters (exogenous) or 56 quarter (endogenous) to achieve long term inflation target, 3%.

If we compare endogenous and exogenous approach, it shows that exogenous monetary policy credibility on the one side would provide convenience, but the results less realistic. This is because exogenous credibility could not capture the rewards - punishments on the attainment of inflation targets as well. In contrast, modeling of endogenous monetary policy credibility on the one side would be more complex, but it provides more realism. It is argue that endogenous credibility possibly could catch the reward - punishment against inflation target better because the credibility of monetary policy are explicitly captured by the deviation of inflation to the inflation target. For example, the greater endogenous credibility of monetary policy, the smaller deviations of inflation from its target thus there are rewards that cause the length of disinflation to 3% would faster than exogenous approach. Conversely, smaller the endogenous credibility, higher deviations of inflation from its target then there are punishments that cause the length of disinflation to 3% would be slower than exogenous approach.

Based on projected results and simulation credibility of monetary policy as stated above, this study specifically shows that:

- Inflation expectations of economic agents are strongly influenced by central bank monetary policy credibility. More credible monetary policy, faster inflation expectations anchored to the inflation target thus greater chance that actual inflation would be anchored to the target. This in turn would accelerate the disinflation process to low and stable inflation in medium-long term.

- Disinflation cost is strongly influenced by central bank monetary policy credibility. The more credible monetary policy, the lower the cost of disinflation (reflected in the Sacrifice ratio) to achieve low and stable inflation and in the medium term - long. This in turn would minimize the trade off of output - inflation.
- More controlled inflation at a low and stable level would provide conducive conditions for sustainable economic growth and controlled exchange rates volatility.
- Slow response of monetary policy than optimum conditions (baseline) may cause higher inflation path. Hence, it would lead to longer on achieving the target, higher interest rates, and higher cost of disinflation.

## **V. CONCLUSIONS**

- ARIMBI with Imperfect Credibility is theoretically coherent and reasonable fit with the data to match the Indonesian economy after the implementation of the ITF, and has the ability to be used as a forecasting and policy simulation (FPAS).
- The result of calculating the degree of credibility of monetary policy indicates that monetary policy in Indonesia has not fully credible (imperfect credibility) with a value of approximately 0.5 (from a scale of 0 to no credibility and scale of 1 to perfect credibility).
- Projection and simulation results show that the disinflation to the target low and stable inflation in Indonesia was influenced by the credibility of monetary policy. The more credible monetary policy, the disinflation process towards the target low and stable inflation would be more quickly achieved. In addition, endogenous monetary policy credibility is more realistic than exogenous approach.
- Projection and simulation results show that the costs of disinflation to the target low and stable inflation in Indonesia (the cost of disinflation), which is measured based on the Sacrifice Ratio, is strongly influenced by the credibility of monetary policy. The more credible monetary policy, the smaller the ratio of Sacrifice, which means every effort to decrease inflation, would cause not too large output loss. The implication is that central bank face a smaller trade-off between stabilizing inflation and stabilizing output.
- The slow response of monetary policy than optimum conditions (baseline) would cause higher inflation path, so that it might lead to a longer achieving the target with higher interest rates and higher cost of disinflation.
- In terms of strategies for achieving the target low and stable inflation in Indonesia, the results showed that the monetary policy conditions are not fully credible (imperfect credibility), and then the central bank tends to make the process of gradual disinflation. This is because if monetary policy is not fully credible, then the central bank's efforts to quickly achieve low

inflation in a short time would have implications on interest rate increases very high (too tight) so it would create very large fluctuations on output and exchange rate.

- Research shows that inflation expectations greatly influenced by the credibility of monetary policy. The implication is that the management of inflation expectations is very important, although not easy, because it requires a credible monetary policy. This condition could be constructed by continuing to demonstrate its commitment to inflation target consistently.
- The simulation results support the mandate of the Bank Indonesia Act No.23 of 1999 and No.3 of 2004 requires the Bank Indonesia to publicly announced inflation target and inflation is the overriding objective of monetary policy through the implementation of inflation targeting framework (ITF). Implementation of the ITF is an effort to enhance the credibility of monetary policy through commitment to achieving the inflation target so that economic agents would calculate their activities based on the rate of inflation and disinflation program.
- Related to its limitations and further research opportunities, the dynamics of the credibility of monetary policy is modeled in a linear fashion. Looking ahead, non-linear credibility would be challenging as it may capture effects of punishment - reward in better and realistic way.

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