Nonlinear Policy Rules, Dual Mandate Monetary Policy and Expectational Consistency

Carlos Eduardo Iwai Drumond[1]
Cleiton Silva de Jesus[2]
João Basílio Pereima Neto[3]

Abstract

The main objective of this paper is to build a macroeconomic model that takes into account a non-linearity in the interest rate rule. We assume that the monetary authority considers, to determine the rate of interest, the interaction between the actual inflation and the capacity utilization, so that the sensitivity of the interest rule to the inflation gap varies in accordance with the business cycle. The macroeconomic policy framework proposed in this work enables the monetary authority to give as much weight to inflation as to the product without losing sight of the expected anchor role of the inflation target.

Keywords: post-Keynesian dynamics, non-linear interest rate, expectational consistency.

1. Introduction

The inflation targets (IT) regime has become the monetary policy norm in a number of central banks around the world since 1990. There are currently about 35 countries which adopt this monetary regime (Schmidt-Hebbel and Carrasco, 2016), and there are many empirical studies that evaluate the macroeconomic performance of countries who followed this policy framework (Ball and Sheridan, 2003; Gonçalves and Salles, 2008; de Mendonça and Souza, 2012).

Even with the advancements in conventional macroeconomic literature over the last two decades in terms of the construction of theoretical models that explicitly consider the IT regime (for example, Clarida, Gali and Gertler, 1999), the post-Keynesian literature only began to consider the IT framework in formal models recently, in particular through the seminal works of Setterfield (2006) and of Lima and Setterfield (2008). In fact, in its original form, the inflation target regime derives from a set of hypotheses that are apparently incompatible to post-Keynesian tradition, especially when it comes to the emphasis given to low-inflation in detriment of concerns related to the level of output. According to Setterfield (2006), this apparent

[1] Associate Professor in the Department of Economics at State University of Santa Cruz (UESC), Brazil.
e-mail: ceidrumond@uesc.br
[2] Associate Professor in the Department of Economics at State University of Feira de Santana (UEFS), Brazil.
[3] Associate Professor in the Department of Economics at Federal University of Paraná (UFPR), Brazil.

mismatch, between the regime and the typical Keynesian concerns, could be overcome provided that: (**i**) the output is considered properly as primordial part of the goals of monetary policy; (**ii**) the distributive conflict component of inflation is not neglected and; (**iii**) the role of aggregate demand is considered to determine the real output.

Based on the works of Setterfield (2006) and Lima and Setterfield (2008), some other works began to incorporate the possibility of an inflation target regime under a fundamentally post-Keynesian framework, with different modeling strategies. A common feature in this literature, both for closed and open economies, lies in the assumption of linearity in the monetary policy rule, as can be seen in the dynamic models developed by Porcile, Souza and Viana (2011), Santos (2011), Drumond and Porcile (2012), and by Drumond and Jesus (2016).

When considering a linear monetary policy rule, it is implicitly assumed that its coefficients are constant. If this is the case, the monetary authority's concern with inflation, for example, is always the same, regardless of whether the economy is in expansion or contraction. Reflecting on this issue, Blinder (1997, p. 6) has recognized that academic macroeconomists tend to use "quadratic loss functions for reasons of mathematical convenience" (which culminates in a linear monetary policy rule) "without full consideration as to their substantive implications". In addition, empirical studies with data from different countries have proposed that cases in which central banks have asymmetric preferences are not infrequent (Martin and Milas, 2004; Dolado et al., 2005; Surico, 2007; Cukierman and Muscatelli, 2008). Considering the above, it seems unreasoned not to assume that the parameters of a monetary policy rule time-varying, so that, for example, they will depend on the phase of the economic cycle that the economy is in.

Additionally, another substantive issue arises when the IT regime is designed under a post-Keynesian framework. The concomitant focus on inflation and on the output can only be fully consistent in the presence of certain policies that will complement the monetary policy, as is the case of the income policy in the model developed by Lima and Setterfield (2008). It turns out that, as this article will try to demonstrate further ahead, in the absence of the natural output hypothesis, as well as in the absence of complementary policies to the monetary policy, a typical interest rule with dual mandate cannot guarantee the convergence of inflation to its target.

