Nominal Income Targeting vs Strict Inflation Targeting: A Comparison.

By

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Abstract:

This paper shows that the instability of nominal income targeting in a simple backward-looking macro model disappears if the policymaker chooses to adopt a hybrid nominal income target. This form of nominal income targeting is compared to a strict inflation target so as to establish the conditions under which the former strategy is preferable to the latter. We derive a U-shaped policy frontier which divides the parameter space into two areas: one where hybrid nominal income targeting is preferred to strict inflation targeting and the other where strict inflation targeting is preferred to hybrid nominal income targeting. For most coefficient estimates reported in the literature hybrid nominal income targeting is likely to dominate strict inflation targeting as a strategy of monetary policy.

We also trace out a policy frontier for the two strategies of monetary policy using a forward-looking specification as our baseline model. This policy frontier is not U-shaped; instead it implies a monotonic trade-off between the relevant parameters. In this model the strict inflation target becomes more attractive relative to the hybrid nominal income target as the Phillips Curve parameter increases in size.

A strict inflation target is more likely to dominate a nominal income growth *rate* target than a hybrid nominal income target for certain values of the Phillips Curve parameter.

JEL Classification: E5

I. Introduction

Over the past 10 years, the focus of monetary policy has changed quite dramatically in a number of countries.[1] In choosing among the available nominal target variables for monetary policy, policymakers in these countries have opted for formal inflation targets. The narrow focus of monetary policy on inflation may at first seem puzzling. After all, one would expect the policymaker to choose a target variable that is broadly consistent with the preferences of the public. Concern over real objectives such as full-employment should indeed lead central banks to adopt a nominal spending variable such as nominal GDP as the target of monetary policy. Yet inflation targeting has found wide appeal. Proponents of inflation targeting attribute the appeal of inflation targeting to the basic realization that monetary policy actions have no ultimate real effects on the economy. Hence monetary policy should focus on the variable that it affects most – inflation. Increased transparency in the conduct of monetary policy, greater accountability by policymakers for poor performance, and relative ease of communication with the public about the goals of monetary policy are often mentioned as additional benefits of a strategy of monetary policy centered on inflation targeting.

In the academic literature several recent contributions discuss the merits of a number of different rule-based or target-based strategies of monetary policy.[2] Taylor (1993, 1994) designs a rule whereby the central bank adjusts the real interest rate in response to deviations in the rate of inflation and the level of real output from their targeted levels. Svensson (1997 a) finds that it is optimal for a central bank to target the forecast of the inflation rate if price stability is the sole goal of monetary policy. Ball (1997) analyzes several different strategies of monetary policy in a simple stochastic macro model. Both strict inflation targeting and nominal income targeting are among the strategies examined. McCallum (1997 b) addresses the issue of whether nominal income targeting is a sensible strategy of monetary policy. In Ball (1997) and McCallum (1997 b) the policymaker, explicitly or implicitly, faces a loss function that includes the variance of inflation and output, respectively.

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[1] Inflation has been designated to be the criterion shaping monetary policy action in New Zealand, Canada, the United Kingdom, Sweden, Australia, Finland, and other countries.

[2] Friedman and Kuttner (1996) and Bernanke and Mishkin (1997) voice their doubts about the effectiveness of strict rule-based monetary policy strategies.

The two models proposed by Ball and McCallum reach strikingly different conclusions on the merits of targeting nominal income. Ball finds nominal income targeting to be a disastrous strategy of monetary policy. Challenging the negative assessment of nominal income targeting, McCallum argues that Ball's findings are a direct result of the specification of the Phillips curve relation.

This paper shows that the alleged instability of nominal income targeting in the backward-looking model disappears if the policymaker chooses to adopt a hybrid nominal income target. This particular form of nominal income targeting requires the monetary authority to target the sum of the rate of inflation and the deviation of real output from capacity. As the hybrid form of nominal income targeting is a viable strategy of monetary policy, we go on to examine the conditions under which a hybrid nominal income targeting strategy is preferable to a strict inflation target. We derive a policy frontier that divides the parameter space (weight on variance of inflation in loss function; sensitivity of inflation to excess demand) into two areas: one where strict inflation targeting is preferred to hybrid nominal income targeting and one where hybrid nominal income targeting is preferred to strict inflation targeting.

Next we examine the case where the backward-looking Phillips curve and IS curve are replaced by their forward-looking counterparts and proceed to trace out a policy frontier based on the strict inflation target and the hybrid nominal income target. Finally, using the forward-looking model as our baseline model, we compare and contrast the merits of strict inflation targeting to a strategy of nominal income growth targeting.

In each of the three comparisons the parameter measuring the response of inflation to deviations of real output from capacity is of critical importance. Drawing on reported parameter estimates for the United States, we attempt to estimate the weight the policymaker has to place on the variance of inflation in the loss function so that he prefers strict inflation targeting to nominal income targeting. The results for the backward- and forward-looking model indicate that in the United States a hybrid nominal income target would be preferred to a strict inflation target for most plausible values of the critical response parameter as long as the weight on inflation variability relative to real output variability in the monetary authorities' loss function is not excessively high. A strict inflation target would become relatively more attractive if the alternative policy

strategy were a nominal income growth target and the forward-looking model served as the baseline model.

The remainder of the paper proceeds as follows. Section II compares and contrasts the backward- and forward-looking models. In Section III we derive the variances of inflation and real output under hybrid nominal income targeting and strict inflation targeting in the context of a backward-looking aggregate model. In addition, we discuss the policy implications of adopting either rule and then derive the policy frontier. Section IV analyzes the two strategies of monetary policy based on a forward-looking aggregate model. In Section V we revisit the issue of nominal income targeting in terms of growth rates. Section VI concludes.

