

The Inflation Bias Result Revisited

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Abstract

The Kydland-Prescott, Barro-Gordon inflation bias result relies on the presumption that policymakers aim at achieving a level of employment above the normal level. This presumption has been recently questioned by both academics and policymakers on the ground of realism. This note shows that even if policymakers are content with the normal level of employment there is an inflation bias if the following two (realistic) conditions are satisfied. The central bank is uncertain about the future state of the economy and is more sensitive to policy misses leading to employment below the normal level than to policy misses leading to employment above it. The note also shows that there is reason to believe the bias today is smaller than in the past and discusses the implications of the analysis for the design of legal central bank objectives.

1 Introduction

The twentieth century has been characterized by positive inflation rates in most countries during most time periods. The, by now, standard explanation for this bias is based on a two ways interaction between policymakers and a rational public within the context of the expectations augmented Phillips curve (Kydland and Prescott (1977), Barro and Gordon (1983)). It is based

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on the notion that monetary policymakers care about both price stability and employment and that their preferred level of employment is higher than the natural level. This is due to either tax distortions (Barro and Gordon (1983)) or to the existence of unions that create excessive unemployment by maintaining the real wage above its market clearing level (chapter 3 of Cukierman (1992)). Under discretion policymakers try to create inflationary surprises in order to push employment above its natural level towards the higher desired level. But individuals understand the temptation of policymakers and correctly forecast inflation, neutralizing any effect of inflation on employment. As a consequence employment remains at its natural level but monetary policy is subject to a suboptimal inflationary bias. This is the well known dynamic inconsistency of monetary policy under discretion.

Some students of monetary policy as well as real life policymakers have recently expressed doubts about the realism of this theory of the inflation bias. McCallum (1995) argues that since they understand the futility of trying to systematically stimulate output by means of inflationary surprises central banks normally refrain from such attempts even under discretion.

After a period of service as Vice Chairman of the Fed Blinder (1998) argues that policymakers at the Fed do not try to systematically maintain employment above the natural level. As a matter of fact he personally felt duty bound to pick monetary policy so as to hit the natural rate when in office (Blinder, *Op. Cit.* p. 43). In his view even if some policymakers were trying to aim above the natural level of employment one could easily dispose of the consequent inflationary bias by directing them to aim at the natural level. Blinder takes the reduction of inflation in the US during the early eighties as evidence in favor of the view that it is possible to tame the inflation bias even under discretion. Those doubts cannot be easily dismissed particularly when they come from an economist like Blinder who combines practical monetary policy experience with a solid understanding of formal models. Yet the standard explanation for the existence of an inflation bias has a lot of appeal both because of its simplicity and the persistence and universality of inflation.

The fact that such doubts have been raised only recently rather than a few years after the publication of the Kydland-Prescott and Barro-Gordon articles may not be accidental. Central banks today are substantially more independent than they were ten years ago (Cukierman

(1998)).¹ When monetary policymaking is dominated by political authorities whose electoral concerns breed short horizons and a strong concern for employment and economic activity the standard inflation bias story seems reasonably realistic. But when, as is currently the case, many central banks have instrument independence and are legally directed to focus solely or mainly on price stability it is more likely that they will recognize the suboptimality of trying to maintain employment and output above their natural levels.² Should we conclude that in the current era of enhanced central bank (CB) autonomy the inflation bias is a shadow of the past? I believe the answer is no. Although the bias producing mechanism may be different when central banks have instrument independence some bias is likely to be present nonetheless.

More precisely, this paper demonstrates that when the central bank is **also** expected to engage in stabilization of employment and output, uncertainty about the future state of the economy and asymmetric concerns about positive and negative output gaps combine to create an inflationary bias. **This result obtains in spite of the fact that the central bank's desired level of economic activity is equal to potential output or normal employment.** In countries like the US, in which the central bank is directed by law to also maintain a reasonably high level of economic activity this, uncertainty induced, bias is likely to represent (in my view) a particularly realistic scenario. But even in countries like Germany, in which the law does not explicitly saddle the CB with the task of stabilization policy, decision makers at the CB are not totally indifferent to the real state of the economy.³

In addition there is a recent respectable academic literature that is based on the premise that monetary policymaking institutions should be devised so as to allow them to engage in the stabilization of non monetary policy induced shocks while eliminating the Kydland - Prescott inflationary bias. In particular, Rogoff (1985) proposes to improve the consequent "credibility - flexibility" tradeoff by appointing a central banker that is more conservative than society. Persson and Tabellini (1993) and Walsh (1995) suggest optimal incentive contracts for central

¹For example, Burns who was Chairman of the Fed during the seventies was more receptive to the wishes of the political establishment than his successors. This might have partly been a matter of different personalities but the general recent trend towards more central bank autonomy and more focus on price stability no doubt played a role.

