MEASURING THE TIME INCONSISTENCYOF MONETARY POLICY IN INDONESIA

***Rini Rahmahdian*[1]**
Perry Warjiyo

Abstract

This study measured the time inconsistency of monetary policy in Indonesia using the asymmetric preference parameter in linear exponential loss function of the central bank. Asymmetric central bank preference becomes an important issue since many of the results on the time inconsistency problem under symmetric preferences may no longer hold under asymmetric preferences. Using two sub-samples, i.e. before and after the implementation of central bank independence act, the conditional mean and the conditional variance of the output gapwere estimated and then proceed to estimate the reduced form of the model. The results showed the existence of an asymmetric preference parameter before the Bank Indonesia independence act, which indicated the presence of a time inconsistency problem of monetary policy. This finding implies Bank Indonesia put a negative weight instead of positive weight on the output gap prior to its independency. However, after the implementation of central bank independence, the monetary policy of Bank Indonesia has been consistent with symmetric policy preference over price stability and output.

Keywords: Time inconsistency, discretionary, monetary policy, asymmetric central bank preference,output gap, inflation bias.
JEL Classification : E52, E58

1 Rini Rahmadian adalah staf Pengajar pada Fakultas Ekonomi Universitas Andalas, Padang (rini_rahmahdian@yahoo.com); Perry Warjiyo adalah peneliti ekonomi Bank Indonesia dan staf pengajar Program Pascasarjana Fakultas Ekonomi Universitas Indonesia (perry_w@bi.go.id). Hasil dan kesimpulan dalam paper ini merupakan pandangan pribadi dan tidak mewakili pandangan institusi dimana penulis bekerja.

I. INTRODUCTION

Seminal papers by Kydland and Prescott (1977), Barro and Gordon (1983) and Rogoff (1985) are the main references on time inconsistency literature. Until now, the topic of dynamic inconsistency remains an interesting debate to be analyzed in the context of monetary policy based the game theoretical model. *Time inconsistency* refers to the difference in the actual policy responses taken from the optimal policy response announced by the central bank after a decision based on public expectations. The difference in policy response is generally motivated by the desire of the central bank to encourage a higher level of output.

As an illustration of a time inconsistency problem, suppose that the central bank announced its pledge to achieve a specific inflation target, and the public believed this, and then formed inflation expectations based on the announcement. In these conditions the central bank has an incentive to not fulfill its promise to pursue the possibility of achieving a growth rate of greater output, with the consequent higher inflation pressures. But in the end the public will know about this renege on the inflation promise so that they will adjust to higher inflation expectations. If the sequence of events is repeated, there will be what is called *inflation bias*, i.e. a situation where an increase in real output does not happen but inflation is higher than the level that it should be.

In Indonesia, the inflation target set by Bank Indonesia often cannot be achieved. The inflation rate is still difficult to converge towards the inflation target announced by the monetary authorities. Since the year 2000, actual inflation in the range of the target inflation occurred only twice, in 2004 and 2007 by 6.4% and 6.6%, with the inflation target to 4.5% -6.5% in 2004 and 6% ± 1% in 2007. Later in the period 2003, 2006 and 2009, although the achievement of actual inflation was lower than the target, the value was below the inflation target range established. The presence of actual inflation deviation from its target indicates that inflation is not optimal situation because it will cause social harm in the community (Warjiyo, 2010).

Harmanta (2009) also reported a slowdown in inflation to the target set by the government and Bank Indonesia, both in the period before and after the ITF. On average, the rate of inflation after the era of the ITF is 7.5%, only a slight decline compared to the era before the ITF with an average inflation rate of 7.9%. This fact raises the question of why inflation in Indonesia tends to be at a fairly high level and slows down towards the inflation target of the monetary authority. Some researchers (including Alamsyah, 2008 and Yanuarti, 2007) assumed that it was due to the persistence of inflation that is still quite high in Indonesia.

If it is true, then is the high persistence of inflation derived from the inertia of the previous inflation because of the behavior of economic agents that tend to be backward looking? Solikin (2004) showed that the *New Keynesian Phillips Curve* (NKPC) equation which was formedin the ITF inflationary era is dominated by the *forward looking* behavior of agents. Yanuarti (2007) and Alam (2008) by using a different study also reinforcedSolikin findings (2004). They found that the degree of persistence of inflation caused by the behavior of backward looking expectations in the era of the ITF tends to decrease.

Harmanta (2009) reported the persistence of high inflation in Indonesia caused by a monetary policy that was not fully credible (*imperfect credibility*). *Imperfect credibility* is the slow pace of inflation expectations caused by economic agents and the actual movement of inflation towards the target. The study also reinforced previous studies conducted by Revenna (2005). Revenna conducted a survey of 82 countries, and in the study of monetary policy, put Indonesia in the category of "low credibility" because of its inability to achieve the inflation target.

The issue of credibility of monetary policy is closely related to *time inconsistency* problems (Goeltom, 2005). *Time inconsistent* policy will potentially lead to the low credibility of monetary policy, so that economic agents will form expectations of higher inflation than the target announced by the authorities. If the time inconsistency problem of monetary policy refers to a lack of credibility of monetary policy, then the question arises whether the low credibility of monetary policy in Indonesia indicates a time inconsistency problem in monetary policy of Bank Indonesia? Goeltom (2005) stated that between the period of 1990-2003 Indonesianmonetary policy still faced time inconsistency problems of that is not optimal, sometimes too loose and too tight sometimes.

Studies on the topic of central bank institutions arean issue that surfaced at the time and not a lot of research has been done, especially in the case of Indonesia. The study of time inconsistency of monetary policy in Indonesia is still very limited. Studies that have been done by Budiyanti (2009) found the presence of the time inconsistency problem of Indonesianmonetary policy in periods before and after the 1997 economic crisis. Budiyanti (2009) used a standard linear quadratic model of Barro-Gordon in explaining the time inconsistency problem of monetary policy in Indonesia. This model basically assumes that the central bank's preference for the output gap is symmetry (symmetric central bank's preference). In other words, the central bank is considered indifferent to the positive and negative output gap.

But in its development, the assumption of symmetric preference has received criticism from academics and theoretical and practical monetary practitioners (McCallum, 1997 and Blinder, 1998). From the empirical research it is also increasingly questionable to assume of a standard model with a linear quadratic symmetric time preference to explain the inconsistency (Cukierman (2000), Ruge-Murcia (2001, 2002), Surico (2003), Tambakis (2004), Gredig (2007), Ikeda (2009), and others). Cukierman (2000) questioned whether the positive and negative deviations of output from its potential value in the same amount, will be in the same proportions? And whether the central bank is really indifferent to the negative output gap and the output gap positive?

Asymmetric preference becomes an important issue and is a worthy topic of study, especially with regard to the research on *symmetric preference* for preferences that hold no asymmetry. There are at least three strategic issues defined as problems in this study, first, whether there are asymmetric preference parameters that indicate a time inconsistency problem of monetary policy in Indonesia for periods before and after the independence act of Bank Indonesia? If yes, then the question is, whether there are differences in the amount of asymmetric preference, which indicates the difference in the degree of time inconsistency of monetary policy before and after the independence act of Bank Indonesia? Second, how the monetary policy implications of the time (in) consistent or policy with a different degree of time inconsistency in the period before and after the independence act of Bank Indonesia in influences the behavior of the output gap in determining the inflation rate in Indonesia? Third, how does the performance (achievement) of inflation in Indonesia before and after the independence of Bank Indonesia in the context of the policy of the time (in) consistent or in the presence of different degrees of time inconsistency?

The period of analysis is divided into two sub-samples, i.e. the period before the independence of Bank Indonesia (1990:1-1999:4) and the period after the independence of Bank Indonesia (2000:1-2009:4). This is due to fundamental changes in the institutional and implementation of monetary policy in Indonesia in 2000, which marked the changing status of the Bank Indonesia from dependent to independent. Independence of Bank Indonesia in the Act legislated in *Bank Indonesia No. 23 of 1999* as amended by *Act 3 of 2004* which explicitly confirmed that monetary policy is focused on a single goal achieving price stability. The division of the sub-sample also refers to Rogoff (1985) which states that the granting of independence to the central bank can overcome the time inconsistency problem. Thus the expected degree of time inconsistency will also be different in the period before and after the independence of Bank Indonesia.

II. THEORY

2.1. Time inconsistency of Monetary Policy Theoretical Review

A policy is said to be time inconsistent if the policy is optimal in a period, t_0, but not optimal at another period, t_1 (Bofinger, 2001). Time inconsistency refers to the difference in the optimal policy measures that have been announced by the central bank after the taking of a decision based on expectations (Kydland Prescott, 1977). Policies that are time inconsistent will occur when there is new information in the economy.