II. The Strategy of Nominal Income Targeting: A Comparison of Two Simple Models.

The model introduced by Ball (1997) consists of backward-looking IS and Phillips curve relations:

$$y_t = \lambda y_{t-1} - \beta r_{t-1} + \varepsilon_t \qquad (1)$$

$$\pi_t = \pi_{t-1} + \alpha\, y_{t-1} + \eta_t \qquad (2)$$

where y is the deviation of real output from capacity

r is the real rate of interest

π is the rate of inflation

Both ε and η are white noise disturbances and $\alpha>0$, $\beta>0$, $0<\lambda<1$.

Using the above model, Ball makes the following three points. First, the simple Taylor rules currently in practice in a number of different countries are inefficient. The inefficiency arises as the estimated coefficient on real output in the Taylor rule reported for these countries is below the range prescribed by the model.[3] Second, both strict and flexible inflation targeting are efficient strategies of monetary policy. Finally, nominal income targeting whether expressed in level or growth rate form is a disastrous strategy

[3] The coefficients on real output and inflation in the Taylor rule derived by Ball depend on the parameters that appear in the IS and the Phillips curve relation. The assumed values for λ, β, and α are .8, 1, and .4, respectively.

of monetary policy as it leads to instability in both the rate of inflation and the level of real output.

McCallum(1997 b) refutes the proposition that nominal income targeting is an unsound strategy of monetary policy. His model takes the following form:

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

$$\pi_t = E_t \pi_{t+1} + a y_t + u_t \qquad (2a)$$

This model is similar to Ball's but differs from it in two important respects. One alteration introduced by McCallum concerns the specification of the Phillips curve relation. The backward-looking Phillips curve employed by Ball is replaced by what McCallum calls a more plausible specification, one that includes expected future inflation. The attractiveness of a forward-looking Phillips curve derives primarily from theoretical considerations.[4] The other change relates to the control lag of monetary policy. In the original model proposed by Ball, a change in the rate of interest affects the level of output with a one period lag and the rate of inflation with a two period lag. In sharp contrast, McCallum employs specifications of the IS and the Phillips curve relation where a change in the interest rate in the current period affects both the level of real output and the rate of inflation in the same period. Put simply, McCallum does away with the control lags of monetary policy. The two changes introduced by McCallum have far-reaching implications: the instability in the rate of inflation and real output under nominal income targeting disappears.[5] It thus appears that McCallum's attempt at restoring the viability of nominal income targeting as a sensible strategy of monetary policy comes at the expense of sacrificing at least one attractive feature of Ball's model: the existence of control lags for monetary policy. But the property that real output responds to monetary

[4] The specification of the Phillips Curve proposed by McCallum (1997 b) is due to Roberts (1995) who shows that the forward-looking Phillips curve is consistent with well-known theoretical models. Another specification of the Phillips curve considered by McCallum is one where the current price level is entirely predetermined, the P-bar model. The P-bar model is an attractive alternative to the forward looking model as it satisfies the strict version of the natural rate hypothesis (McCallum (1994), pp. 259-61).

[5] McCallum also employs the expected level of real output ($E_t y_{t+1}$) instead of the lagged level of output in the IS relation. However, he argues that the instability result reported by Ball is a direct consequence of the specification of the Phillips curve.

policy before the rate of inflation changes imparts a more realistic flavor to Ball's model as it accords with both stylized facts.[6]

III. Policy Analysis Based on the Backward-Looking Phillips Curve

III.A. A Hybrid Nominal Income Target

Ball's examination of the merits of nominal income targeting considers the case where the policymaker targets the growth rate of nominal income and the case where the policymaker attempts to achieve a fixed level of nominal income. His analysis does not consider hybrid forms of nominal income targeting. Various forms of this strategy have been discussed in the literature.[7] A particularly appealing yet simple form of the hybrid strategy involves setting a target value for the sum of inflation and the level of real output measured relative to capacity output. If the relevant time interval is one year, then the target value is formed by adding the rate of inflation (measured as a percentage) to the percentage real output deviation. Let the target value by $z^* = E_{t-1}[y_t + \pi_t] = 0$. Combining the target with equations (1) and (2) yields the following time series processes for real output and the rate of inflation:

$$y_t = -\alpha y_{t-1} - \pi_{t-1} + \varepsilon_t \qquad (3)$$

$$\pi_t = \pi_{t-1} + \alpha\, y_{t-1} + \eta_t \qquad (4)$$

The variances of real output and the rate of inflation under the hybrid nominal income targeting strategy (NIT) are given by

$$V(y_t)^{NIT} = \frac{2\alpha\sigma^2_\varepsilon + \sigma^2_\eta}{\alpha(2-\alpha)} \qquad V(\pi_t)^{NIT} = \frac{\alpha^2\sigma^2_\varepsilon + \sigma^2_\eta(1+2\alpha-\alpha^2)}{\alpha(2-\alpha)} \qquad (5)$$

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[6] Empirical results favorable to the backward-looking Phillips curve specification have been reported by Gordon (1996) and Fuhrer (1996). Moreover, McCallum (1995) concedes that … "prices evidently react more slowly than output in response to monetary actions, …". It should be noted though that McCallum (1997 b) invokes the empirical results reported by Roberts (1995) to back up his preference for the forward-looking specification of the Phillips curve relation.