²Many recently revised CB laws grant the bank instrument but not goal independence. The distinction between those two kinds of independence was first drawn by DeBelle and Fisher(1994) and Fischer (1995).

³Clarida and Gertler(1997) produce evidence suggesting that, while its rethoric is different than that of the Fed, the Bundesbank has engaged in stabilization policy.

bankers and Svensson (1997a) shows that, in some cases, such optimal contracts can be implemented by means of a simple inflation target. The basic premise of this literature is that, in the absence of a Kydland - Prescott bias the use of monetary policy to stabilize shocks to the natural level of employment is socially beneficial.⁴ This note shows that this approach leads to an inflationary bias even if policymakers are content with the secular or permanent level of employment so that the Kydland - Prescott inflation bias is non existent. It is, therefore, a warning against the dangers inherent in saddling the central bank with the task of stabilizing shocks to the natural level of employment.⁵

Milton Friedman and others have stressed that monetary policy operates with "long and variable lags". As practical central bankers well know current monetary policy decisions are, therefore, made on the basis of forecasts about the state of the economy rather than on the basis of its actual state.⁶ The inflation bias mechanism presented here draws on the notion that when current policies are chosen decision makers at the CB are uncertain about the real state of the economy at the time the planned policy is expected to impact the economy. Since the CB is more concerned about downward deviations of employment from its normal level than about upward deviations monetary policy is chosen so as to make the probability of erring on the side of tightness smaller than the probability of erring on the side of ease.⁷ As a result planned monetary expansion and inflation are positive on average. Since they understand this tendency of the CB rational individuals expect a positive inflation. This pushes policymakers to be even more accomodating and creates, a somewhat higher, permanent inflationary bias. As in

⁴This premise transcends the recent literature on "strategic monetary policy" as illustrated, *inter alia*, by the work of Fischer (1977) and Taylor (1993).

⁵Friedman (1968) who originally coined the term "natural level of employment" defines it as that level of employment that would be generated by the general equilibrium of the economy in the absence of inflationary surprises. Here, I am using this term in the same sense.

⁶This is probably the main reason for the extensive forecast effort made by the research departments of the Fed and of the newly formed European Central Bank. Uncertainty about the upcoming state of the economy complicates the task of the CB in trying to achieve employment as well as inflation objectives. The effects of this uncertainty for the operation of inflation targets is examined in Svensson (1997b).

⁷This assumption is obviously realistic for the political establishment. In a world in which the CB is supposed to be, at least partly accountable, to elected officials this asymmetry is likely to permeate, perhaps to a lesser extent, the objectives of the CB. Although central banks today are substantially more independent from political authorities than ten years ago they are nonetheless expected by many to pay attention to the wishes of political authorities. Stiglitz (1998, p.19), for example, expresses the view that, since monetary policy is a key determinant of macroeconomic performance, removing it from the control of democratically elected officials should at least raise some questions.

the standard model this bias is suboptimal. Although policymakers prefer to err on the side of expansion in order to reduce the probability of the costlier downward deviations of employment from its normal level the positive expected inflation neutralizes the effect of this policy on the distribution of employment.

2 The Model

2.1 Basic structure

The supply side of the economy is represented by an expectations augmented Phillips curve

$$Y = Y_n + \alpha(\pi - \pi^e), \tag{1}$$

where Y and Y_n are the actual and the natural levels of output, π and π^e are actual and expected inflation, and α is a positive parameter that characterizes the effect of unanticipated inflation on employment. The natural level of output is subject to stochastic fluctuations and is given by

$$Y_n = Y_p + \epsilon \tag{2}$$

where Y_p is potential output and $\epsilon = Y_n - Y_p$ is the output gap in the absence of inflationary surprises. For simplicity, ϵ is specified as a zero mean stochastic shock to the natural level of output with distribution function $G(\epsilon)$. (Staiger, Stock and Watson (1997) present evidence suggesting that the natural level of employment in the US is subject to substantial uncertainty).⁸ Inflation is determined both by the choice of monetary policy as well as by the realization of the shock, ϵ and is given by the following equation :