Kydland and Prescott Model

Kydland and Prescott (1977) analyzed time inconsistency to indicate that the general rule is better than discretion in the formulation of policy. Assuming there are only two periods of policy, the objective function of the policy maker is:

$$U = U(x_1, x_2, \pi_1, \pi_2) \tag{1}$$

where U is the preference of policy makers, *x*an economic agent's decision variables, and π is aninstrument variable of policy makers. Furthermore, it is assumed that economic agents consider the policies formulated by the economic decision-making authority in the following:

$$x_1 = x_1(\pi_{1,}\pi_2) \tag{2}$$

$$x_2 = x_2(x_1, \pi_{1,}\pi_2 \tag{3}$$

To perform optimization across time, the decision of the two variables of policy instruments are carried at period 1.

$$U(.) = U(x_1(\pi_{1,}\pi_2), x_2(x_1(\pi_{1,}\pi_2), \pi_{1,}\pi_2), \pi_1, \pi_2) \tag{4}$$

Optimal conditions with *rule* (π^*_1,π^*_2), obtained through the *first order condition* as the following:

$$\frac{\partial U(.)}{\partial \pi_2} = \left[\frac{\partial U}{\partial x_1}\frac{\partial x_1}{\partial \pi_2} + \frac{\partial U}{\partial x_2}\frac{\partial x_2}{\partial x_1}\frac{\partial x_1}{\partial \pi_2}\right] + \left[\frac{\partial U}{\partial x_2}\frac{\partial x_1}{\partial \pi_2} + \frac{\partial U}{\partial \pi_2}\right] = 0 \tag{5}$$

For policies that are discretionary, policy makers in period 1 would determine π^*_1 and π^*_2 like the step above. But in the second period of realization π_1 and x_2 are already there. So in period 2 policy makers will decide again:

$$U = U(x_1, x_2, \pi_1, \pi_2) \tag{6}$$

subject to:

$$x_2 = x_2\left(x_1, \pi_{1,}\pi_2\right) \tag{7}$$

$$x_1 = x_1 \tag{8}$$

$$\pi_1 = \pi_1^* \tag{9}$$

From the first order derivative conditions for the period 2 with discretion will result in policy π_1** as the following:

$$\frac{\partial U}{\partial x_2}\frac{\partial x_2}{\partial \pi_2} + \frac{\partial U}{\partial \pi_2} = 0 \tag{10}$$

The first order derivative condition (FOC) on this discretion will only be the same as the FOC rule above if:

$$\frac{\partial x_1}{\partial \pi_2}\left[\frac{\partial U}{\partial x_1} + \frac{\partial U}{\partial x_2}\frac{\partial x_2}{\partial x_1}\right] = 0 \tag{11}$$

But in reality this condition difficult to meet, so the optimal solution by rule (π^*_1, π^*_2) will be different from the optimal solution discretion (π^*_1, π^{**}_2). And because the solution to the rule (π^*_1, π^*_2) maximizes inter-temporal utility, then the solution to the discretion (π^*_1, π^{**}_2) be not optimal. This is due to discretionary policy in period 2 that does not consider the effect of the decision in period 1(x_1, π_1).

Barro and Gordon Model

Barro and Gordon (1983) analyzed the *time inconsistency* in monetary policy through *game-theory* a la Nash equilibrium between the central bank and the private sector in the economy. The Barro-Gordon model assumes the central bank is able to manage the process of economic and monetary policy directed to social welfare which also incorporates community preferences. Society only has the action of formingparameter inflation expectations. *Time inconsistency* will arise due to: (a) the community forming expectations of inflation at the beginning of the period and is held until the end of the game, and (b) the central bank has full discretion in determining the strategy all the time. In this situation, the inflation target that is set at the beginning of the period will not necessarily be optimal at the end of the period, and will result in social losses for the central bank and the public.

Mathematically, Barro-Gordon models are formulated as follows - the central bank minimizes the loss of social welfare function:

$$L = [b(U - U^*)^2 + \pi^2] \tag{12}$$

where b > 0 and the initial inflation target $\pi^* = 0$. Unemployment is assumed to follow the expected *augmented Phillips curve* as follows:

$$U = U^n - a(\pi - \pi^e) \tag{13}$$

with a > 0 and $U^* = kU^n$, where 0 < k < 1. Furthermore, central banks have assumed control of inflation through monetary policy, so that the inflation rate will be in line with the growth in money supply ($\pi = \mu$). In this condition there is no problem in the transmission of monetary policy. With these assumptions, the central bank minimizes the social welfare function following loss:

$$Z = \{b[(1 - k)U^n - a(\pi - \pi^e)]^2 + \pi^2\} \tag{14}$$

By determining the conditions of the first order derivative, we obtain the optimal rate of inflation π^{**} as follows:

$$\frac{\partial Z}{\partial \pi} = -2ab[(1 - k)U^n - a(\pi - \pi^e)] + 2\pi = 0 \tag{15}$$

$$\pi^{**} = \frac{ab(1-k)U^n}{1+a^2b} + \frac{a^2b}{1+a^2b}\pi^e \quad (16)$$

$$\pi^{**} = \frac{ab(1-k)U^n}{1+a^2b} + \theta\pi^e \quad (17)$$

Solution π** in the above shows the *time inconsistency*, in which target setting π* = 0 is not optimal at the end of the period. There is an expected *augmented Phillips curve* leading to the optimal inflation rate as influenced by inflation expectations. Because in general inflation expectations $\pi^e > 0$, then the optimal inflation rate is also greater than 0 (π**>0). Even if inflation expectations $\pi^e = 0$, optimal inflation is still greater than 0 (>0). This is due to the social cost parameter (*b*) and the phenomenon of unemployment (*k*) and the deviation of inflation from its target (*a*). The inflation rate greater than null (π**>0) can be sourced from inflation surprise, bias and inflation rule, as outline below.

Inflation Surprise

Inflation can still occur despite the central bank setting an initial target inflation π* = 0, along with this, the central bank does not work to eliminate the deviation of inflation from its target due to the condition of the real sector, or in other words if the central bank is pro-growth. In these conditions the actual inflation is:

$$\pi^s = \frac{ab(1-k)}{1+a^2b}U^n \quad (18)$$

Social cost of inflation is:

$$L^s = \left\{b\left[(1-k)U^n - \frac{a(ab(1-k)U^n}{1+a^2b}\right]^2 + \left[\frac{(1-k)U^n}{1+a^2b}\right]^2\right\} \quad (19)$$

$$L^s = \frac{b[(1-k)U^n]^2}{1+a^2b} \quad (20)$$

Inflation bias

Although community expectations are rational and the function of the central bank losses and the Philips curve are known, the initial target inflation π* = 0 will not be credible. In these conditions the interaction between central banks and economic agents follow the *Stackleberg Game Theory*. Inflation expectations will be equal to the central bank's target, $\pi^e = \pi^*$. Thus the actual inflation rate and social losses in a row is:

$$\pi^{REH} = ab\,(1-k)U^n \quad (21)$$

$$L^{REH} = b[(1-k)U^n]^2 + [ab(1-k)U^n]^2 \quad (22)$$

$$L^{REH} = b(1+a^2b)[(1-k)U^n]^2 \quad (23)$$

InflationRule

Barro and Gordon (1983) argued that with rational expectations and behaviors follow the *Stackleberg Game* as above, then the social loss will be reduced by giving the rule to the central bank that inflation $\pi = 0$ and the rate of growth of money supply = μ. In this condition, the rate of inflation and social loss rule is:

$$\pi^{RULE} = 0 \tag{24}$$

$$L^{RULE} = b[(1-k)U^n]^2 \tag{25}$$

The above analysis shows that the lowest *social cost* is *asurprise inflation* condition and the highest inflation in the *inflation bias*, while the *inflation rule* is in between. Thus, in the context of the game theory, the Barro-Gordon model results in *aprisoner's dilemma* because it produces the optimal strategy for both players (central banks and the public) with adverse results to both.

Rogoff (1985)

Rogoff (1985) stated that in order to overcome the problem of *time inconsistency*, then monetary policy should be delegated to an independent central bank and a conservative. An independent central bank is *inflation averse* and would be able to reduce the average inflation, but it will increase the variability of output. It means that aconservative central bank can reduce *inflation bias* caused by *time inconsistent* monetary policy, but on the other hand,, it has a lesserrole in stabilizing *output*. In this concept the public are assumed to have two options to achieve the goal of price stability, namely: achieving its own (with the formation of the government) or delegating monetary policy to a conservative central bank with the task of focusing on price stability.