Taking the above observations into account, the main objective of this article is to build a post Keynesian macroeconomic model that takes non-linearity in the interest rule into account. We have considered that the closer (distant) the economy to its full level of capacity utilization, the more (less) sensitive the monetary authority will be to deviations of the inflation in relation to the targets. This dependence of the inflation parameter (in the interest rate rule) on the level of economic activity is a clear distinction between the model developed here and those available in the post-Keynesian literature.

In terms of the macroeconomic policy, the main contribution of the present work is to present a monetary policy rule, which allows the monetary authority to put as much weight on inflation as on the output without losing sight of the role of the expected anchor inflation target when conditioned by institutional constraints, especially regarding incomes policy. No less important is the fact that the model should be built without imposing the *ad hoc* convergence of inflation to its target, and without imposing some limiting form of expectational behavior, such as the hypothesis of rational expectations.

In addition to this introduction, this article is organized in three sections. In the second section, we present a brief literature review, and in the third section we develop a post-Keynesian standard model as the starting point for our analysis. Finally, the fourth section is dedicated to the analysis of the model in the context of the non-linear interest rate rule. The article ends with the conclusions.

2. Literature Review and Motivation

The main ingredients of Post-Keynesians models that take the IT regime into account are as follows: (**i**) the role of aggregate demand is central to determine the macroeconomic equilibrium; (**ii**) the market for goods operates below full employment (there is excess capacity in the economy); (**iii**) the Phillips curve is derived from a wage-bargaining process; (**iv**) the monetary authority handles the interest rate to achieve specific macroeconomic objective(s) (money supply is endogenous); (**v**) there is no natural interest rate; and (**vi**) expectational inflation matters in determining the current level of inflation. In addition, considerations of political of income[4], open economy and

[4] Setterfield (2007, p. 129) defines income policies as either "formal and/or informal institutions that frame and mediate aggregate wage and price setting behavior in such a way as to reduce conflict over

fiscal policy have also been incorporated into post-Keynesians macro models without too much difficulty.

In the models built by Setterfield (2006), Lima and Setterfield (2008) and Santos (2011), the compatibility between IT and a post-Keynesian macroeconomics scheme is possible because there is an important role for the incomes policy, which makes it feasible for political authorities to place so much emphasis on the level of activity and inflation and, at the same time, ensure the stability of the economic system. According to Setterfield (2006, p. 665), one of the peculiarities of their extended post-Keynesian model lies in the fact that this structural model "involves policy making that explicitly recognizes the importance of aggregate demand conditions for real economic activity and the 'conflicting claims' basis of the inflation process".

In fact, one of the main results of the model by Lima and Setterfield (2008) is that when the more orthodox is the mix of policies, the more adverse are the consequences for macroeconomic stability and the viability of the IT regime in a post-Keynesian economy. The model developed by Santos (2011) in turn, which is an extension to the model of Lima and Setterfield (2008), suggests that for the dynamic equilibrium in a post-Keynesian economy to be stable, "the incomes policy should at least react to the inflation gap, while the monetary policy should at least react to the output gap" (Santos 2011, p. 316). As shown by Carvalho (2015, p. 127), although many followers of Keynes – including certain Keynesians of the neoclassical synthesis such as Tobin (1985) – have recognized that the incomes policy can be a supplementary stabilization policy, it is not clear whether Keynes would propose income policies permanently. In practice, most of the experiments with an incomes policy in the post-war period were based on control or on the monitoring of wages. However, it is known that a barrier to the permanent implementation of incomes policies in modern capitalist economies is the institutional framework of wage-bargaining in each country. Differences in the process of wage moderation and trade-union bargaining can derail the implementation of incomes policies to mediate the distributive conflict and fight inflation, from a political point of view. The greater the country (and its workforce) and the more fragmented its society (and unions), the less possible the incomes policy becomes.

---

income shares and better reconcile conflicting income claims". It is in this sense that the idea of incomes policies has been considered in the present article.