⁸For concreteness the discussion in the paper is in terms of potential output and the output gap. Obviously all the discussion can also be conducted in terms of employment or unemployment by mapping potential and actual output into normal and actual employment respectively. The qualitative results are identical.

$$\pi = m - \gamma\epsilon, \tag{3}$$

where m is the rate of inflation planned by the CB and γ is a positive parameter that determines the effect of shocks to employment on inflation. Equation (3) states that, given planned inflation, actual inflation is lower the larger is the supply shock to the economy. Provided there is no instrument uncertainty, this formulation is consistent both with cases in which the policy instrument is the interest rate as well as situations in which it is some nominal stock.⁹

Casual observations suggest that the political establishment is more sensitive to the costs of recessions than it is content with expansions. Since, in a democratic society, independent, but accountable, central banks are not totally insensitive to the wishes of the political establishment some of this asymmetry trickles down into the objective function of the CB as well. This hypothesis is captured by specifying the loss function of the CB as :

$$\begin{aligned} L &= \frac{A}{2}(Y_p - Y)^2 + \frac{\pi^2}{2} \text{ when } Y_p - Y > 0 \\ L &= \frac{\pi^2}{2} \text{ when } Y_p - Y \leq 0. \end{aligned} \tag{4}$$

Equation (4) states that, the CB dislikes inflation as well as negative output gaps. But, given inflation, the CB has no interest in deliberately creating positive output gaps. This specification is consistent with and is partly motivated by the observation of a Fed insider that "In most situations the CB will take far more political heat when it tightens preemptively to avoid higher inflation than when it eases preemptively to avoid higher unemployment" (Blinder (1998, pp. 19, 20). This is partly supported by recent evidence suggesting that, at least during the sixties and the seventies the Fed's interest rate policy reacted more vigorously to recessions than to expansions (Gerlach (2000)). In a recent survey on political economy and macroeconomic policy Persson and Tabellini, (1999) also posit a politically motivated **asymmetric** objective

⁹In order to focus on the effects of uncertainty about the state of the economy, I abstract, for simplicity, from instrument uncertainty. The effects of relaxing this assumption are discussed in subsection 3.2.

function (section 3).¹⁰

The sequence of events and the structure of information is as follows. First expectations, π^e , are formed and embedded into nominal contracts. In the second stage the CB picks the value of its instrument, m . Finally the stochastic real shock to employment, ϵ , realizes and determines, along with monetary policy, both employment and inflation. This sequence is illustrated in Figure 1. A crucial element is that, when it chooses the setting of its instrument, the CB is uncertain about the magnitude of the real shock to employment. This is *a fortiori* true for the public when they form their expectation.

Figure 1 : The Sequence of Events

1. π^e is formed \longrightarrow 2. policy, m , chosen \longrightarrow 3. ϵ realizes \longrightarrow

The shock, ϵ , affects employment directly, as well as indirectly by creating, given monetary policy, unanticipated inflation in a direction that is opposite to the sign of the shock. From equations (1) through (3) the combined marginal impact of the shock on employment is

$$q \equiv 1 - \alpha\gamma. \tag{5}$$

I assume that the direct effect of the shock on employment dominates its indirect effect via unexpected inflation so that q is positive.

¹⁰Note that equation (4) is a positive description of CB objectives rather than a social welfare function. It implicitly assumes that the "desired" level of employment is equal to its normal or secular level. This specification is motivated by the following two considerations. First casual empiricism suggests that, as a positive matter, monetary policy is at least partly directed at ironing out real shocks to employment and output. Second, in order to focus on the "new" bias stressed in this paper I abstract from the Kydland - Prescott, bias by assuming that desired employment and output are equal, on average, to their actual values.