If done alone (mandate to the government), then the government will minimize the following loss function:

$$\min L = b(y_t - y^*)^2 + (\pi_t - \pi^*)^2 \tag{26}$$

$$s.t.\text{Philips Curve}: \; y_t - y^p = a(\pi_t - \pi^e) + \varepsilon_t \tag{27}$$

Furthermore, to facilitate the analysis, it is assumed that $\pi^* = 0$ and $y^p = 0$. Thus the loss function will be:

$$L_G = b(y_t - y^*)^2 + {\pi_t}^2 \tag{28}$$

Next the substitution of the constraint functions for the function objectives is done, and the optimization is performed to obtain the optimal inflation rate.

$$L_G = b(a(\pi_t - \pi^e) + \varepsilon_t - y^*)^2 + \pi_t{}^2 \tag{29}$$

$$\frac{\partial L_G}{\partial \pi_t} = 2ab[a(\pi_t - \pi^e) + \varepsilon_t - y^*] + 2\pi_t = 0 \tag{30}$$

$$2a^2b\pi_t - 2a^2b\pi^e + 2ab\varepsilon_t - 2aby^* + 2\pi_t = 0 \tag{31}$$

$$\pi_t(1 + a^2b) - a^2b\pi^e + ab\varepsilon_t - aby^* = 0 \tag{32}$$

$$\pi^{**} = \frac{a^2b\pi^e}{1+a^2b} + \frac{aby^*}{1+a^2b} - \frac{ab\varepsilon_t}{1+a^2b} \tag{33}$$

Because the expectations were formed before the government took the policy, then the $\pi^e_t = E_{t-1}(\pi t) = aby^*$, so that the rate of inflation and output are respectively:

$$\pi_t^{**} = aby^* - \frac{ab}{1+a^2b}\varepsilon_t \tag{34}$$

$$y_t^{**} = \frac{1}{1+a^2b}\varepsilon_t \tag{35}$$

From the two equations above, we can obtain the variance of inflation and output respectively as follows:

$$var\ \pi_t^{**} = \left(\frac{ab}{1+a^2b}\right)^2 \sigma_\varepsilon^2 \tag{36}$$

$$var\ y_t^{**} = \left(\frac{ab}{1+a^2b}\right)^2 \sigma_\varepsilon^2 \tag{37}$$

Thus, if the monetary policy mandate given to the government, can be concluded as:

1) There will be *inflation bias*, since $\pi^e_t => 0$
2) The higher the preference for *output* stabilization (b), the higher inflation will be, which $\frac{\partial E_{t-1}(\pi_t)}{\partial b} = ay^* > 0$, and $\frac{\partial var\ \pi_t^{**}}{\partial b} > 0$
3) Provide monetary policy mandate to the government's pro-growth, it will not increase *output* on average, because the average *output* is 0 (because $y^p = 0$), so that $E(y^{**}) = 0$ $\frac{\partial E(y^{**})}{\partial b} = 0$, but will only reduce *output* volatility, where $\frac{\partial vary^{**}}{\partial b} < 0$

Implications of Rogoff (1985) is that in order to achieve the goal of price stability in the sense of low inflation, then choose a conservative central bank that is more *inflation averse*. If monetary policy is delegated to a conservative central bank, the rate of inflation and output respectively are as follows:

$$\pi_t^{**} = a\hat{b}y^* - \frac{a\hat{b}}{1+a^2\hat{b}}\varepsilon_t \quad (38)$$

$$y_t^{**} = \frac{1}{1+a^2\hat{b}}\varepsilon_t \quad (39)$$

$\hat{b}$ is a conservative central bank preference for output stabilization, the value of which is lower than the preference of the government to stabilize output (b), because the more conservative central bank is *inflation averse*, while government is more pro-growth, so $0 < \hat{b} < b$. Thus, delegating monetary policy to a conservative central bank will be able to achieve a lower inflation rate than if the government mandated monetary policy.

2.2. Symmetric versus Asymmetric Central Bank Preference

Symmetric Central Bank Preference

Symmetric central bank monetary policy preference describes preferences that assume the central bank weighs the same policy towards deviations of the positive and negative output (unemployment) and/or inflation from its target. In the monetary policy preferences of symmetry of the *output gap*, the central bank is assumed to be *indifferent* between the positive *output gap* and negative *output gap*. If there is a positive deviation of *output* from its potential value by 1% or if there is a negative deviation in the same amount (1%), it will lead to increased loss to the central bank in the same amount. Therefore, a positive *output gap* and the negative *output gap* with the same proportion arenot favored by the central bank.

According to this model, the inflation bias will occur as a result of the central bank's desire to achieve the level of output that exceeds its potential value or to achieve lower unemployment than the natural rate. Based on the Barro-Gordon model,monetary policy preferences are symmetric with respect to the *output gap*, and as the central bank sets a target level of potential *output*, the *inflation bias* is null.

Monetary policy preferences of symmetry is mathematically described using a standard model consisting of a linear quadratic loss function of the central bank in a quadratic form and function of linear *aggregate demand* and *aggregate supply*.

$$L = \frac{1}{2}\left[(\pi_t - \pi^*)^2 + \lambda {y_t}^2\right] \quad (40)$$

Where π_t is the actual inflation, is the target inflation, π^* is y_t the *output gap* (deviation of actual *output* from potential *output*) and λ is the preference parameters of monetary policy on *output* stabilization.

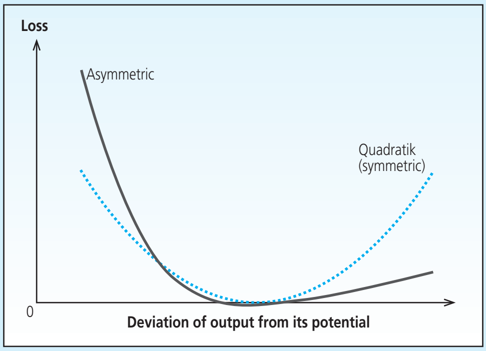
Asymmetric Central Bank Preference

Asymmetric preference illustrates the different treatment of the central bank (asymmetry) in the face of a recession and boom or in response to positive and negative deviations of *output* (unemployment) and/or inflation from its target. In contrast to the *symmetric central bank preferences* as described by standard linear quadratic function, the asymmetry of monetary policy preferences is described by the central bank loss function in the form of a linear exponential (linex).

$$L_t = \frac{1}{2}(\pi_t - \pi^*)^2 + \lambda\left[\frac{exp(\gamma y_t) - \gamma y_t - 1}{\gamma^2}\right] \tag{41}$$

The linex function has several important properties, such as: first, it allows for different policy weights for the positive deviation and negative deviation of actual *output* from its potential value. This condition is indicated by the value $\gamma \neq 0$. Parameter $\gamma < 0$ implies that the negative gap is treated with greater weight than positive gap. Otherwise $\gamma > 0$ indicates a positive gap meaning that the policy responded with a weight greater than the negative gap. Suppose $\gamma < 0$, if the output exceeds the target or potential value (positive gap), the linear part of the function progressively become larger. Consequently, loss will increase linearly with increasing output. Conversely, if the output is below potential (negative gap), the exponential will dominate functions that cause harm withexponential increases due to lower output. Therefore, the negative deviation from its target output of weighted policy is greater than the positive deviation in the central bank's loss function. In other words it can be interpreted that the central bank different weights of monetary policy at the time of contraction and expansion of output or at the time of recession and boom. Conditions where $\gamma \neq 0$, shows the time inconsistency problem in monetary policy. Second, it refers to the standard model for the case of the linear quadratic $\gamma \rightarrow 0$. If $\gamma = 0$, then using the L'hopital rule, this function will be the same as the standard linear quadratic function that refers to the Barro-Gordon model that is widely used in the literature of *time inconsistency*.

Graphically, the difference between symmetric preference and asymmetric preference can be described as follows:



Source: Ruge-Murcia (2002)

Figure 1
Symmetric vs. Asymmetric Central Bank Preference

The dashed line in the figure is the central bank's loss function in the preferences that are symmetric, while the solid red line is the central bank loss function for asymmetry preference. The symmetric loss function (quadratic) shows that if there are positive and negative deviations of output from its potential value in the same amount, it will give the amount of the loss that is equally as great. So that the positive and negative output gap will be responded to the same weightedpolicy. But in the asymmetric function, if there is a positive deviation of output from its potential (positive output gap), then the central bank losses will increase linearly. But if the output gap is negative, then the central bank losses will increase exponentially. Thus, in the context of the linex function, central bank preferences are asymmetric to the output gap, where the negative output gap will be responded with a policy of greater weight than the positive output gap by the central bank in an effort to reduce losses.