[7] See, for instance, Bryant, Hooper, and Mann (1993), Henderson and McKibbin (1993), Hall and Mankiw (1994), Bryant (1996), and McCallum (1997 a). The adoption of the hybrid form of nominal income targeting is predicated on knowing the level of capacity output. Under level or growth rate nominal income targeting no such knowledge is required.

Both variances are positive and hence well defined as long as $\alpha < 2$.[8] Thus the conclusion that nominal income targeting is a disastrous strategy for monetary policy does not apply in the case of a hybrid target.[9] An explanation for the apparent reversal of the instability result is warranted. In pursuing a hybrid target, the policymaker is no longer required to adhere to the constant marginal rate of substitution between the price level and real output imposed by the fixed nominal income target (or between inflation and real output growth in case of a nominal income growth target). But it is the strict adherence to maintaining a constant tradeoff between the price level (inflation) and real output (growth) that causes instability in the behavior of real output and inflation under nominal income (growth) targeting in Ball's model.[10,11] There is a further noteworthy result concerning the absence of symmetry in the effects of the disturbances. Under a hybrid nominal income target, the effects of demand side disturbances will fall disproportionately on real output. For $0 < \alpha < 2$ the coefficient of σ^2_ϵ is greater in the expression for $V(y_t)$ than in the expression for $V(\pi_t)$. In a similar vein, as long as $0 < \alpha < 2$ the effect of shocks to the Phillips curve relation will fall disproportionately on the rate of inflation. The coefficient on σ^2_η in the expression for the variance of inflation is always greater than its counterpart in the expression for the variance of real output.[12]

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[8] The parameter α is viewed as being structural.

[9] Svensson (1997 b) suggests a staggered form of nominal income growth to avoid instability. However, this staggered form has only limited applicability in practice as it focuses on the *current* rate of inflation and *lagged* output gap *growth.*

[10] For a detailed description of how a positive shock to inflation causes instability in the real output gap and the rate of inflation under a nominal income growth target see Svensson (1997 b). In essence, the positive shock to inflation, which causes the rate of inflation to ratchet up every period, requires offsetting declines in the output gap to keep the growth rate of nominal income in line with the target rate.

[11] Most analyses of the merits of nominal income targeting in a closed-economy framework emphasize its ability to insulate the economy from the effects of aggregate demand side disturbances (e.g. Bean (1983), West (1986), Asako and Wagner (1992), Frankel and Chinn (1995)). This insulating property does not carry over to the current framework – as evidenced by the presence of the variance of IS shocks in both the variance of real output and the variance of inflation.

[12] In fact the magnitude by which the two coefficients differ is always one. The finding that the effects of shocks on real output and inflation differ under a strategy of hybrid nominal income targeting stands in marked contrast to the symmetric results obtained under nominal income targeting in standard stochastic macro models (e.g. authors named

III.B. A Strict Inflation Target

If the policymaker pursues a strict inflation target then he sets the expected rate of inflation two periods into the future equal to zero.

$$E_t\pi_{t+2}=0$$

The existence of a control lag for monetary policy makes it impossible for the policymaker to affect the rate of inflation in the current or in the next period. Imposing the target value for the rate of inflation on the model (equations (1) and (2)) yields the following time series processes for real output and the rate of inflation.

$$y_t = -y_{t-1} - (1/\alpha)\pi_{t-1} + \varepsilon_t \qquad (6)$$

$$\pi_t = \pi_{t-1} + \alpha\, y_{t-1} + \eta_t \qquad (7)$$

The variances of real output and the rate of inflation under a strict inflation targeting regime (SIT) are given by

$$V(y_t)^{SIT} = 2\sigma^2_{\varepsilon} + \frac{\sigma^2_{\eta}}{\alpha^2} \qquad V(\pi_t)^{SIT} = \alpha^2\sigma^2_{\varepsilon}{}^2 + 2\sigma_{\eta}{}^2 \qquad (8)$$

Even in case of a strict inflation target the variance of inflation is strictly positive as a consequence of the inability of the policymaker to exercise immediate and complete control over the rate of inflation. The variance of real output is inversely related to the size of α while the variance of inflation varies positively with the size of α.

III.C. Ranking the Two Policy Rules and Policy Implications

In this section we attempt to evaluate the circumstances under which the policymaker would prefer a strict inflation target to a hybrid nominal income target.

We begin by comparing the variances of real output and the rate of inflation under both regimes. The variance of real output is lower under NIT relative to SIT only for $\alpha < 1$. The variance of inflation under SIT lies below the variance of inflation under NIT for all values of α. These results imply that the policymaker would always opt for a strict inflation target in case $\alpha > 1$. For $0 < \alpha < 1$ the policymaker decides on the appropriate

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in preceding footnote, and Froyen and Guender (1997)).

strategy on monetary policy by taking account of the emphasis placed on minimizing inflation variability relative to output variability.[13]

The policymaker faces an expected loss function consisting of the variances of real output deviations and the rate of inflation:

$$\Omega_t = V(y_t) + \mu V(\pi_t) \qquad (9)$$

μ indicates the fixed weight the policymaker places on the variability of inflation relative to the variability of real output. μ can take on any value between 0 and $\propto$.[14]

After inserting into the loss function the variance of real output and the rate of inflation under either strategy of monetary policy, we obtain the following two expressions:

$$\Omega_t^{NIT} = \frac{2\alpha\sigma^2_\varepsilon + \sigma^2_\eta}{\alpha(2-\alpha)} + \mu\left(\frac{\alpha^2\sigma^2_\varepsilon + \sigma^2_\eta(1+2\alpha-\alpha^2)}{\alpha(2-\alpha)}\right) \qquad (10)$$

$$\Omega_t^{SIT} = 2\sigma^2_\varepsilon + \frac{\sigma^2_\eta}{\alpha^2} + \mu(\alpha^2\sigma^2_\varepsilon{}^2 + 2\sigma_\eta{}^2) \qquad (11)$$