2.2 Equilibrium

Using equations (1) through (3) in equation (4) the objective function of the central bank may be rewritten as :

$$\begin{aligned} L &= \frac{A}{2} [q\epsilon + \alpha(m - \pi^e)]^2 + \frac{1}{2}(m - \gamma\epsilon)^2 \quad \text{for } \epsilon < \frac{\alpha}{q}(\pi^e - m) \\ L &= \frac{1}{2}(m - \gamma\epsilon)^2 \quad \text{for } \epsilon \geq \frac{\alpha}{q}(\pi^e - m) \end{aligned} \quad (6)$$

I now proceed to characterize the (sub game perfect) equilibrium of this game, as usual, by starting from the second stage.¹¹ At this stage the CB takes expectations as given and chooses the planned rate of inflation m so as to minimize the expected value of its loss function. From equation (6) this expected value is

$$\frac{A}{2} \int_{-\infty}^{b(\pi^e - m)} [q\epsilon + \alpha(m - \pi^e)]^2 dG(\epsilon) + \frac{1}{2}E(m - \gamma\epsilon)^2 \quad (7)$$

where E is the expected value operator and

$$b \equiv \frac{\alpha}{q}. \quad (8)$$

Minimization of equation (7) with respect to m yields the following behavioral rule for the monetary authority

$$m = \frac{1}{1 + \alpha^2 AG[b(\pi^e - m)]} \left[\alpha^2 AG[b(\pi^e - m)] \pi^e - \alpha Aq \int_{-\infty}^{b(\pi^e - m)} \epsilon dG(\epsilon) \right]. \quad (9)$$

$G[.]$ is the probability that ϵ is smaller than a certain threshold whose value depends on the difference between expected inflation and the level that was planned by the monetary authority.

¹¹Since only "nature" moves in the third stage the last strategic stage is the second one.

I turn next to expectation formation which occurs at the first stage of the game. Although individuals do not know the realization of ϵ at this stage, they do know its stochastic structure as well as the structure of the economy and of CB objectives. Taking the expected value of inflation conditioned on this information as the operational proxy for the public's rational expectation of inflation and using equation (3), we obtain

$$E\pi \equiv \pi^e = m = -\alpha Aq \int_{-\infty}^{b(\pi^e - m)} \epsilon dG(\epsilon). \quad (10)$$

2.3 An uncertainty induced inflation bias

In equilibrium both equations (9) and (10) must be satisfied. It follows that $\pi^e - m = 0$ so that equation (10) becomes

$$E\pi \equiv \pi^e = m = -\alpha Aq \int_{-\infty}^0 \epsilon dG(\epsilon) = -\alpha Aq G(0) E[\epsilon \mid \epsilon < 0]. \quad (11)$$

$G[0]$ is the probability of a recession. More precisely it is the probability that the realization of the employment shock, ϵ , is lower than the mean of this shock which is zero. $E[\epsilon \mid \epsilon < 0]$ is the expected value of ϵ conditioned on the economy being in a recession (ϵ negative). Since the probability of a recession is positive and the expected value of ϵ conditioned on the economy being in a recession is negative both planned and expected inflation are positive. Furthermore, in spite of its attempt to reduce the size of recessions the CB has no influence on output which remains at its natural level. Had the CB precommitted to a zero rate of monetary expansion output would still be at its natural level. Hence there is an "inflationary bias" on average.

Intuitively, this bias arises because the CB is more sensitive to policy errors in which monetary policy is too tight than to policy errors in which it is too expansionary in conjunction with the fact that it does not have perfect information about the state of the economy. This in turn is a direct consequence of the fact that policymakers pay a political price that increases with unemployment when unemployment is above a certain threshold but their political benefits do not increase to the same extent when unemployment decreases below that threshold.

The upshot is that an inflationary bias arises even when policymakers are content with achieving the potential level of output. This bias arises because policymakers are more averse to negative than to positive output gaps and because they are uncertain about the state of the economy. Both conditions appear to be satisfied in reality.

As in the standard explanation for the existence of an inflation bias, the bias is an increasing function of the slope of the short run Phillips curve (α) as well of the relative importance attributed by policymakers to employment (A). Hence, as in Rogoff (1985), the more conservative is the CB (the lower A), the lower is the bias. A novel element here is that, given those parameters, the bias is higher the higher is the probability of a recession, and the deeper this recession is expected to be, once it occurs. Thus if $G(\cdot)$ is skewed to the right so that the mean median spread of ϵ is positive, the inflationary bias is larger than in the case in which it is symmetric around its mean. By the same token, the larger is the average size of the expected recession ($E[\epsilon | \epsilon < 0]$ is larger in absolute value) the larger is the bias. That is, other things the same, more real recession prone economies suffer from a higher inflationary bias. The broad intuition underlying this result follows. Due to their asymmetric attitude to recessions and to expansions, policymakers tend to raise monetary expansion more when the likelihood, and the expected magnitude of a recession is higher. Since the public is aware of that it adjusts its inflationary expectation accordingly and neutralizes in the process any effects of monetary policy on employment and output. Thus, employment remains at its natural level but the bias is higher due to the stronger incentive of policymakers to inflate.¹²