2.3. Previous studies

Ireland (1993) examined whether the *time inconsistency* problem of the Barro-Gordon model (1983) to explain the behavior of inflation in the United States. Although the data rejected the predictions of the short-term dynamic between inflation and unemployment, the model was able to explain the long-term dynamic prediction in which the relation of the two variables is linear and has a positive co-integration.

Ozlale and Ozkan (2003) conducted a study on the *time inconsistency* problem of monetary policy in Turkey over the past two decades. By using the quadratic loss function of Barro-Gordon, this study indicated the *time inconsistency* problem of monetary policy in Turkey in the short and long term. The research also indicated that Turkish monetary authorities directed monetary policy to achieve price stability rather than output stabilization.

Sachida, Divino and Cajueiro (2005) tested the Barro-Gordon model to explain the behavior of inflation and unemployment the United States divided into five periods of observation, the period of Martin I (1951:2-1960:4), the period of Martin II (1961:1-1969 : 4), the period of office of Burn and Miller (1970:1-1979:2), Volcker regime (1979:3-1987:2) and Greenspan period (1987:3-2005:2). In addition the study also classifiedan outline of the analysis periods, i.e. the period before Volcker regime (1951:2-1979:2) and after Volcker's appointment as governor of the Federal Reserve (1979:3-2005:2). Results showed that the Barro-Gordon model was able to explain the behavior of inflation and long-term unemployment in the Burn leadership and Miller, Greenspan periods, after the appointment of Volcker, and for the overall analysis (full sample). While in the short term, the Barro-Gordon model was only significant at Greenspan's period of office. These findings are contradictory to the view that Greenspan's anti-inflation policy was very strong.

For the case of Indonesia, Budiyanti (2009) analyzed the implications of *time inconsistency* of monetary policy in Indonesia using the method of maximum likelihood with the Kalman filter algorithm. By using the quarterly data of inflation and output period 1983-2008 and divide the analysis period into two sub periods, the test results showed that there is a *time inconsistency* problem of monetary policy in the long term period before and after the crisis, but only short-term *time inconsistency* occurred in the period before the crisis .

The Barro-Gordon Model *time inconsistency* as described previously explained that the *inflation bias* in the economy was caused by the central bank that was too ambitious to reduce unemployment below the natural rate or to stimulate output to exceed its potential level. Although some previous studies presented demonstrate the validity of the Barro-Gordon model in some countries, the assumption of Barro-Gordon in the development raised doubts and questions by many academics and monetary theoretical, practical and empiricalpractitioners.

Ruge-Murcia (2002) tested the Barro-Gordon model's predictions using data inflation and unemployment the United States. By establishing a common model of *game theory* with asymmetric preferences referring to Barro-Gordon model and an alternative model of Cukierman as a special case. This test assumed that when the target is at the natural rate of unemployment, the coefficient of unemployment has zero expectations. In this condition the model of Cukierman applies. Furthermore, if the preference parameters are established in accordance with the quadratic loss function, the coefficient of the conditional variance is zero, then the Barro-Gordon model applies. The likelihood ratio test indicated that the restrictions required by the Barro-Gordon model rejected by the data, but the Cukierman model accepted it. The test results indicated that the behavior of U.S. inflation is best explained by a model in which the central bank has asymmetric unemployment preferences, rather than explained by the Barro-Gordon model with quadratic preferences and target unemployment below the natural rate. Although the preference asymmetry parameter cannot be identified by the reduced form coefficients, the results of this study are consistent with the view that the Federal Reserve gave greater weight to policy with a positive deviation of unemployment from its target than when the deviation was negative. These findings are also in line with Dolado et al. (2000) who found that the Federal Reserve reacted more strongly against the negative *output gap* than the positive *output gap*.

Surico (2003) measures the *time inconsistency* of monetary policy of the United States when the central bank preferences were asymmetric. Issues *time inconsistency* and *inflation bias* are described as regime-specific. Regime change is expected to cause changes in the degree of *time inconsistency* and the average inflation bias. Therefore Paolo divided the study period into two sub-samples of the period before Paul Volcker was the governor of theFederal Reserve and the period when Paul Volker served as governor. The results showed that the target inflation and average inflation bias in the regime before Volker is 3:42% and 1.01%. This number decreased significantly over the past two decades to 1.96% for the inflation target and the average inflation bias was almost nonexistent. The studies showed that this is due to the stabilization policy preferences of greater output and asymmetry before the Volcker regime, and this was not the case at the time Volcker regime. Although other factors such as creating better policy and better conditions for supporting supply shock also plays an important role in lowering the degree of *time inconsistency* and the average inflation bias, only the Paolo study described the quantitative results of the empirical findings of inflation behavior in the United States.

Kim and Seo (2007) examined whether the Bank of Korea's preference is consistent with the assumption of quadratic preferences that describe monetary policy in most standard time inconsistency literature. This study estimated the reaction function and asymmetry parameter preference against the inflation gap, the output gap, and the inflation targeting period in Korea. The empirical results showed that the asymmetry of the inflation preference parameters isstatistically significant. Furthermore, the study also indicated that the Bank of Korea monetary policy gives excessive weight to the positive deviation of inflation from its target in the event of a negative deviation.

Ikeda (2009) did time varying estimates of Monetary Policy (TVMP) in the Euro area using monthly data from the period 1999:1 to 2008:9. The test results showed that the *loss function* of the European Central Bank (ECB) often deviates from quadratic forms and the ECB does not look like the inflationary conditions caused by the expansion of output. Furthermore, estimates of preference implies the importance of the independence of the ECB fiscal policy of each member state and the importance of business cycle synchronization in the euro area since the ECB does not allow expansion of the economy at the expense of price stability in the Euro area.

III. METHODOLOGY

3.1. Variables and Data

Technically, the data used in this study include(i)inflation, (ii) *conditional mean output gap*, dan (iii) *conditional variance output gap*. *Output gap* is the deviation of real output from its potential output, measured with Hoderick-Prescott filter (avalaible from Tjahjono, Munandar, and Waluyo, 2010). Inflation is defined as change of Consumer Price Index. The data for *conditional mean* and *conditional variance output gap* are not directly available, hence estimated from the *output gap*. The calculations for conditional mean and conditional variance output gap are not immediately available and will be described in the next section.

The data covers the time 1990:1 to 2009:4.Sources of data obtained fromBank Indonesia, Indonsia Statistic (BPS), and other sources.

Any data collected directly or calculated will go through stationaritytesting. Stationarity means that the data at any point of time does not correlate with the data at a different point in time. Nachrowi and Usman, 2006) stated that the collection of the data is stationary if the mean and variance of the time series data do not systematically change over time, or some experts claim that the average and its variance are constant. Using data that is not stationary will likely lead to *spurious regression*. There are many ways to detect stationarity. A popular one is stationary *Augmented Dickey Fuller Test (ADF test)*. The framework used in this test is to compare the value of the test statistic with the critical value obtained from the table. The null hypothesis that the series has a unit root is rejected if the value of the test statistic obtained is greater (in absolute terms) than the critical value table. This research used stationarity tests applying the ADF test. Furthermore, if there was any structural break, then testing stationarity using the ADF test was equipped with *Philips Peron Testin* (asthe Philip Peron Test is better for testing structural breaks).

3.2. Empirical Model

The model used in this study is a model of linear exponential (linex) containing the policy preferences of the asymmetry parameter. The model refers to work of Cukierman (2000), Ruge Murcia (2002), and Surico (2003). The behavior of economic agents form expectations based on the *Augmented Phillips Curve*:

$$y_t = \theta(\pi_t - \pi_t^e) + u_t, \theta > 0 \tag{42}$$

y_t is the output gap which is the deviation of actual output from potential value. π_t inflation is a period t and π^e_t is the expectationinflation period tformed in period t-1. u_t is a supply shock that could potentially happen under the autoregressive $u_t = \rho u_{t-1} + \varepsilon_t$ where $\rho \in [0.1]$ and ε_t isi.i.d shock with zero mean and constant variance σ^2_t.