In this sense, an alternative to the use of the incomes policy as a tool to combat inflation in a post-Keynesian environment is to consider a linear interest rule or IROP (Interest Rate Operating Procedure) that takes both inflation and the output/employment into account. The models of Porcile, Souza and Viana (2011), Drumond and Porcile (2012) and Drumond and Jesus (2016) have been constructed based on this perspective. In these works, when considering a set of fundamentally post-Keynesian hypotheses for a small open economy, the authors are able to show that depending on the arrangement of the macroeconomic policy under consideration, the dynamic equilibrium derived for the model is stable, even without consideration to any kind of incomes policies. On the other hand, as will be demonstrated further below, despite generating a stable dynamic equilibrium, a linear interest rule generates an important expectational inconsistency by failing to ensure the convergence of inflation to its target.

In the following section, we will seek to describe a standard model that will serve as a basis for the subsequent exercises proposed in this work.

3. A standard post-Keynesian model

The equilibrium in the goods market and the IS curve

In this section, we will attempt to construct a standard post-Keynesian model considering the existence of excess capacity in the economy. Consider the following aggregate demand for a closed economy:

$$Y = C + F + I \qquad (1)$$

In which Y represents the aggregate output/demand, C represents the aggregate consumption, F represents the government spending and I represents the aggregate investment. The aggregate consumption is written as a linear function of income, so that $C = cY$, with $0 < c < 1$. For purposes of simplicity and in view of the objectives of this work, differences between the marginal propensity to consume has been disregarded both for capitalists and workers.

The following is finally obtained after normalizing the aggregate demand in terms of capital stock:

$$uv = cuv + f + g \qquad (2)$$

With $u = \frac{Y}{\bar{Y}}$ representing the rate of capacity utilization, $\bar{Y}$ representing the product of full employment, *v* stands for the inverse of the capital-product relationship, considered to be constant, *c* represents the marginal propensity to consume, f represent the government spending as a proportion of capital stock and *g* represents investment as a proportion of capital stock.

Investment as a proportion of capital stock, in turn, can be described as a positive function of the rate of capacity utilization and as a negative function of the real interest rate:

$$\frac{I}{K} = g = g_0 + \delta_1 u - \delta_2 r \qquad (3)$$

With g_0 representing a positive parameter that seeks to represent the "animal spirit" of entrepreneurs, *r* standing for the real interest rate and δ_1 and δ_2 as positive parameters. The correct specification of the investment function leads to controversy in post-Keynesian/Kaleckian literature, considering that different closings for the models can be obtained from different investment functions, as can be seen in Setterfield (2017) and Hein, Lavoie and van Treeck (2011). In this article, we disregard the possible influence that a rate of capacity considered normal by the capitalists could exert on their decision to invest. The use of the interest rate on the investment function, in turn, requires, in similar manner as for Setterfield (2009) and Rochon and Setterfield (2006), the indirect incorporation of the impact of interest on the net profit rate earned by the capitalists.

When considering the equilibrium in the market for goods and replacing equation (2) in equation (3), it is possible to obtain the following *IS* curve normalized in relation to capital stock:

$$u = \frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1} \qquad (4)$$

Based on the Keynesian condition for equilibrium $v(1-c) > \delta_1$, the *IS* curve is negatively inclined in the plan rate of capacity utilization versus the real interest rate: a positive (negative) variation in the real interest rate, everything else constant, will decrease (increase) the level of capacity utilization.

Inflation, distributive conflict and Phillips curve

Considering an environment of imperfect competition in which companies have monopoly power, the Phillips curve for this type of economy is built from the distributive conflict between workers and capitalists, in line with the tradition started by Rowthorn (1977). In this economy with imperfect competition, variations in the price level are equal to the sum of the nominal wage variation, variation of the mark-up of the companies and labor productivity. Whereas, for simplicity purposes, when considering mark-up and labor productivity as constants, inflation can be fully explained by variations in nominal wages, which are described as a function of the gap between the wage share in the workers' desired income and the effective wage share on income determined by the market power of the companies. In addition, workers also take the expected inflation rate into account, in order to preserve his current income's purchasing power. Based on these assumptions, we obtain the following Phillips curve:

$$\pi = \pi^e + \emptyset(w^d - w^f) \quad (5)$$

Where π represent the effective inflation rate, π^e represent the expected inflation rate and w^d and w^f , respectively, represent the wage share on the income desired by workers and the wage share on income as determined by the capitalists, where $\emptyset$ is a strictly positive parameter. The bargaining power of workers is modeled as a function of the rate of capacity utilization, so that $w^d = \alpha u$, with α as a positive parameter. This suggests that, as the economy approaches the full use of its capacity utilization, workers acquire more bargaining power and can generate pressure for higher wages. Rewriting the equation (5):

$$\pi = \pi^e + \emptyset(\alpha u - w^f) \quad (6)$$

It is worth noting that the equilibrium in the wage-bargaining process – equality between the share on income desired by the workers and the effective wage share on income – implies that there is expectational consistency, with current inflation equal to the level of inflation expected by the workers. However, this is not a derived hypothesis, which imposes no predetermined expectational model, and is fully compatible with heuristic behaviors of agents in an attempt to anticipate inflation.

4. Dual mandate monetary policy and expectational consistency

In light of the existence of a negative relationship between the rate of unemployment and the capacity utilization, the interest rate rule is written as a function of the inflation and the rate of capacity utilization. In a first moment, the attempt is to build a typical linear interest rule that takes both inflation and the rate of capacity utilization into account. As explained further below, when embedded in a post-Keynesian model, this kind of rule generates expectational inconsistencies that must be circumvented.

Expectational consistency and interest rate rule

Consider a dynamic interest rule in which the actual interest rate variation over time, $\dot{r} = \frac{dr}{dt}$, is a linear function of the gap between the current inflation and the inflation target, as well as the difference between the rate capacity utilization and its desired level by the political authorities.

$$\dot{r} = \gamma(\pi - \pi^T) + \beta(u - u^T) \qquad (7)$$

With γ e β as positive parameters, to the extent that inflation is higher/lower than the current inflation target π^T, the real interest rates will rise/fall. On the other hand, the real interest also responds to the gap between the rate of capacity utilization and its target, u^T, that is pre-established by the political authorities. This interest rule can be modified considering monetary policy schemes that are exclusively focused on inflation (if $\beta = 0$) or exclusively concerned with the output (if $\gamma = 0$).

Once the interest rule has been defined, it is important to consider the expectational convergence process. In the present work, an expectational dynamic identical to that presented by Tobin and Buiter (1976), and Turnovsky (1995) has been taken as reference, in which the forecast errors are continually reviewed by the agents in a learning process.

$$\dot{\pi^e} = k(\pi - \pi^e) \qquad (8)$$

Equation (8) describes the expectational dynamics for inflation as a response to the deviation of the current inflation from the expected inflation, with $k>0$ as a parameter that measures inflation memory. One of the advantages to using this equation is that it does not require the imposition of some *ex-ante* expectational anchor process

such as, for example, imposing that inflation necessarily converges toward a predetermined goal.

Equations (7) and (8) form a two-dimensional linear dynamic model that can be analyzed when combining the Phillips curve, the *IS* curve, the interest rate rule and the expectational dynamics. After some algebraic manipulation, the interest rates dynamics and the expected inflation can be described as follows:

$$\dot{r} = \gamma\left[\pi^e + \emptyset\left(\alpha\left(\frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1}\right) - w^f\right) - \pi^T\right] + \beta\left[\left(\frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1}\right) - u^T\right] \quad (9)$$

$$\dot{\pi^e} = k\emptyset\left(\alpha\left(\frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1}\right) - w^f\right) \quad (10)$$

From then on, it is possible to evaluate the dynamic properties of the model taking the Jacobian matrix of the system formed by equations (9) and (10) into account.

$$J = \begin{bmatrix} \frac{\partial \dot{r}}{\partial r} & \frac{\partial \dot{r}}{\partial \pi^e} \\ \frac{\partial \dot{\pi^e}}{\partial r} & \frac{\partial \dot{\pi^e}}{\partial \pi^e} \end{bmatrix} \quad (11)$$