2.4 Symmetric preferences as a benchmark

This subsection highlights the origin of the bias in the absence of a Kydland-Prescott, Barro-Gordon type bias by showing that when the objective function is symmetric uncertainty alone does not produce a bias. Symmetric preferences imply that the first branch of the loss function in equation (4) holds for the entire range of values of the output gap. That is the CB dislikes any given negative output gap to the same extent that it dislikes a positive output gap of the same size. For this case the reaction function of the CB in equation (9) is replaced by:

¹²Preliminary evidence reported in Gerlach (2000) indicates that during the sixties and the seventies interest rate policy in the US responded more strongly to recessions than to expansions.

$$m = \frac{\alpha^2 A}{1 + \alpha^2 A} \pi^e.$$

Rationality of expectations implies that $E\pi \equiv \pi^e = m$. In conjunction with the CB reaction function this implies that the average inflationary bias and expected inflation are both zero.

The lesson from this subsection is that in the presence of uncertainty about the future state of the economy asymmetric CB objectives are essential for the bias producing mechanism of this paper.

3 Further Implications and Discussion

The recent flurry of reform in CB laws raised the issue of whether the only objective of the central bank should be price stability or whether the law should also require the bank to take into consideration the state of the real economy. Since there are different views on this question among professional central bankers and academics it is interesting to examine whether it is possible to rank those two alternative institutional arrangement from a welfare point of view. The equilibrium described in the previous section corresponds to the case in which the law charges the CB with the dual task of "price stability" and a "sufficiently high level of economic activity and employment". In the case in which the bank is directed to achieve only price stability, the first term in equation (7) vanishes. Maximization of the remaining expression yields the policy rule

$$m = 0, \tag{12}$$

which implies that the average inflationary bias is zero. Equation (3) and rational expectations imply that if the law is strictly observed by the CB expected inflation is zero as well. From equations (1) and (2) this implies that economic activity is at its (fluctuating) natural level

$$Y_n = Y_p + \epsilon. \tag{13}$$

Consider now the behavior of output in the case in which the CB is charged by law with the dual task of price stability and high employment as is the case for example in the US. In this case the equilibrium in equation (11) is the relevant one, $m = \pi^e$, and economic activity is therefore given again by equation (13). Thus, given the realization of the shock ϵ , economic activity is the same in the two cases but average inflation is higher in the case in which the CB is also directed to choose its policy so as to maintain a "reasonable" level of economic activity. The upshot of this comparison is that, in the presence of uncertainty about the state of the economy and asymmetric losses from over and under employment, a legal requirement from the CB to maintain a sufficiently high level of employment produces a suboptimal inflationary bias as was the case in the standard model.

This result would seem to imply that price stability should be the only legal objective of the CB. But the matter is not as clear cut as it may seem. For simplicity and focus I have assumed that the information sets of the public and of the CB are identical. This assumption rules out socially beneficial stabilization policy. But, if at the time it picks monetary policy the CB has more information about the state of the real economy than what the public had when they formed their expectations there is room for beneficial stabilization policy. The model could be extended to allow for the existence of beneficial stabilization policy by introducing some persistence in the employment shock and by allowing the monetary authority to have more (although not fully) precise information on its future value than the public had when it formed its expectation.¹³

In such an extended framework there will be, as in Rogoff (1985) and Lohmann (1992), a trade-off between the credibility needed to reduce the inflationary bias and the flexibility that is required to enable the CB to transform its information advantage into a socially beneficial stabilization policy. Although the precise investigation of the extended framework is beyond

¹³Note that this does not necessarily imply that the monetary authority is better informed about the state of the economy at the **same** point in time. All it requires is that the CB chooses policy after some additional persistent information, that was not available at the time of expectation formation, is revealed.

the scope of this paper it is easy to see that leaving the door open for some stabilization of the real economy by not totally excluding employment from the legal objectives of the CB may in that case be socially beneficial. The higher is the information advantage of the central bank in comparison to the extent to which it is uncertain about the future the more likely it is to be the case.