Furthermore, the private sector has rational expectations, which is expressed by the following equation:

$$\pi_t^e = E_{t-1}\pi_t \tag{43}$$

E_{t-1} indicates the formation of inflation expectations for period t based on the information available in period t-1. Furthermore, the central bank is assumed to have full and direct control of inflation by minimizing the following function:

$$\min_{\{\pi_t\}} E_{t-1} \sum_{T=0}^{\infty} \delta^T L_{t+T} \tag{44}$$

Where δ is the *discount factor*.To bring forth asymmetric preference parameters, loss function is specified in the form of the linear exponential.

$$L_t = \frac{1}{2}(\pi_t - \pi^*)^2 + \lambda \left[\frac{exp(\gamma y_t) - \gamma y_t - 1}{\gamma^2}\right] \tag{45}$$

Where λ > 0, parameter λ is the relative weight of monetary policy on output stabilization. γ is the asymmetricpreference parameter of monetary policy on output stabilization. If there is no asymmetric preference parameters in the monetary policy to stabilize output then γ = 0; so by using L'hopital rule, the equation loss function (45) can be expressed in terms of the following standard linear quadratic:

$$L = \frac{1}{2}\left[(\pi_t - \pi^*)^2 + \lambda {y_t}^2\right] \tag{46}$$

Therefore, according to Ruge-Murcia (2002) it is very important to test whether γ is significantly different from zero or not to show the time inconsistency of monetary policy.

Time inconsistency of monetary policy arises because the asymmetry of policy preferences are driven by the desire to achieve the central bank's output that exceeds its potential value, as represented by the parameter γ. The level of conservatism of the central bank can be indicated by the amount of λ and γ. The more conservative the central bank's monetary policy preference, the smaller the output stabilization (λ), and the preferencesfor policymakers for output symmetry would be indicated by the low value of the absolute γ.

Further minimization of equation (45) with the constraint equation (42) which is the *Philips Curve Equation* and the additional constraint equation (43) which is the assumption of rational expectations, is used to obtain the expression of the following equation:

$$(\pi_t - \pi^*) + E_{t-1}\left\{\frac{\lambda\theta}{\gamma}[exp(\gamma y_t) - 1]\right\} = 0 \tag{47}$$

To be able to identify the value γ, a transformation equation is done to form a linear exponential equation (47) by using a *first order Taylor Expansion* to obtain the following equation expression:

$$(\pi_t - \pi^*) + \lambda\theta E_{t-1} y_t + \frac{\lambda\theta\gamma}{2} E_{t-1} {y_t}^2 + \varepsilon_t = 0 \tag{48}$$

By rearranging the above equation, the reduced form is obtained by the following equation:

$$\pi_t = \pi^* + \alpha E_{t-1} y_t + \beta E_{t-1} {y_t}^2 + \varepsilon_t \tag{49}$$

Where :

$\alpha = -\lambda\theta$ and $\beta = -\frac{\lambda\theta\gamma}{2}$

The next stage is to eliminate the expectation sign. According to Ruge-Murcia (2002), the expected value in the above equation can be replaced with actual values by establishing conditional mean and conditional variance of the output gap, so that the obtained expression yields the following equation:

$$\pi_t = c + \alpha E_{t-1} y_t + \beta \sigma^2_{y,t} + \varepsilon_t \tag{50}$$

Where $E_{t-1}y_t$ is conditional mean of the output gap, and $\sigma^2_{y,t}$ is the conditional variance of the output gap. Average inflation target π^* is assumed to be normally distributed around a constant c, and ε_t isthe *reduced form disturbance.*

3.3. Estimation Techniques

In this study, empirical testing was done using the equation reduced form (50). Tests using the reduced form (50) raised several problems, including the data expectation from the *output gap* and the *conditional variance* which is not readily available. Therefore, some preliminary testing stages were required to obtain the expected value of the *output gap* (conditional mean of the output gap) and the *conditional variance* before estimating reduced form models.

Consider this, the empirical testing was conducted by a Two-Step Ordinary Least Square (TSLS). The first stage is to assess the conditional mean and conditional variance output gap. The second stage is the mean regression model in reduced form (50) using the estimation results in the first stage. Testing was initially done for the whole sample period (full sample: 1990:1-2009:4). Furthermore, the estimated period was divided into two sub-samples of beforethe independence of Bank Indonesia (1990:1-1999:4) and after the independence of Bank Indonesia (2000:1-2009:4). The division of sub-sample aims to discern the degree of time inconsistency of monetary policy before and after the independence of Bank Indonesia.

Conditional Mean Output Gap Estimates

Expected value of the output gap was estimated by means of smoothing the output gap by using the time series Box-Jenkins *Autoregressive Integrated Moving Average (ARIMA)*. This method is excellent for predicting the data that have a pattern that is less clear, because it does not assume the shape of a particular data pattern. The *Box-Jenkins ARIMA model* focuseson a combination of principles, i.e. regression and smoothing methods (smoothing). *ARIMA* (p, d, q) is a combination of AR (p) and MA (q), where p is the order of the autoregressive, d is the order of integration, and q is the order of the moving average. The selection of the ARIMA model (p, d, q) or ARMA (p, q) will be determined by the degree of integration or stationarity of the output gap. If the data at the level of the output gap stationary, the estimated expected value of the output gap is done with ARMA (p, q). But if the output gap is integrated in first differences or higher order, then the assessment will be done by ARIMA (p, d, q).

To estimate the ARIMA model, there are several steps that must be done. First, identify the model or the degree of integration of data and stationarityorderof the ARIMA.Second, the estimated parameters of the model have been based on the results of the identification. Third, is the diagnostic checking and selection of the best model based upon several criteria: (i) coefficients that were statistically significant (in terms of statistics and t or p-value), (ii) random error or white noise (indicated by the Q statistic exceed the 5% confidence level (Q statistic> α)), and (iii) the smallest *standard error regression*.

Conditional Variance Estimation of Output Gap

Conditional variance estimated the output gap by drafting a model specification using ARCH / GARCH. With reference to the Ruge-Murcia (2002), the conditional variance was assessed by the lag of the regression output gap. So this variable will explain how the lag output gap will help predict the rate of inflation in a non-linear manner. But modeling using ARCH / GARCH is only valid in the framework of time series where the output gap is conditionally heteroscedastic or if changes over time. Therefore, before estimating the conditional variance using the ARCH/ GARCH, the *Langrange multiplier (LM test)* must first be appliedto determine if the model contains an ARCH effect. If the *LM test* is significant or there are ARCH effects, the models have problems in heteroscedasticity, and thus the ARCH / GARCH modeling would be valid.

IV. ANALYSIS AND RESULTS

4.1. Estimation of the *Conditional Mean Output Gap*

The expected value of the output gap is obtained by smoothing the output gap using the ARIMA (p, d, q), where p is the order of the autoregressive, d is the order of integration, and q is the order of the moving average. The data for the output gap used is estimated by the method of *Hodrick Prescott filter*.

Based on the stationaritytest results, the output gap is already stationary atthe integrated level on the order of 0 I (0), so the order of d is 0 (d = 0). This indicated that the model to be used is Autoregressive Moving Average (ARMA). Furthermore, to get the maximum order of p and q (AR (p) and MA (q)) will be seen from the number of autocorrelation coefficients that are significantly different from zero. Order maximum AR (p) partial autocorrelation is seen from the line, while the maximum order MA (q) is seen from the line of autocorrelation. From the test results it was known that maximum order of AR is 1 and the maximum order for the MA is 3. So that the model to be estimated is the ARMA (1,1), ARMA (1,2), and ARMA (1.3). Estimation parameter results from the model according to identification are presented in Table1 below:

Table 1
ARMA Model Regression Results

Model ARMA	Parameter	Value Estimation Parameters	p-value from T Ratio	Description (S / TS *)	Probability Q				Standard Error
					5	10	15	20	
(1,1)	Constant	-0.052			0.119	0.350	0.094	0.305	2.196
	AR(1)	0.668	0.001	S					
	MA(1)	0.043	0.889	TS					
(1,2)	Constant	-0.052			0.045	0.202	0.068	0.256	2.209
	AR(1)	0.711	0.035	S					
	MA(1)	0.016	0.971	TS					
	MA(2)	-0.077	0.780	TS					
(1,3)	Constant	0.007			0.138	0.597	0.020	0.094	2.097
	AR(1)	-0.142	0.660	TS					
	MA(1)	0.991	0.000	S					
	MA(2)	0.583	0.043	S					
	MA(3)	0.468	0.000	S					

* S = Significant, TS = Not Significant

The next stage was to determine the best ARMA model in accordance with the criteria mentioned earlier. The selected model was ARMA (1,1). Model ARMA (1,1) was chosen because it had a residual white noise. Of the three ARMA model specifications that were tested, only the ARMA (1,1) which had residual white noise. Therefore the conditional mean value of the output gap will be estimated using the fitted value ARMA (1,1).