For $\alpha = 1$ the two loss functions are equal irrespective of the weight placed on μ. In this particular case both strategies are equally preferred. For $\alpha > 1$ a strict inflation target is always preferred to a nominal income target irrespective of the weight placed on μ. For $0 < \alpha < 1$ we can depict the tradeoff between α and μ by constructing a policy

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[13] In comparisons of alternative monetary policy strategies based on stochastic macro models involving rational expectations (e.g. Froyen and Guender (1997)), the parameters of the aggregate demand schedule play an important role in determining the superiority of one rule over another. This is not the case in the current model as β does not figure in the calculation of the variance of real output and inflation, respectively.

[14] Rogoff (1985) marks an early contribution to the debate on the "weight issue". The approach taken in the present paper suggests that the variance of real output enter the policymaker's expected loss function even under a strict inflation target. This stands in marked contrast to Ball (1997) and Svensson (1997 a) where a strict inflation target implies an infinitely large weight on the variance of the rate of inflation. The objective in the current paper, however, is to establish the size of the weight the policymaker has to place on inflation variability in the expected loss function for the strict inflation target to dominate the hybrid nominal income target. In practice, even if the overriding goal of monetary policy is control of inflation, in the *short-run* central banks have stabilization goals other than inflation such as full employment.

frontier. This policy frontier divides the admissible parameter space into separate regions where one strategy of monetary policy dominates the other. Representative values for α are gleaned from the literature and are arranged in Table 1. For a given value of α we trace out the policy frontier by choosing the appropriate value for μ so that the two loss functions are equal.[15] Figure 1 shows that the policy frontier is U-shaped and symmetric. Over the range $0 < \alpha < 1$ values of α close to 0 and 1 require high values of μ for the policymaker to be indifferent between hybrid nominal income targeting and strict inflation targeting. For less extreme values of α corresponding lower values of μ make the policymaker indifferent between pursuing either strategy. The indifference curve bottoms out at $\alpha = .5$ and $\mu = 8$. The policymaker chooses to pursue a strict inflation target if the combination of α and μ lies above the policy frontier. Conversely, a nominal income target is optimal if the combination of the two parameters lies below the frontier.

The values of μ that generate indifference on the part of the policymaker between targeting hybrid nominal income and inflation for estimated values of α taken from the literature appear in the fourth column of Table 1. The calculated values of μ range from a high value of 42.11 to a low value of 8.21. According to Figure 2 all values lie on the downward sloping and flat portion of the policy frontier. This is a direct result of all estimated values of α being less than .5.

These results point to the following policy implications. With all reported estimates of α being considerably lower than 1, the area to the right of the U-shaped policy frontier where a strict inflation target is unambiguously superior to a hybrid nominal income target ($\alpha > 1$) is of little practical relevance. As Figure 2 shows, four of the six empirical estimates of α lie between .3 and .42 and imply corresponding values of μ between 8.21 and 9.52. The policymaker would thus have to value inflation variability

[15] The variances of real output and inflation are divided by σ^2_ϵ so that either variance is only a function of $\sigma^2_\eta/\sigma^2_\epsilon$. The shape or location of the policy frontier is invariant to changes in $\sigma^2_\eta/\sigma^2_\epsilon$. More specifically, for a given α the value of μ that makes the two loss functions equal is independent of changes in $\sigma^2_\eta/\sigma^2_\epsilon$. Changes in the ratio of the variances of the disturbances merely cause equal changes in the numerical value of the loss function for both strategies. In addition, for $\sigma^2_\eta/\sigma^2_\epsilon \neq 1$ the coefficients on the variance of real output and the variance of the rate of inflation are not equal under hybrid nominal income targeting.

roughly 9 times more than real output variability for him to prefer a strict inflation regime to a hybrid nominal income target. Such strong emphasis on keeping inflation variability at bay is perhaps a bit unlikely in the United States.[16] For extremely low values of α such as the one reported by Hall and Mankiw, a strict inflation target can be safely ruled out.[17]

IV. Policy Analysis Based on the Forward-Looking Phillips Curve

In this section we again examine two strategies of monetary policy, one geared towards attaining an announced hybrid nominal income target and the other focusing solely on meeting a prespecified inflation target. However, we now adopt the model proposed by McCallum (1997 b). We replace the backward IS and Phillips curve relations with their forward-looking counterparts:

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

$$\pi_t = E_t \pi_{t+1} + a y_t + u_t \qquad (2a)$$

IV.A. A Hybrid Nominal Income Target

Following McCallum (1997 b), we specify the nominal income target in terms of current observable values. The hybrid nominal income target consists of the of the sum of the deviation of real output from capacity and inflation: $z^* = [y_t + \pi_t]$. Let $z^* = 0$ for simplicity.

Imposing this condition on the model consisting of equations (1a) and (2a) yields the following two equations for real output and the rate of inflation, respectively:

$$(1+a)y_t = - E_t \pi_{t+1} - u_t \qquad (12)$$

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[16] After all the Fed is bound by the guidelines of the Humphrey-Hawkins Act of 1978 which would tend to lower the weight the Fed can place on μ. However, a larger weight on inflation variability is more likely in countries like New Zealand where the overriding goal of monetary policy is to ensure price stability.