3.1 Is the bias today smaller than in the past?

When the Kydland-Prescott, Barro-Gordon inflation bias analysis was proposed political authorities had relatively more influence on monetary policy than what is currently the case. This is due to at least three interrelated reasons. First, since then many central banks have been granted substantially higher legal independence. Secondly, the globalization of financial markets and the removal of restrictions on capital flows increased the relative influence of central banks in the conduct of monetary policy. Finally, some of the intellectual revolution triggered by the acceptance of a long run vertical Phillips curve and the related inflation bias analysis trickled down to actual policymaking convincing policymakers that monetary policy should not be used to systematically maintain employment below its normal level.¹⁴ A good illustration of this is Blinder's account of the recent position of the FOMC members on this issue during his tenure at the Fed (see Introduction).

Although the analysis in this note suggests that an inflation bias remains even when policymakers recognize the futility of trying to maintain employment above its normal level it is possible that this recognition has contributed to a **reduction** in the size of the bias. This conjecture can be examined by comparing the size of the bias obtained in the previous section to its size when the desired level of economic activity, Y^* , is larger than potential output, Y_p . In this case the loss function of policymakers in equation (4) has to be respecified as :

$$\begin{aligned}
 L &= \frac{A}{2}(Y^* - Y)^2 + \frac{\pi^2}{2} \text{ when } Y^* - Y > 0 \\
 L &= \frac{\pi^2}{2} \text{ when } Y^* - Y \leq 0
 \end{aligned}
 \tag{14}$$

¹⁴This thesis is developed, using least square learning, in Sargent (1999).

in order to recognize that the desired level of output is now larger than the potential level. This specification states that policymakers incur losses whenever output is below a level Y^* that is larger than potential output. Note that the case analyzed in the previous section in which policymakers do not try to raise employment above its normal level is obtained as a particular case when $Y^* = Y_p$. Using equations (1) through (3) in equation (14) and rearranging, the loss function of the CB in equation (7) now becomes

$$A \int_{-\infty}^{k+b(\pi^e-m)} [Y^* - Y_p + \alpha(\pi^e - m) - q\epsilon]^2 dG(\epsilon) + \frac{1}{2}E(m - \gamma\epsilon)^2 \quad (15)$$

where

$$k \equiv \frac{Y^* - Y_p}{1 - \alpha\gamma} \equiv \frac{Y^* - Y_p}{q} > 0. \quad (16)$$

Taking expectations as given, the CB chooses m so as to minimize this loss function. This yields the following reaction function

$$m = \frac{1}{1 + \alpha^2 AG[k + b(\pi^e - m)]} \left[\alpha A (qk + \alpha\pi^e) G[k + b(\pi^e - m)] - \alpha A q \int_{-\infty}^{k+b(\pi^e-m)} \epsilon dG(\epsilon) \right]. \quad (17)$$

Rationality of expectations implies as before that expectations are given by $\pi^e = m$. Combining this equation with equation (17) produces the following expression for the average inflation bias.

$$E\pi \equiv \pi^e = m = \alpha A q \left(kG(k) - \int_{-\infty}^k \epsilon dG(\epsilon) \right) = \alpha A q G(k) (k - E[\epsilon | \epsilon < 0]). \quad (18)$$

Comparison of this expression with its counterpart in the case $k = 0$ (equation (11)) reveals that when policymakers aim at maintaining employment above the normal level, k is positive and the bias is obviously larger than when they aim at the normal level ($k = 0$). But

as we saw in the previous section the bias in the latter case is nonetheless still positive. The upshot is that even if, during the last two decades, policymakers at the Fed have realized the futility of using monetary policy to maintain unemployment below its normal level this **should reduce but not eliminate the inflation bias**.

3.2 Instrument uncertainty

For simplicity and focus I have assumed that there is no instrument uncertainty. Had there been additive instrument uncertainty in the model, its effect on the inflationary bias would be qualitatively similar to that of uncertainty about the state of the economy. This point is made in a recent paper by Jordan (1998) for a uniform distribution of the monetary control error but (as demonstrated below) is true for many other distributions as well provided the control error is additive¹⁵. The more general lesson is that the presence of asymmetries in the CB concern about over and under employment (additive) uncertainties of **various types** lead to an inflationary bias even if the CB desired level of employment is identical to its normal level.