4.2. Estimation of *Conditional Variance*

Conditional variance was estimated with regression to the output gap against its lag. Thus, this variable will explain how the lag of the output gap will help predict the rate of inflation in non-linear manner. But this prediction is only valid in the framework of time series where the output gap is conditionally heteroscedastic or if $\sigma^2_{y,t}$ changes over time. If $\sigma^2_{y,t}$ isconstant, then the coefficient β cannot be identified. Therefore it is very important to test whether the conditional variance is time-varying. For this purpose, the output gap to 4 of its lag periods is regressed using OLS. Further testing of the *LM (Langrange Multiplier)* was used to detect whether the model contains ARCH effects or not. If there are ARCH effects, the null hypothesis with no conditional heteroscedastic was rejected. So the use of ARCH/ GARCH would be valid.

The results of the test statistic F and TR^2had a p-value of 0013 and 0016 that were less than 5% confidence level indicating that the models contain ARCH effects. Thus modeling methods ARCH / GARCH was valid. Furthermore, the conditional variance of the output gap was estimated using a GARCH (1,1), as all the ARCH-LM test were significant, meaning the coefficient of the modeling GARCH (1,1) is better.

The next stage was to assess the effect of the ARCH model of GARCH (1,1) to determine whether the model specification used to be able to capture all of the output gap ARCH effects. Table 2 shows the results of testing of ARCH effects using OLS and GARCH (1,1).

Table 2
ARCH Effects Test Results

Estimation method	Indicator Testing	Value	p-value	Comments
OLS	F-statistic	3.423	0.013	There are ARCH effects
	Obs*R-squared	12.217	0.016	There are ARCH effects
GARCH (1,1)	F-statistic	0.534	0.711	There are no ARCH effects
	Obs*R-squared	2.225	0.694	There are no ARCH effects

* S = Significant, TS = Not Significant

The test results showed that the residuals no longer contain ARCH effects, which means that the model was able to capture the whole issue of heteroscedasticity in the output gap. Thus, the conditional variance to the output gap was estimated using GARCH (1,1).

4.3. Stationarity Test

A modern technique for detecting stationarity is the unit root test. One popular test is the *Augmented Dickey Fuller test stationary (ADF test)*. The framework used in this test is to compare the value of the test statistic with the critical value obtained from the table. The null hypothesis is, the series unit root is rejected if the value of the test statistic obtained is greater (in absolute terms) than the critical value table. This research used the ADF stationarity test for testing the unit root to determine the level of each variable used. To complete the testing, stationarity using *Augmented Dickey Fuller* unit root test was also carried out using *Philips Peron*. This is because the occurrence of a structural break in the economy before the independence of Bank Indonesia, in 1997:3 to 1998:3. If the economy was experiencing a structural break, the stationarity test results using Philip Peron is better. Here is a summary of the results of the stationary tests using ADF and Philip Peron.

Table 3
Testing stationarity Augmented Dickey Fuller (ADF Test) and Philip Peron (PP Test)

Sample period	Variable	t-statistic ADF test	Adj. t-stat PP test	Comments
Full sample (1990:1-2009:4)	Inflation	-5.095**	-3.125*	Stationary
	Output gap	-3.787**	-3.790**	Stationary
	Expectation *Output gap*	-3.895**	-3.942**	Stationary
	Conditional Variance Output gap	*-6.516***	*-6.702***	*Stationary*
Before Independence Bank Indonesia (1991:1-1999:4)	Inflation	-3.526*	-3.497*	Stationary
	Output gap	-2.382*	-2.401*	Stationary
	Expectation *Output gap*	-2.544**	-2.541**	Stationary
	Conditional Variance Output gap	*-4.432***	*-4.475***	*Stationary*
AfterIndependence Bank Indonesia (2000:1-2009:4)	Inflation	-3.771**	-3.066*	Stationary
	Output gap	-2.873**	-2.591*	Stationary
	Expectation *Output gap*	-4.253*	-4.444**	Stationary
	Conditional Variance Output gap	*-6.65***	*-6.691***	*Stationary*

** and * indicates significance level of rejection of the null hypothesis that the data contain a unit root at 1% confidence level and 5%

Both testing methods gave the same conclusion, that all series are integrated on the same level, where all the variables were used in the stationary level. So testing that requires time series data must be stationary were met.

4.4. Empirical Tests

Estimation Results

Empirical tests were performed using the reduced form (50). But because of the occurrence of a structural break in the Indonesian economy caused by the 1997 economic crisis, the crisis dummy variable was added to the reduced form for the test period of the overall sample (full sample) and the period before the independence of Bank Indonesia. The value of the dummy variable is 1at the time of crisis,and 0 at the time of no crisis. Thus the specification of the model used for testing the entire sample period (full sample) and the pre-independence period are as follows:

$$\pi_t = c + \alpha E_{t-1} y_t + \beta \sigma_{y,t}^2 + \delta dkrisis + \varepsilon_t \qquad (51)$$

As for the period after the independence of Bank Indonesia reduced model without the dummy form is as follows:

$$\pi_t = c + \alpha E_{t-1} y_t + \beta \sigma_{y,t}^2 + \varepsilon_t \tag{52}$$

To correct the problem of heteroscedasticity and autocorrelation in the error term, the *Newey-West estimator* was used to calculate the standard error of the covariance matrix (Greene, 2008).

Table 4
Empirical Testing Results

Period	Coefficient			
	C	α	β	Δ
Full Sample (1991:1-2009:4)	7.703** (0.941)	-1.660 (0.980)	0.010** (0.001)	29.372** (8.823)
Before Independence (1991:1-1999:4)	7.832** (1.494)	-2.228** (1.053)	0.004** (0.001)	33.004** (3.765)
After Independence (2000:1-2009:4)	7.766** (1.083)	1.785 (1.204)	0.064 (0.060)	-

Number in parentheses is the standard error
* And ** indicate significance at the 1% and 5%degree level of confidence

Time Inconsistency of Monetary Policy with Asymmetric Preferences

The test results showed that in the period before independence, Bank Indonesia faceda time inconsistency problem of monetary policy. This is evident from the significance of the coefficient β. The significant coefficient β indicates that the key parameter γ, which is the asymmetric preference parameter, was significantly different from zero. So it can be said that Bank Indonesia monetary policy preferences in the period before independence was asymmetric in nature to the output gap. Detection of the presence of an asymmetric preference parameter indicates that the monetary authority had a policy preference that was asymmetric in response to the economy in recession and boom. This means that Bank Indonesia gives weight and different treatment policies in response to current economic conditions during periods of contraction (negative output gap) and expansion (positive output gap).

The value $\beta > 0$ an asymmetric preference parameterwhich implies $\gamma < 0$ (because λ and $\theta > 0$). This condition means that Bank Indonesia in the period before independence was not indifferent between the negative output gap and a positive output gap. The negative output gap is relatively less favored than the positive output gap. So the monetary authority has an incentive to give greater weight to policy negative deviation of the value of potential output (the negative output gap) than when the economy is experiencing a positive deviation (positive output gap). Or in other words it can be said that Bank Indonesia is more focused on the output gap in a recession.

This is understandable, because when the economy contracted where the output gap is negative, and with reference to the central bank's loss functionin the context of linex, the central bank losses would increase exponentially. While when a boom occurs, there is a positive output gap, and the central bank loss function in the context of linex only increases linearly. Thus, the central bank has an incentive to focus on the output gap in a recession to stimulate economic growth in the short-term to minimize losses. This condition indicates that the monetary authorities have an asymmetry preference (i.e. the central bank has anasymmetric preference) to the output gap, by giving greater policy weight to the negative output gap than the positive output gap. But this action is very inflationary, because monetary policy in the long-run is not believed to affect economic growth. As a result, the output remains at initial levels, while inflation continues to go higher.

This condition is very relevant to the portrait before the independence of monetary policy. Where in this period, according to the *Law No. 13 Year 1968* on the central bank, Bank Indonesia has diverse goals (multiple objectives), namely: first, organize, preserve, and maintain the stability of the rupiah, and secondly, encourage smooth production and development to expand employment opportunities in order to improve the living standard of the people. Achievement of these objectives are not always consistent and often overlap. With these dual goals, Bank Indonesia monetary policy preferences are asymmetry of the output gap, because in addition to preserving price stability, Bank Indonesia also acts as an agent of development, which is obliged to provide employment. So when the economy slows, Bank Indonesia has the incentive to add additional policies to stimulate employment and output, thereby potentially compromising the goal of price stability. With the policy adjustments made by the monetary authorities in response to the prevailing economy, Bank Indonesia's monetary policy is seen as discretionary and time inconsistent.

These findings corroborate previous research conducted by Budiyanti (2009) who found that in the period before the crisis (1990-1997) Bank Indonesia faceda time inconsistency problem in the short-term and long-term. The results are also consistent with Goeltom (2005) which stated that Bank Indonesia monetary policy period 1990-2003 still faced time inconsistency problems, as seen from the monetary policies that are sometimes too tight and sometimes too loose.