[17] At the same time it is not necessary for the policymaker to assign an infinitely large weight to the variance of the rate of inflation under strict inflation targeting for a strict inflation target to be preferable to a hybrid nominal income target. Rogoff (1985, p. 1187) also concludes that "society will not (in general) want the weight to be infinite."

$$\pi_t = E_t\pi_{t+1} + ay_t + u_t \qquad (13)$$

Two points are noteworthy. First, the hybrid nominal income target shields the economy from the effects of aggregate demand side disturbances as indicated by the absence of v_t from both equations. This result is in stark contrast to the model of section III which employs the backward-looking specification of the Phillips curve. The insulating property of the hybrid nominal income strategy exists in the current framework because there is no control lag, i.e. the policymaker can vary the instrument in a given period and affect both the level of real output and inflation contemporaneously. Second, we note the absence of any lagged variables such as y_{t-1}. Employing the method of undetermined coefficients, we pose the following putative solutions for y_t and π_t:

$$y_t = \tau_{11}u_t \qquad (14)$$

$$\pi_t = \tau_{21}u_t \qquad (15)$$

The solutions for the two undetermined coefficients are

$$\tau_{11} = -1/(1+a)$$

$$\tau_{21} = 1/(1+a)$$

Substituting the solutions back into the expressions for real output and the rate of inflation, we obtain

$$y_t = -\ 1/(1+a)\ u_t \qquad (16)$$

$$\pi_t = \ 1/(1 + a)\ u_t \qquad (17)$$

Notice the symmetric effect of the supply-side disturbance on real output and the rate of inflation, respectively. The variances of real output and the rate of inflation under a hybrid nominal income target are then given by

$$V(y_t)^{NIT} = (1/(1+a))^2\sigma^2_u \qquad V(\pi_t)^{NIT} = (1/(1+a))^2\ \sigma^2_u \qquad (18)$$

The variance of real output is identical to the variance of inflation under the hybrid nominal income targeting scheme. This result is very different from the finding obtained for the backward-looking model where the effect of supply shocks is borne disproportionately by the variance of inflation. Moreover, the variances of real output and inflation in the forward-looking model are inversely related to the size of the parameter a.

IV.B. A Strict Inflation Target

As the policymaker has the ability to affect real output and the rate of inflation contemporaneously, a strict inflation target would entail setting the current and the expected rate of inflation equal to zero:

$$\pi_t = E_t\pi_{t+1} = 0 \qquad (19)$$

Thus under a strict inflation targeting regime the variance of inflation reduces to zero. The strict inflation target implies further that real output observes the following process:

$$y_t = -(1/a)\, u_t \qquad (20)$$

The variance of real output is then given by

$$V(y_t)^{SIT} = \sigma^2_u / a^2 \qquad (21)$$

IV.C. Ranking the Two Policy Rules and Policy Implications

Several noteworthy results emerge from our examination of the two strategies of monetary policy in the context of the forward-looking model. First, the variability of inflation is zero under the strict inflation target and hence lower than under the hybrid nominal income target. Second, the variance of real output is always lower under the hybrid nominal income targeting strategy.

The third noteworthy result concerns the shape of the policy frontier of the forward-looking model depicted in Figure 3. Unlike the U-shaped policy frontier that emerged from the backward-looking model the current frontier involves a monotonic trade-off between a and ：. As a increases in size lower values of ： are required to maintain equality between hybrid nominal income targeting and strict inflation targeting as strategies of monetary policy. Initially, for low values of a, small increases in a are associated with large declines in ： as we move along the frontier. Increasingly smaller declines in ： are necessary to stay on the frontier as a continues to increase. The policymaker prefers strict inflation targeting (hybrid nominal income targeting) if combinations of a and ： lie above (below) the frontier. Finally, it should be noted that there is only one value of ： for a =1 where the two monetary policy strategies are equally preferred. This is in stark contrast to our previous finding in the context of the backward-

looking model where for $\alpha = 1$ the policymaker is indifferent between choosing a hybrid strategy of nominal income targeting or a strict inflation targeting irrespective of the value of :.

There is a clear and unambiguous policy implication. The greater the size of a the more attractive a strict inflation target becomes. Drawing on the empirical estimates for a reported by Roberts (1995), .249 and .337, we find that the policymaker will have to assign a weight of approximately 24.16 or 14.74 to the variance of inflation in order to remain indifferent between strict inflation targeting and hybrid nominal income targeting.[18] Should the parameter a increase in size to .75, then the weight on the variance of inflation would drop to 4.44. For the extremely large value of a = 3 the value of : drops to .78 in which case the weight on the variance of the rate of inflation lies below the weight placed on the variance of real output.

V. Nominal Income Growth Targeting vs a Strict Inflation Target in the Forward-Looking Model

In this section we first assess the implications of framing a monetary policy strategy aimed at reaching a nominal income growth *rate* target. Then we compare this strategy to the strict inflation targeting regime. Finally, we take a closer look at the implications of designing a strategy of monetary policy in terms of a nominal income growth rate target as opposed to a hybrid nominal income target in a setting where the alternative strategy is a strict inflation target. The forward-looking model is again our baseline model.