The effect of a control error can easily be added to the conceptual framework of this paper by respecifying the inflation equation as

$$\pi = m - \gamma\epsilon + \psi \equiv m + \delta \tag{19}$$

where ψ is a zero mean stochastic variable that represents the control error. The stochastic variable δ combines both the uncertainty about the state of the economy and the uncertainty due to imperfect control of the monetary instrument. From a formal point of view, δ plays the same role that ϵ did in the model with no control error, and like ϵ it has a zero mean. Hence in the presence of both types of uncertainty, the inflation bias in equation (11) is replaced by

$$E\pi \equiv \pi^e = m = -\alpha Aq \int_{-\infty}^0 \epsilon dG(\epsilon) = -\alpha Aq F(0) E[\epsilon \mid \epsilon < 0] \tag{20}$$

¹⁵Jordan (1998) shows that a multiplicative control error does not lead to a bias.

where $F(\cdot)$ is the distribution of the stochastic variable δ that combines the uncertainty about the state of the economy with instrument uncertainty.

Although either of those two types of uncertainty alone creates an upward bias the addition of one on top of the other does not necessarily raise the bias. Whether it does or not depends on the relative skewness properties of the distributions $G(\cdot)$ and $F(\cdot)$ in equations (11) and (20).

4 Concluding Remarks

The standard Kydland-Prescott, Barro-Gordon inflationary bias story has enriched our understanding of the possible reasons for persistent and widespread inflation under discretion. This conceptual framework heavily relies on the presumption that policymakers are tempted to use monetary policy to raise employment above its normal or secular level. The stabilization of inflation during the eighties and the recent worldwide increase in CB autonomy raise the possibility that this presumption is no longer true because, as stressed by Sargent (1999), more CB officials have now learned that the long run Phillips curve is vertical. This view is also supported by the fact that after a period of service as Vice Chairman of the Fed Blinder (1998) reports that policymakers at the Fed do not try to systematically raise employment above its normal level but that the Fed takes more political heat when it strikes preemptively against inflation than when it strikes preemptively against unemployment.

Taking this at face value implies that, at least as far as the Fed is concerned, the risk of a "Barro-Gordon" type inflation bias may be substantially smaller than in the past. But this note shows that, in the presence of forecasting uncertainty, the asymmetric attitude of the CB to positive and to negative monetary policy errors implies that the bias has not vanished. Even if the desired level of employment is identical to its normal level an inflation bias **does** occur because the CB is more sensitive to policy errors that lead to below normal employment levels than to policy errors that lead to the opposite.¹⁶

During the last decade many CB charters underwent fundamental reforms. An important

¹⁶The **conjunction** of an asymmetric objective function with an imperfect forecasting ability on the part of the CB is essential to generate this bias.

common feature of those reforms is a substantially enhanced focus on price stability. Although in many cases price stability is mentioned as the only or the main legal objective of the CB, some of the new laws also make the CB responsible for "growth and employment". A case in point is the new charter of the Bank of England. In a similar vein, the Report of the 1998 Israeli Committee for reform of the Law of the Bank of Israel recommends that, in addition to its main objective which is price stability, the Bank of Israel should **also** consider the state of employment and growth when setting monetary policy. The result in this note implies that this requirement is likely to create an inflationary bias even if the CB does not attempt to systematically maintain employment above its secular value.

One may think that since monetary policy can be adjusted quickly while the natural level of employment changes relatively sluggishly there should be no uncertainty induced bias. But the analysis in the paper suggests that this intuition is misleading. As long as the CB is not fully certain about the upcoming state of the real economy the bias mechanism outlined here operates independently of the relative speeds of changes in the natural level of employment and of adjustments in monetary policy. When, as is the case in the US and many other countries, the policy instrument is the short term interest rate this, uncertainty induced, bias translates into a downward bias in short term nominal interest rates. But the note also shows that recognition by policymakers of the futility of trying to use monetary policy to maintain employment above its normal level contributes to the reduction of the bias.

The analysis in the paper implies that the bias is smaller when the probability of a recession is small and that it increases when this probability rises. Hence the recent low rates of inflation in the US may, at least partially, reflect the beneficial effect of the sustained strong performance of the US economy on monetary policy choices during the last few years. The analysis in the paper is a warning against taking this record as a reason for complacency. In particular, the possibility that the bias may increase when the probability of recession becomes higher should not be neglected.

5 References

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