Turning to the sub-sample after the independence of Bank Indonesia, the time inconsistency problem of monetary policy in this period was no longer detectable, as seen from the value of the β coefficient which was not statistically significant. The insignificant Coefficient β implied that the asymmetric preference parameter (γ) is equal to zero. This means that Bank Indonesia monetary policy preferences were symmetric to both the output gaps (positive and negative). In other words it can be said that Bank Indonesia was indifferent toboth a positive output gap and a negative output gap. Symmetric preferences with respect to the output gap reflects a consistent monetary policy and commitment in achieving low inflation, by reducing the element of discretion in responding to economic conditions (boom or recession). Thus, monetary policy in the period after the independence of Bank Indonesia wasseen to be symmetric and consistent with the goal of achieving low inflation.

Thisfinding is thought to be very relevant to the status of the independence of Bank Indonesia. The independence of Bank Indonesia was marked by the birth of a law expressing requirement for monetary policy to focus on achieving the goal of price stability as a sole objective, regardless of the intervention of other parties. With a policy preference that has symmetry in this period,it was also shown that there was improved performance using a monetary policy framework for inflation targeting. Thus monetary policy preferences that aresymmetric and focuses on low inflation can reduce accommodative elementsor avoid the temporal inconsistency problem. This finding is consistent with Rogoff (1985) which stated that in order to overcome the problem of time inconsistency, the monetary policy should be delegated to an independent conservative central bank. A conservative central bank is a central bank that prefers low inflation (*inflation averse*).

As has been mentioned before, time inconsistency is closely related to the credibility of monetary policy (Goeltom, 2005). The more consistent monetary policy, the more credible the policy is in the perception of economic agents. The results of empirical testing found that after a period of monetary policy independence is time consistent, in fact, also this was also followed by increased credibility of monetary policy by Bank Indonesia. Harmanta (2009) reported that the credibility of monetary policy of Bank Indonesia increased after the implementation of the ITF, although not fully credible (*imperfect credibility*). This is understandable given the full implementation of the ITF was relatively short.

Effect of Output Gap for Inflation

The test results showed that the effect of the output gap on inflation was significantly negative in the period before independence. That is, the wider the output gap, the lower the inflation; whereas the smaller the gap between actual and potential output, the higher the inflation. In the context of monetary policy and time inconsistent preferences, with asymmetric monetary policy, the monetary authority gave greater weight to the policy of the negative output gap. This shows that when the deviation from potential output is negative, it will be responded to by an expansionary monetary policy to push output back to potential or at least to minimize the negative gap. Of course, this expansionary policy will push the inflation rate higher. As a result, the central bank's asymmetric preference would lead to growing pressure of the negative output gap in the rapid inflation.

The test results also indicated that the effect of the output gap on inflation is non-linear. This reflects the *Philips curve* is not linear in in case of Indonesia in accordance with Solikin (2004). Strong evidence of the existence of non-linearity of the *Phillips curve* is also found in the research by Laxton et al. (1995), Clark et al. (1996), Debelle and Laxton (1997), and Fisher et al. (1997). Solikin (2004) reported that the non-linearity is partly due to the limited capacity (capacity constraints) reflected in the more powerful influence of excess demand shocks (excess demand) for inducing inflationary shocks of the excess supply (excess supply) in efforts to reduce inflation.

Meanwhile, in the period after the independence of Bank Indonesia, the effect of the output gap on inflation was not seen again, which is explained by coefficient α thatwas not statistically significant. This is presumably due to the reduction in monetary policy preferences towards output stabilization (λ) within the framework of inflation targeting. This condition explains that monetary policy with commitment may result in an inflation rate will be independent of the pressure of the output gap. These findings indicate a change of behavior in Indonesia's *Philips curve* according to Solikin (2004). Solikin (2004) found that the presence and behavior of the *Philips curve* would change from time to time, in line with changes in the structure of economic fundamentals. In particular, Solikin'sstudy reported that the formation pattern of expectations and linearity in the *Phillips curve* experiencedasignificantdifference (change) between periods before and after the crisis.

Coefficient α and β were not significant which reflects the Indonesia Central Bank as an increasingly conservative (hawkish) central bank. The level of conservatism of the central bank according to Rogoff (1985) can be explained by the parameters λ and γ. A conservative central bank is characterized by a reduction in monetary policy preferences on output stabilization (where λ becomes smaller and smaller) and a symmetry of the monetary policy preferences (γ the lower).

Inflation

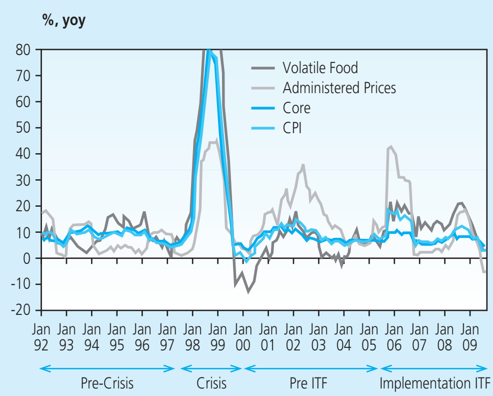
The test results showed that the achievement of inflation on average in the period after independence was lower than the average inflation period before independence. Where there are no other influencing factors, the inflation rate period before independence was 7.77%, which is lower than the pre-independence period at 7.83%. But the level of the inflation was not very encouraging, as there was only a very small decrease. This reflects the slow pace of the decline in inflation in Indonesia. Several previous studies have also reported a similar case, where the decline in inflation towards the target announced by the monetary authorities was assessed as sluggish. Harmanta (2009) reported slow progress in Indonesia in inflation caused by monetary policy that was not fully credible (imperfect credibility). The low credibility of monetary policy to encourage people form expectations of higher inflation that exceeds the actual inflation target announced by the monetary authorities. Table 5 shows that the value of public inflation expectations are always higher than the announced targets, except in 2003 and 2007 in which inflation expectations were lower than the target.

Table 5
Target, Expectations and Actual Inflation (CPI)

Year	Target CPI	Expectation CPI	Actual CPI
2000	6.00	10.61	9.35
2001	7.25	14.29	12.55
2002	9.50	12.12	10.03
2003	9.00	8.04	5.06
2004	5.50	7.38	6.40
2005	6.00	9.75	17.10
2006	8.00	9.20	6.60
2007	6.00	7.47	6.60
2008	5.00	7.75	11.06
2009	4.00	4.90	2.78

Source: Harmanta, Bathaluddin, andWaluyo (2010)

Inflation measured by the CPI was formed by three components, namely inflation (core inflation), administered prices and volatile foods. Figure 2 illustrates the decomposition of inflation on in Indonesia for the period of pre-crisis, crisis period, pre ITF and ITF full implementation period.



Source : Harmanta, Bathaluddin, and Waluyo (2010)

Figure 2
Decomposition of Inflation in Indonesia

The graph shows that the inflationary component of administered prices and volatile food tends to fluctuate more than core inflation. Core inflation is relatively more stable and showed a slight tendency to decline in the period after the independence of Bank Indonesia (pre-ITF and ITF implementation) when compared with the previous period. Of the three components, core inflation can only be controlled by monetary policy, while administered price is the price of some strategic commodities regulated by the government, such as the price of fuel, electricity, and LPG among others. Meanwhile, inflationary pressure from volatile food is determined more flexibility on the supply side, and is particularly vulnerable to natural phenomena such as climate change, crop failure, and natural disasters.

Table 6
Disaggregation of Inflation in Indonesia

Period	CPI	Core Inflation	*Volatile Food*	*Adminis-tered Price*
Pre-Crisis (1992:1-1997:12)	8.08	8.50	9.13	6.91
Pre ITF (2000:1-2005:6)	7.94	7.69	4.47	14.96
Post ITF (2005:7-2009:8)	9.75	7.41	14.18	13.33
Total (excl. Crisis)	8.47	7.93	8.84	11.44

Source : Harmanta, Bathaluddin, and Waluyo (2010)

Table 6 provides an overview that is not much different from Figure 2. Inflation in the period after independence (pre-ITF and post-ITF) is dominated by inflation that cannot be controlled by monetary policy (administered prices and volatile foods). The magnitude of the effect of administered prices and volatile foods on the inflation target achievement for the period after the independence of Bank Indonesia sawsignificant inflation for this period. This was likely contributed by (i) the plan to reduce subsidies and the price adjustment of strategic commodities (fuel, electricity, LPG, etc.) to market mechanism and (ii) the frequent disruptions in supply and distribution of basic commodities (rice, sugar, wheat, chilli, cement, spices, etc.). As for the inflation that can be controlled by monetary policy (core inflation) adecreasing trend was evident as compared to the period before independence (pre-crisis). This showed that a good performance of monetary policy in the period after the independence of Bank Indonesia, and commitmentto the sole purpose of achieving price stability.