Specifying a nominal income growth target implies that the change in nominal income (Δx_t) is set equal to a constant value. For simplicity, let the constant be zero:

$$) x_t = B_t + y_t - y_{t-1} = 0 \qquad (22)$$

[18] The question of whether the parameter a (or α) can actually be interpreted as being structural arises. Roberts (1995, p. 982-83) argues that the […] "New Keynesian Phillips Curve is structurally stable despite the substantial difference in average inflation in the

Combining equation (22) with equations (1a) and (2a), we obtain again two expressions for real output and the rate of inflation:

$$(1+a)y_t = - E_t\pi_{t+1} - u_t + y_{t-1} \qquad (23)$$

$$\pi_t = E_t\pi_{t+1} + ay_t + u_t \qquad (24)$$

The variances of real output and the rate of inflation under the nominal income growth rate target are given by

$$V(y_t)^{NITG} = \frac{N_{11}^2 F_u^2}{N_{21}(2 - N_{21})} \qquad V(B_t)^{NITG} = \left[\frac{N_{21}^2}{N_{21}(2 - N_{21})} + (N_{11} + N_{21})^2 - N_{11} \right] F_u^2 \qquad (25)$$

where $N_{11} = \frac{2 + a - (a^2 + 4a)^{.5}}{2}$ $\qquad N_{21} = \frac{- a + (a^2 + 4a)^{.5}}{2}$

Recall that under a strict inflation target in the forward-looking model the policymaker can eliminate inflation. As a consequence, only the variance of real output deviations appears in the loss function.

$$V(y_t)^{SIT} = \sigma_u^2 / a^2$$

In Figure 4 the solid line traces out the policy frontier for the two monetary policy strategies. The two important features of the policy frontier depicted in Figure 3 carry over to the policy frontier shown in Figure 4. The policy frontier again involves a trade-off between a and μ and strict inflation targeting becomes a more attractive strategy of monetary policy as the size of a increases. Employing once more the empirical estimates of a reported by Roberts (1995), .249 and .337, we observe that a weight of 24.6 and 11.7, respectively, is required on the variance of inflation in the loss function for the policymaker to remain indifferent between strict inflation targeting and nominal income growth targeting.

The relative attractiveness of specifying a nominal income target in terms of a growth rate as opposed to the hybrid form is brought out by comparing the two policy frontiers of Figure 4. The broken line represents the policy frontier shown in Figure 3 which is based on a comparison of the hybrid nominal income target with the strict

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two parts of the sample (before and after 1973)."

inflation target. It appears that for very low values of the parameter a the growth rate specification of the nominal income targeting strategy does slightly better than the hybrid form in the direct comparison of nominal income targeting with strict inflation targeting. Conversely, the hybrid form of nominal income targeting is preferred to the growth rate targeting scheme for values of a lying above approximately .254.[19] For instance, for a=.249 the value of μ on the policy frontier under the nominal income growth rate target(24.6) is slightly greater than under the hybrid target(24.16) In contrast for a=.337 the associated value of μ under the nominal income growth target(11.7) is lower than under the hybrid target(14.74). Another example highlights the difference between the two strategies of nominal income targeting relative to strict inflation targeting. Consider the case where the policymaker places a weight of .78 on the variance of inflation in the loss function. Under the hybrid form of nominal income targeting the associated value of a on the policy frontier is 3 while under the growth rate targeting scheme the implied value is much lower, namely 1.

VI. Summary and Conclusion

This paper addresses the issue of whether nominal income targeting is a viable strategy of monetary policy in the simple backward-looking model suggested by Ball (1997). Our findings imply that a hybrid form of nominal income targeting, one where the policymaker aims at achieving a pre-specified target consisting of the sum of the output gap and the rate of inflation, does not lead to instability in the rate of inflation or real output evident in Ball's model. Under hybrid nominal income targeting both the variance of real output and the variance of the rate of inflation are finite even though monetary policy affects real output and the rate of inflation at different lags.

In this paper we also examine the circumstances under which the policymaker prefers some type of a nominal income target to a strict inflation target as the fulcrum of monetary policy. The merits of both strategies of monetary policy are evaluated in the context of the backward- and the forward-looking model.

A comparison of hybrid nominal income targeting to strict inflation targeting in

[19] The two policy frontiers intersect at a=.254 and μ=23.29.

the backward-looking model yields a U-shaped policy frontier. For most coefficient estimates reported in the literature hybrid nominal income targeting is likely to dominate strict inflation targeting as a strategy for monetary policy.

Carrying out a comparison of the two strategies of monetary policy in a forward-looking model of the type suggested by McCallum (1997 b), we trace out a very different policy frontier. The shape of the policy frontier now suggests a monotonic trade-off between the weight placed on the variance of inflation in the loss function and the parameter a in the Phillips curve. As the parameter a increases in size the strict inflation target becomes a more attractive strategy of monetary policy relative to the hybrid form of nominal income targeting.

Finally, we match a strategy of targeting the growth rate of nominal income against a strict inflation target in the forward-looking model. The shape of the policy frontier again suggests a monotonic tradeoff between the weight placed on the variance of inflation and the parameter in the Phillips curve. A strict inflation target is more likely to dominate this form of nominal income targeting than the hybrid form for given values of a which are approximately greater than .25.

In conclusion, while not establishing that different forms of nominal income targeting are superior to strict inflation targeting, this paper does rebut the argument that all forms of nominal income targeting are a disastrous strategy of monetary policy. We have seen that the relative attractiveness of either strategy depends on a number of factors, in particular on empirical estimates of the relevant parameters, and the specification of the baseline model. In view of these results further empirical work on the appropriate specification of the Phillips Curve seems warranted. After all only one of the two baseline models can be a fitting description of the actual economy.