It is easy to notice that matrix (11) has the following elements:

$$\frac{\partial \dot{r}}{\partial r} = \frac{-\delta_2(\emptyset\gamma\alpha + \beta)}{v(1-c) - \delta_1} < 0 \quad (12)$$

$$\frac{\partial \dot{r}}{\partial \pi^e} = \gamma > 0 \quad (13)$$

$$\frac{\partial \dot{\pi^e}}{\partial r} = \frac{-k\emptyset\alpha\delta_2}{v(1-c) - \delta_1} < 0 \quad (14)$$

$$\frac{\partial \dot{\pi^e}}{\partial \pi^e} = 0 \quad (15)$$

Since *J* has negative trace and positive determinant, it can be concluded that the dynamical system formed by equations (9) and (10) converges to a stationary state that is a stable equilibrium point.

$$Det(J) = \frac{k\emptyset\alpha\delta_2\gamma}{v(1-c) - \delta_1} > 0 \quad (16)$$

$$Tr(J) = \frac{-\delta_2(\emptyset\gamma\alpha + \beta)}{v(1-c) - \delta_1} < 0 \quad (17)$$

The expected inflation converges toward the effective inflation in the stationary state, provided that when $\dot{\pi^e} = 0$, then $\pi = \pi^e$. This necessarily implies that the wage share on income as desired by workers converges toward the effective wage share on income. On the other hand, the model generates an inconsistency of monetary policy, since there is no guarantee that the expected inflation and effective inflation converge toward the inflation target as determined by the monetary authority.

Consider equation (9) in the stationary state with $\pi = \pi^e$:

$$0 = \gamma\left[\pi + \emptyset\left(\alpha\left(\frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1}\right) - w^f\right) - \pi^T\right] + \beta\left[\left(\frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1}\right) - u^T\right] \quad (18)$$

Equation (10) leads to $\left(\alpha\left(\frac{g_0+f-\delta_2 r}{v(1-c)-\delta_1}\right) - w^f\right) = 0$ in the stationary state. Therefore, equation (18) can be rewritten as follows:

$$\gamma[\pi - \pi^T] = \beta\left[u^T - \left(\frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1}\right)\right] \quad (19)$$

Based on equation (19), it is possible to realize that for given values of γ and β, **and** only in the case in which the government can achieve the target for the rate of capacity utilization, inflation will converge toward the inflation target (and *vice versa*). However, there is no endogenous mechanism in the model that guarantees the long-term equality between u and u^Tor between π and π^T, so that achieving the two goals simultaneously is something completely random. In case of open economies, similar results are found in the models developed by Drumond and Porcile (2012) and Drumond and Jesus (2016).

The inconsistency between inflation target and current inflation is certainly a problem for the operation of monetary policies over time. Given this inconsistency, it is possible to consider two opposing alternatives in terms of monetary policy, namely a monetary regime exclusively focused on inflation (by setting β = 0), and a monetary regime exclusively focused on the use of capacity utilization (by setting $\gamma = 0$).

In fact, in the case of a monetary regime exclusively focused on inflation, the system is stable and the economy converges to a steady state wherein not only the current inflation equals the expected inflation, it also equals the inflation target. The determinant of the Jacobian matrix remains as shown in equation (16) while the line

equals to $\frac{-\delta_2(\emptyset\gamma\alpha)}{v(1-c)-\delta_1} < 0$. In the case of a monetary regime exclusively focused on the use of installed capacity ($\gamma = 0$), on the other hand, the model generates a dynamic indetermination that cannot be considered as stability, so that the determinant of matrix *J* becomes null. Jesus and Correia (2016) have develop a macroeconomic model with an active fiscal policy and arrived at the same conclusion when assuming that the movements of the interest rate within a closed economy depend solely on the output gap.