V. CONCLUSION

This study provides some conclusions, firstly, asymmetric preference parameters were detectedfor the Bank Indonesia monetary policy period before their independence which indicates a time inconsistency problem of monetary policy preferences that are asymmetrical to the output gap. Whereas in the period after independence, monetary policy was time consistent with symmetry in monetary policy preferences. Second, the time inconsistent monetary policy in the period before independence caused large negative output gap pressure on inflation, while monetary policy after independence was consistently able to remove the effect of the output gap on inflation. Third, the consistent application of ITF in the period after independence was able to direct and achieve a lower rate of inflation, although the decline seemed slow and not as expected.

The three above conclusionshave several implications: first, the need for Bank Indonesia to increase consistency. In connection with the empirical facts that have been presented, the effectiveness of the achievement of the ultimate objective of monetary policy for the sole objective of price stability will depend on the extent of Bank Indonesia's commitment to avoid temporal inconsistency trouble in pursuing the development of low and stable inflation. Monetary policy should be done more consistently with clear rules and that reduces the accommodative element (discretion). Monetary policy was consistent with the ITF has proven to be able to reduce inflation, although inflation target was satisfactorily achieved. To further enhance public confidence in the reputation of Bank Indonesia, Bank Indonesia needs to further improve the consistency of monetary policy committed to the sole purpose of achieving price stability. The second implication is the need to improve coordination. Given that not all components of inflation can be influenced by monetary policy (administered prices and volatile food), it is necessary to coordinate monetary policy consistent with other government policies to reduce inflationary pressure from administered prices and supply constraints. Therefore, coordination established between the government and Bank Indonesia needs to be improved in order to achieve the goal of price stability. In addition to minimizing the amount of inflationary pressures stemming from increases in administered prices and volatile foods, policy coordination is essential for strengthening synergies in the management of the overall economy. The third implication is the need to improve communication. Management of inflation expectations are very important in the framework of the new monetary policy (inflation targeting framework), given the magnitude of the effect of inflation expectations as a factor causing inflation. Because the dominant formation pattern of public expectations of inflation are still backward looking, more transparent monetary policy is needed to reduce the information asymmetry between Bank Indonesia and the economic agents. Bank Indonesia needs to improve the communication of monetary policy, in order to direct the public expectations to be more anticipatory (forward looking) as required by an inflation targeting framework. The main objective of strengthening the communication strategy is to gradually help lower inflation expectations that lead to the achieving inflation targetsthat have been set.

REFERENCE

Alamsyah, Halim, 2008, *Persistensi Inflasi and Dampaknya terhadap Pilihan and Respon Kebijakan Moneter di Indonesia*. Disertasi. FEUI.

Bank Indonesia. *Laporan Tahunan* (Beberapa Periode).

Barro. RJ and Gordon D., 1983, Rules, Discretion and Reputation in a Model of monetary Policy. *NBER Working Paper*.

Bofinger, Peter., 2001, *Monetary Policy: Goals, Institution, Strategies and Instrument.* Oxford University Press.

Budiyanti, Eka. 2009, *Time Inconsistency dalam Kebijakan Moneter Kasus Indonesia: Sebelum and Sesudah Krisis*. Tesis. FEUI.

Cukierman, Alex, 2000, *The Inflation Bias Result Revisited.* Tel-Aviv University.

Goeltom, Miranda S, 2005, Perspectives of Time Consistency and Credibility in Monetary Policy: The Case of Indonesia. Paper for Bank Indonesia International Conference on Marrying Time Consistence in Monetary Policy with Financial Stability. Dalam *Essay in Macroeconomic Policy: The Indonesian Experience*. Gramedia Pustaka Utama. Jakarta

Gredig, Fabián, 2007, Asymmetric Monetary Policy Rules and The Achievement of The Inflation Target: The Case of Chile. *Gerencia De Investigación Económica*, Banco Central De Chile.

Greene, William H., 2008, *Econometric Analysis.* 6th Edition. Pearson International Edition. Pearson Education.

Harmanta, M. Barik Bathaluddin, and Jati Waluyo, 2010, *Inflation Targeting under Imperfect Credibility based on ARIMBI (Aggregate Rational Inflation – Targeting Model for Bank Indonesia); Lessons from Indonesian Experience.* Economic Research Bureau Bank Indonesia.

Harmanta, 2009, *Kredibilitas Kebijakan Moneter and Dampaknya Terhadap Persistensi Inflasi and Strategi Disinflasi di Indonesia: Dengan Model DSGE*. Disertasi. FEUI.

Ikeda, Taro, 2009, *The Time-Varying Preference of Monetary Policy in The Euro Area: Evaluation with An Asymmetric Loss Function.* Graduate School of Economics, Kobe University. Kobe. Japan.

Ireland, Peter N., 1998, Does The Time-Consistency Problem Explain The Behavior of Infation in The United States? *Working Paper in Economic*. Economics Department Boston College.

Kim, Sokwon and Seo, Byeongseon, 2007, Nonlinear Monetary Policy Reaction with Asymmetric Central Bank Preferences: Some Evidence for Korea. *Hitotsubashi Journal of Economics* 49 (2008). Hitotsubashi University.

Kydland, F and Prescott E., 1977, Rules Rather Than Discretion: The Inconsistency of Optimal Plans*. Journal of Political Economy.*

Mc Callum, 1997, Crucial Issues Concerning Central Bank Independence*, Journal of Monetary Economics.*

Nachrowi, D.N, and Usman, Hardius, 2006, *Pendekatan Populer and Praktis Ekonometrika Untuk Analisis Ekonomi and Keuangan.* Lembaga Penerbit Fakultas Ekonomi Universitas Indonesia.

Ozlale, Umit and Ozkan Kivilcim M., 2003, Does The Time Inconsistency Problem Apply for Turkish Monetary Policy*? Discussion Paper, Turkish Economic Association.*

Revenna F., 2005, *Inflation Targeting with Limited Policy Credibility*. University of California-Santa Cruz April.

Rogoff, Kenneth, 1985, The Optimal degree of Commitment to an Intermediate Monetary Target. *The Quarterly Journal of Economics.*

Ruge-Murcia, Fransisco J., 2002, Does The Barro Gordon Model Explain The Behavior of The US Inflation? A Reexamination of The Empirical Evidence*. Journal of Monetary Economics* 50 (2003). Elsevier.

Sachida, Adolfo. Divino, Jose A and Cajueiro, Daniel O., 2005, Inflation, Unemployment, and The Time Inconsistency of The US Monetary Policy*. Working Paper Series Department of Economics and Finance*, The University of Texas Pan American No.09/2007.

Solikin, 2005, *Fluktuasi Makroekonomi and Kebijakan Moneter yang (Sub)Optimal: Studi Kasus di Indonesia*. Disertasi. FEUI.

___________, 2004, Kurva Philips and Perubahan Struktural di Indonesia: Keberadaan, Linearitas, and Pembentukan Ekspektasi. *Buletin Ekonomi Moneter and Perbankan (Maret).* Bank Indonesia.

Solikin and I Sugema, 2004, Rigiditas Harga Upah and Implikasinya pada Kebijakan Moneter di Indonesia. *Buletin Ekonomi Moneter and Perbankan* Vol. 7 No. 2.

Tambakis, Demosthenes N., 2004, *Inflation Bias With A Convex Short-Run Phillips Curve and No Time-Inconsistency.* Pembroke College. Cambridge.

Tjahjono, Endy Dwi, Munandar H, and Waluyo J., 2010, Revisiting Estimasi Potential Output and Output Gap Indonesia: Pendekatan Fungsi Produksi berbasis Model. *Working Paper Bank Indonesia. WP/02/2010.*

Walsh, Carl E., 2000, *Monetary Policy and Theory*. MIT Press.

Warjiyo, Perry and Solikin, 2004, Kebijakan Moneter, dalam *Bank Indonesia Bank Sentral Republik Indonesia: Sebuah Pengantar*. Editor: Perry Warjiyo, Pusat Pendidikan and Studi Kebanksentralan. Bank Indonesia.

Warjiyo, Perry, 2011 and 2005, *Modul Kuliah Ekonomi Moneter and Perbankan.* Program Pascasarjana Ilmu Ekonomi. FEUI.

Yanuarti, Tri , 2007, Persistensi Inflasi di Indonesia. *Working Paper Bank Indonesia.*

____________ , 2007, Has Inflation Persistence in Indonesia Changed?. *Working Paper, Bank Indonesia.*

This page is intentionally left blank