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Table 1:

Parameter Estimates of α

Source	Sample Period	Estimated Value of α	Value of μ Required to Generate Indifference
Ball (1996)[a]	---------	.4	8.33
Hall and Mankiw (1994)[a]	---------	.05	42.11
Romer (1996)[b]	1952:1994	.37-.42	8.58 – 8.21
Gordon (1996)[c]	1955:2-1996:1	.3	9.52
Fuhrer (1995)[c]	1960:2-1993:4	.19	13

[a] Ball bases his choice for α on the sacrifice ratio reported in Ball (1994). Hall and Mankiw choose α so that it is consistent with the estimates of the output-inflation tradeoff reported in Ball, Mankiw, and Romer (1988).

[b] The equation estimated by Romer is based on the inclusion of the current deviation of output from capacity. Her results are based on annual data.

[c] Based on quarterly data. Gordon includes the current unemployment gap in his model while Fuhrer derives his empirical estimate by including the lagged unemployment gap. The unemployment gap is defined as the current unemployment rate minus the natural rate.

The respective value for α is obtained by multiplying the response of the rate of inflation to deviations of unemployment from the natural rate by -.5. This is the value of the parameter in the equation linking deviations of output from capacity to the deviation of the rate of unemployment from the natural rate of unemployment (Okun's Law) and is reported by Gordon (1996).

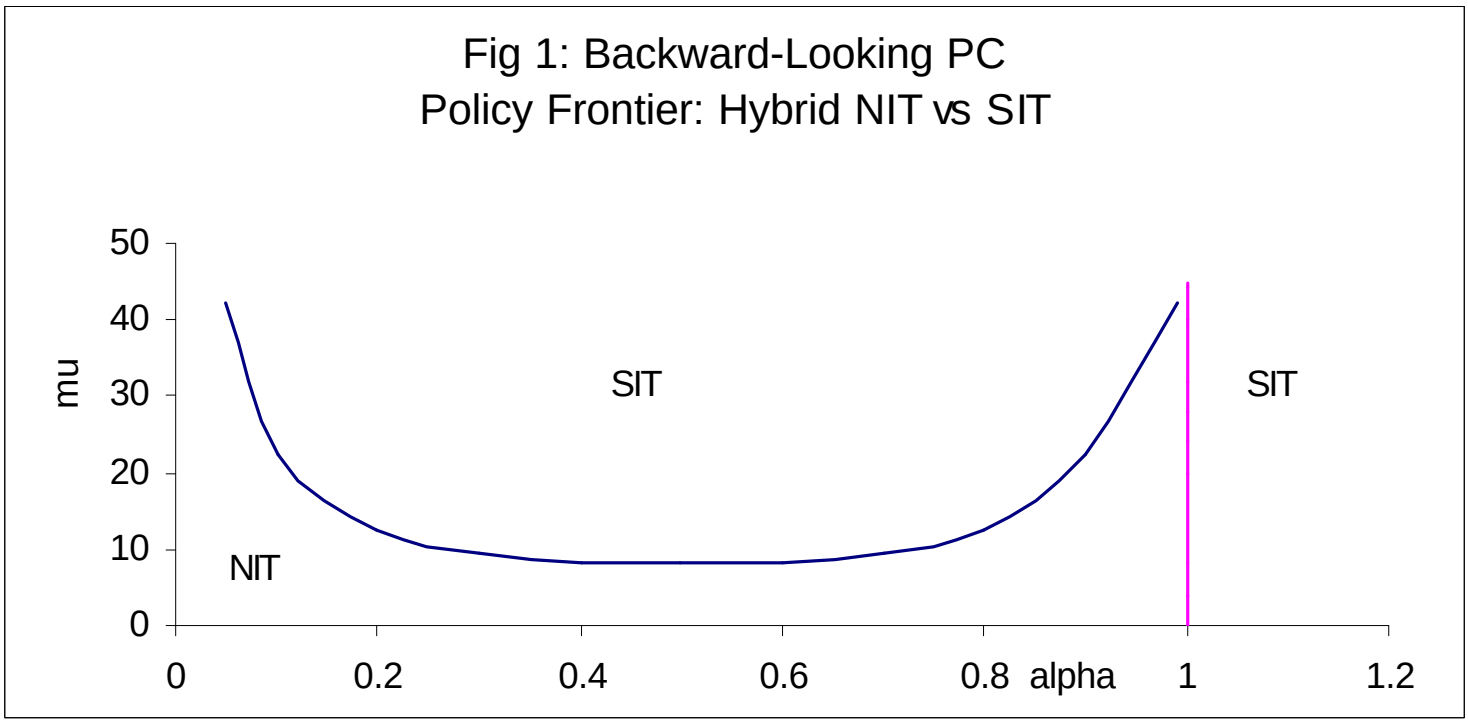
Fig 1: Backward-Looking PC
Policy Frontier: Hybrid NIT vs SIT
mu
50
40
30
20
10
0
NIT
SIT
SIT
0
0.2
0.4
0.6
0.8
alpha
1
1.2