5. Non-linear interest rate rule

The main objective of this paper is to propose an alternative monetary policy rule, which on the one hand becomes a viable monetary regime of dual mandate and, on the other hand, circumvents the aforementioned inconsistency problem in monetary policies. Instead of proposing an explicit target for the rate of capacity utilization, in this work we propose an interest rule in which the monetary authority's sensitivity to deviations in inflation is endogenous and responds to changes in the rate of capacity utilization. On the one hand, the closer to one is the rate of capacity utilization, more sensitive the monetary authority will be to deviations of inflation from the target. On the other hand, the closer to zero, less sensitive the monetary authority will be regards to the inflation. This non-linear interest rule is described by the equations below:

$$\dot{r} = \gamma(\pi - \pi^T) \quad (20)$$

$$\gamma = \beta u \quad (21)$$

$$\dot{r} = (\beta u)(\pi - \pi^T), \quad \beta > 0 \quad (22)$$

There are no explicit goals for the capacity utilization in the interest rule equation (22), however, the monetary policy reacts non-linearly to the inflation gap, so that the product of full employment $\bar{Y}$ is implicitly considered as a target. In other words, the reaction of the monetary policy to the inflation gap in relation to the inflation target will only be maximum when the output gap ($lnY - ln\bar{Y}$) is null.

Solving the model with this new interest rule results in the following two-dimensional dynamical system:

$$\dot{r} = \left(\beta\left(\frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1}\right)\right)\left[\pi^e + \emptyset\left(\alpha\left(\frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1}\right) - w^f\right) - \pi^T\right] \quad (23)$$

$$\dot{\pi^e} = k\emptyset\left(\alpha\left(\frac{g_0 + f - \delta_2 r}{v(1-c) - \delta_1}\right) - w^f\right) \qquad (24)$$

The pair of equations (23) and (24) form a nonlinear dynamical system whose stability should be evaluated by taking the partial derivatives of the equations in their respective stationary points:

$$J = \begin{bmatrix} \left(\frac{\partial \dot{r}}{\partial r}\right)_{(r^*,\pi^{e*})} & \left(\frac{\partial \dot{r}}{\partial \pi^e}\right)_{(r^*,\pi^{e*})} \\ \left(\frac{\partial \dot{\pi^e}}{\partial r}\right)_{(r^*,\pi^{e*})} & \left(\frac{\partial \dot{\pi^e}}{\partial \pi^e}\right)_{(r^*,\pi^{e*})} \end{bmatrix} \qquad (25)$$

Evaluating the partial derivatives in stationary points:

$$\left(\frac{\partial \dot{r}}{\partial r}\right)_{(r^*,\pi^{e*})} = -\left[\frac{\beta\delta_2}{(1-c) - \delta_1}\right]\left(\pi^e + \emptyset\left(\alpha\frac{g_0 + f - \delta_2 r^*}{v(1-c) - \delta_1} - w^f\right) - \pi^T\right) + \beta\left(\frac{g_0 + f - \delta_2 r^*}{v(1-c) - \delta_1}\right)\left(\frac{-\emptyset\alpha\delta_2}{v(1-c) - \delta_1}\right) \qquad (26)$$

With $\left(\pi^e + \emptyset\left(\alpha\frac{g_0+f-\delta_2 r^*}{v(1-c)-\delta_1} - w^f\right) - \pi^T\right) = 0$ we have:

$$\left(\frac{\partial \dot{r}}{\partial r}\right)_{(r^*,\pi^{e*})} = -\beta\left(\frac{g_0 + f - \delta_2 r^*}{v(1-c) - \delta_1}\right)\left(\frac{\emptyset\alpha\delta_2}{v(1-c) - \delta_1}\right) \qquad (27)$$

$$\left(\frac{\partial \dot{r}}{\partial \pi^e}\right)_{(r^*,\pi^{e*})} = \beta\left(\frac{g_0 + f - \delta_2 r^*}{v(1-c) - \delta_1}\right) \qquad (28)$$

$$\left(\frac{\partial \dot{\pi}^e}{\partial r}\right)_{(r^*,\pi^{e*})} = \frac{-k\emptyset\alpha\delta_2}{v(1-c) - \delta_1} \qquad (29)$$

$$\left(\frac{\partial \dot{\pi}^e}{\partial \pi^e}\right)_{(r^*,\pi^{e*})} = 0 \qquad (30)$$

It is important to note that $\frac{g_0+f-\delta_2 r^*}{v(1-c)-\delta_1} = u^*$, wherein u^* is the rate for the rate of capacity utilization of the economy in stationary state. Because the use of capacity utilization is always a positive number, the derivative in (27) is negative and the derivative in (28) is positive.

The trace in the Jacobian matrix for this version of the model is the same as equation (27) and assumes a negative number, while the determinant of the matrix is positive, as described below:

$$Det(J) = \beta\left(\frac{g_0+f-\delta_2 r^*}{v(1-c)-\delta_1}\right)\frac{k\emptyset\alpha\delta_2}{v(1-c)-\delta_1} > 0 \qquad (31)$$

The result of the model implies that the economy converges to a stable stationary state in which the inflation target is achieved in a way that there are no intertemporal inconsistencies in the monetary policy. There is also expectational coherence, in a way that the effective inflation converges toward the expected inflation, which in turn converges toward the target set by the monetary authority.

The proposition of a nonlinear monetary rule suggests the possibility to incorporate a concern about the rate of capacity utilization in the process of implementation of the monetary policy, however without the need to incorporate incomes policies in the model. This result does not invalidate the efforts of alternative formulations for monetary policies that combine inflation targets and incomes policies, as in the works of Setterfield (2006), Lima and Setterfield (2008) and Santos (2011). Nevertheless, we believe that the model developed in this paper contributes to post-Keynesian literature with an alternative option for monetary policies in macrodynamic models for closed economies, especially because the monetary policy rule considered here is not of difficult implementation in modern capitalist economies.

6. Conclusions

Based on the works of Setterfield (2006) and Lima and Setterfield (2008), a series of studies went on to consider the possibility of making the regime of inflation targets with the post-Keynesian assumptions about the functioning of modern economies. One of the solutions in this attempt to reconcile is the use of incomes policies in addition to monetary policy.

In the present work, we argue that in the absence of institutional feasibility of using incomes policies, it is important to assess an alternative form of policy. One option is the use of monetary policies with dual mandate interest rule, which consider

both the output gap and the inflation gap in comparison to a target. We analyze the characteristics of the model in the context of this dual mandate interest rule and show that even though it converges to a stable stationary state, this rule implies an expectational inconsistency in the long run. As demonstrated in this work, in the absence of the natural output, as well as in the absence of complementary policies to the monetary policy, a typical double mandate interest rule cannot guarantee the convergence of inflation to its target.

Having affirmed that, we propose a non-linear interest rule in which the sensitivity of the monetary policy to the inflation gap is sensitive to the rate of capacity utilization. In this new formulation, the closer (further) the economy to the full use of capacity utilization, the more (less) sensitive the monetary authority will be to deviations of inflation to the target. We show that a monetary policy rule of this type is not only difficult to implement in the real world, it meets the conditions for stability in a macrodynamic post-Keynesian model, so that inflation converges to the long-term inflation target even when the monetary authority is concerned about smoothing out the business cycle.

In terms of macroeconomic policies, the main contribution of this paper is to offer a monetary policy rule conditioned by institutional constraints, especially regarding incomes policies, allowing the monetary authority to consider both inflation and the unemployment/output without losing sight of the role **of the expectational inflation target anchor.** New researches can be carried out considering other non-linearities in the monetary policy rule, or even in the Phillips curve. Notwithstanding, a natural extension of this work is to verify that the dynamic properties of the model remain valid in the case of an open economy or when considering the active role of fiscal policy with a budget constraint to the public sector.

References

Blinder, A., (1997). Distinguished lecture on economics and government: what central bankers could learn from academics and vice versa. Journal of Economic Perspective 11, 3–19.

Carvalho, F. C. Liquidity Preference and Monetary Economies, Routledge, 2015.

Clarida, R., Gali, J. & Gertler, M. (1999) The science of monetary policy: a New Keynesian perspective, *Journal of Economic Literature*, 37, pp. 1661– 1707.