Figure 2: The Relationship Between mu and the Empirical Values of alpha

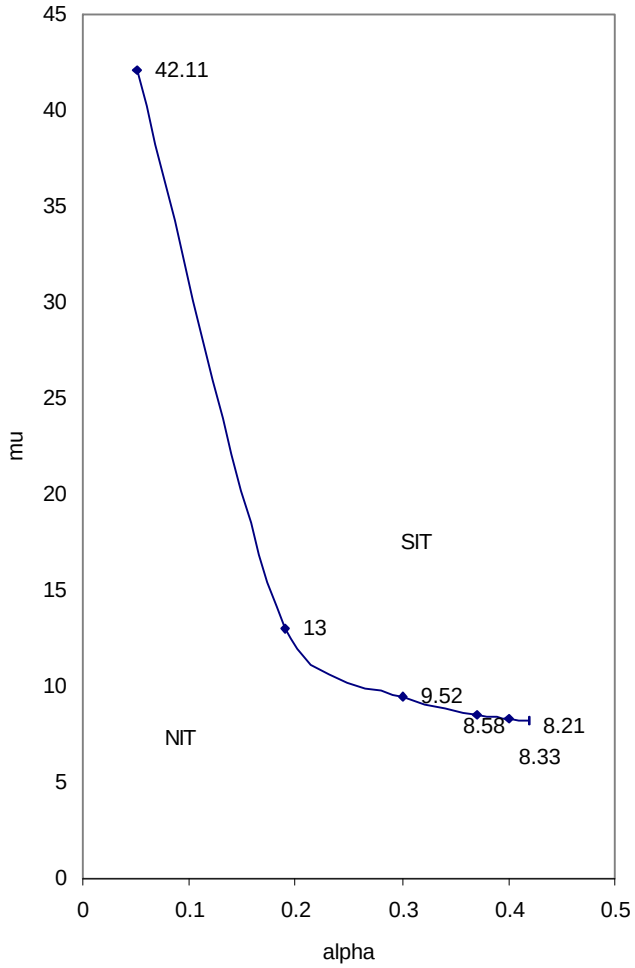

Fig. 3: Forward-Looking PC Policy Frontier: Hybrid NIT vs SIT

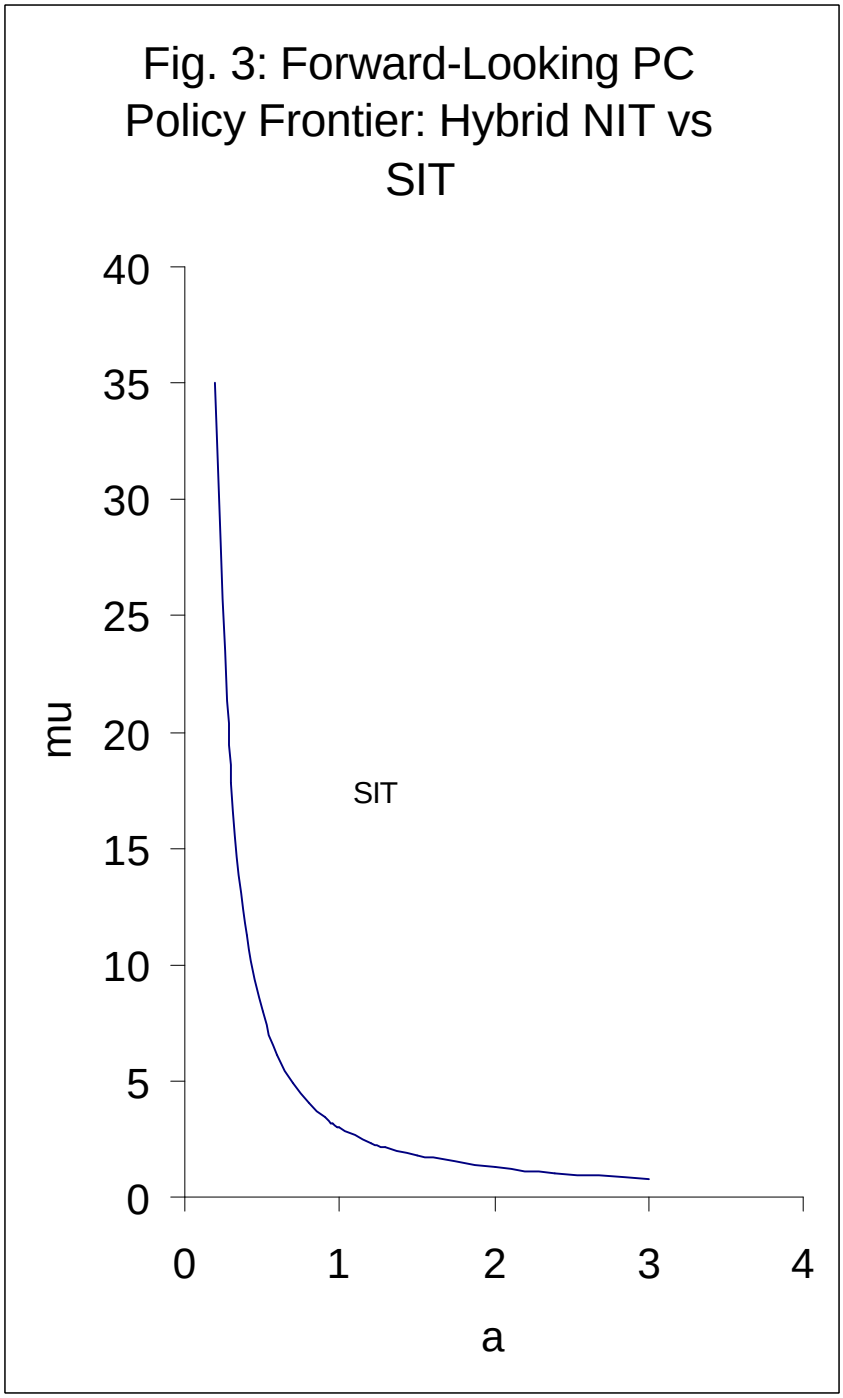

Fig. 4: Forward-Looking PC
Policy Frontier: NIT(Growth Rate) vs SIT