Cukierman, N; Muscatelli, A. Nonlinear Taylor rules and asymmetric preferences in Central Banking: evidence from the United Kingdom and the United States. *The B.E. Journal of Macroeconomics,* v. 8, n. 1, 2008.

Dolado, et al. Are monetary-policy reaction functions asymmetric? The role of nonlinearity in the Phillips curve. *European Economic Review*, v. 49, n. 2, 2005.

Drumond, C. E.; Porcile. G. (2012) Inflation target in a developing economy: policy rules, growth and stability, *Journal of Post Keynesian Economics*, Vol. 35(1), 137-162.

Drumond, C. E.; Jesus, C. S. (2016) Monetary and fiscal policy interactions in a post-Keynesian open-economy model, *Journal of Post Keynesian Economics* (…).

Hein, E.; Lavoie, M.; Treeck, T. (2011). Some instability puzzles in Kaleckian models of growth and distribution: a critical survey, *Cambridge Journal of Economics*, Oxford University Press, vol. 35(3), p. 587-612.

Jesus, C, S; Correia, F. M. (2016) Active fiscal policy and macroeconomic stability. *Journal of Economic Studies*, Vol. 43 Iss 5 pp. 749 – 762.

Lima, G. T.; Setterfield, M. (2008) Inflation targeting and macroeconomic stability in a Post Keynesian economy, *Journal of Post Keynesian Economics*, vol 30(3), p. 435-461.

Martin, C., Milas, C., (2004). Modelling monetary policy: inflation targeting in practice. Economica 71, 209–221.

Rochon, L.P.; Setterfield, M. (2007) Interest Rates, Income Distribution and Monetary Policy Dominance: Post-Keynesians and the 'fair rate' of interest, *Journal of Post Keynesian Economics*, Fall, 30 (1), pp. 13-41.

Porcile, G., Souza, A.; Viana, R. (2011) External debt sustainability and policy rules in a small globalized economy, *Structural Change and Economic Dynamics*, 22, pp. 269–276.

Rowthorn, R. (1977) Conflict, inflation and money, *Cambridge Journal of Economics*, 1, pp. 215-239.

Santos, A. L. M. (2011) Inflation targeting in a Post Keynesian economy, *Journal of Post Keynesian Economics* 34(2): 295-318.

Setterfield, M. (2006) Is Inflation Targeting Compatible with Post Keynesian Economics? *Journal of Post Keynesian Economics*, 28, 653-71.

_____. The Rise, Decline and Rise of Incomes Policies in the U.S. During the Post-War Era: An Institutional-Analytical Explanation of Inflation and the Functional Distribution of Income. Journal of Institutional Economics, 2007, 3 (2), 127–146.

_____. (2009) Fiscal and monetary policy interactions: lessons for revising the EU Stability and Growth Pact, Journal of Post Keynesian Economics, vol 31(4), p. 623-643.

_____. (2017) Long-run variation in capacity utilization in the presence of a fixed normal rate. Working Papers 1704, New School for Social Research, Department of Economics.

Schmidt-Hebbel, K.; Carrasco, K. (2016). The Past and Future of Inflation Targeting: Implications for Emerging-Market and Developing Economies, p. 583-622. In Chetan Ghate and Kenneth M. Kletzer (org) Monetary Policy in India: A Modern Macroeconomic Perspective, Springer.

Surico, P. The Fed's monetary policy rule and U.S. inflation: The case of asymmetric preferences. *Journal of Economic Dynamics and Control*, v. 31, n. 1, 2007.

Tobin, J.; Buiter, W. H.. Long run effects of fiscal and monetary policy on aggregate demand, In: *Monetarism*, J. L. Stein, ed., North Holand, Amsterdan, 273-309, 1976.

Tobin, J. Theoretical issues in macroeconomics. In: FEIWEL, G. (ed.), Issues in contemporary macroeconomics and distribution. Londres: MacMillan, 1985

Turnovsky, S.J. *Methods of Macroeconomic Dynamics.* Cambridge: MIT Press, 1995