The Optimal Perception of Inflation Persistence is Zero

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Abstract
This paper shows that in an economy with inflation persistence, it is always welfare-improving for a central bank that operates under discretion to behave as if there is no inflation persistence. Under reasonable assumptions about inflation persistence, all of the inefficiency associated with discretionar policymaking is then removed.

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1. Introduction

During the last 15 years an increasing number of central banks have abandoned systems of targeting intermediate variables such as the exchange rate or money growth rate, and is now steering policy directly towards inflation stability in a discretionary manner. Since Kydland and Prescott (1977), however, we have known that discretionary policymaking is associated with inefficiencies in the form of inflation and stabilization biases. In the New Keynesian framework (see, Clarida et al., 1999; Woodford, 2003), private sector behavior depends on expectations about future policies. Through an appropriate commitment to future policies, a policymaker is able to influence these expectations and hence private behavior in a favorable manner. Under discretion, however, a policy needs to be sub-game perfect in order to be a rational expectations equilibrium. This inability to commit creates discretionary inefficiencies in the form of stabilization biases. It is widely believed that the central bank does not possess technology that would make a commitment credible and the discretionary equilibrium is therefore the relevant one.

Targeting of inflation under discretion implies using all relevant information about the transmission mechanism in order to guide policy (i.e., Svensson, 2003). The optimality conditions of policy depends crucially on the degree of structural inflation persistence (see, e.g., Svensson, 2003; Leitemo, 2005; Woodford, 2003). Unfortunately, there is a high degree of uncertainty associated with the true degree of inflation persistence. Estimates of inflation persistence ranging between zero and unity can be found in the literature. This paper argues, however, conveniently, that it will always improve discretionary policymaking to assume that there is no inflation persistence. The reason is that in the discretionary equilibrium, the central bank stabilizes output too much and inflation too little. By assuming that there is no inflation persistence, the central bank stabilizes inflation more and output less, hence improving on the discretionary equilibrium. This insight relieves the policymaker from the uncertainty associated with the true degree of inflation persistence. In fact, under reasonable assumptions about inflation persistence, the strategy removes all inefficiency of discretionary policymaking.

The insight in this article has also implications for the principal-agent theory of monetary policy (see Kydland and Prescott, 1977). Under discretionary policymaking, it will
be welfare improving for the Government to appoint a Governor that perceives inflation not to be persistent, irrespective of the true degree of inflation persistence.¹

Section 2 presents the model and sets up the policy problem. Section 3 derives the optimal perception of inflation persistence and Section 4 offers a few concluding remarks.

2. Model and policy problem

We adopt the inflation adjustment equation due to Woodford (2003). He extends the Calvo (1983) framework in assuming that in each period a given fraction of firms adjust their prices optimally and the remaining firms index their prices by a fraction \( \gamma \), \( 0 \leq \gamma \leq 1 \), to the most recent inflation rate (\( \gamma = 1 \) implies complete indexation). This leads to a Phillips curve with inflation being structurally persistent, as

\[
\pi_t - \gamma \pi_{t-1} = \delta E_t(\pi_{t+1} - \gamma \pi_t) + \kappa x_t + \varepsilon_t,
\]

where \( \pi \) is inflation, \( x \) is the output gap, \( \varepsilon_t \) is a white-noise cost-push shock that represents all factors other than the output gap that influence real marginal costs, \( \delta \) is the discount factor of the representative agent and \( E_t \) is the rational expectations operator conditional on information available in period \( t \). \( \kappa \) is a function of deep parameters that are all unrelated to the monetary policy strategy. The Phillips curve may then be written in a familiar form as

\[
\pi^{qd}_{t} = \delta E_t \pi^{qd}_{t+1} + \kappa x_t + \varepsilon_t,
\]

where \( \pi^{qd}_t \equiv \pi_t - \gamma \pi_{t-1} \) is the quasi-differenced inflation rate.

The central bank objective is to minimize the expected value of the periodic loss function, i.e.,

\[
\min(1 - \delta)E_0 \sum_{t=0}^{\infty} \delta^t L_t,
\]

¹This assumes that an enforceable contract can be set up that effectively stops the Governor from learning about the true degree of inflation persistence. Although we see no reason why such a contract could not be monitored and enforced, this article does not discuss the conditions that must hold for this to be true.
where the period loss function is given by

\[ L_t = \left( \tilde{\pi}_t^{qd} \right)^2 + \lambda x_t^2. \]  

(Woodford (2003) shows that the period loss function can be viewed as a second order approximation to the utility of the representative consumer if \( \lambda = \frac{\psi}{\bar{w}} \) where \( \psi \) is the price elasticity of demand facing the individual firm.

The minimization is subject to the Governor’s view of the transmission mechanism. For simplicity, we use the output gap as the policy instrument. As \( \delta \to 1 \) the objective of the bank is to minimize the weighted conditional variance of quasi-differenced inflation rate and output gap. We shall assume that \( \delta = 1 \) for the remainder of the paper.

The Governor perceives inflation to be determined by

\[ \pi_t - \hat{\gamma}\pi_{t-1} = E_t(\pi_{t+1} - \hat{\gamma}\pi_t) + \kappa x_t + \varepsilon_t, \]  

where \( \hat{\gamma} \) may differ from \( \gamma \). Consequently, the policymaker’s estimate of the quasi-differenced inflation rate is \( \hat{\pi}_t^{qd} \equiv \pi_t - \hat{\gamma}\pi_{t-1} \).

3. Policy analysis

The policymaker solves the policy problem by forming the Lagrangian

\[ \mathcal{L} = E_0 \sum_{t=0}^{\infty} \left\{ \left( \hat{\pi}_t^{qd} \right)^2 + \lambda x_t^2 + \mu_t \left( \hat{\pi}_t^{qd} - \hat{\pi}_{t+1}^{qd} - \kappa x_t - \varepsilon_t \right) \right\}. \]

and finds the first-order conditions for a discretionary equilibrium, as

\[ \frac{\partial \mathcal{L}}{\partial \hat{\pi}_t^{qd}} = 2\hat{\pi}_t^{qd} - \mu_t = 0, \]

\[ \frac{\partial \mathcal{L}}{\partial x_t} = 2 \lambda x_t - \kappa \mu_t = 0. \]
By substituting for the Lagrange multiplier, the optimality condition is given by

\[
\begin{align*}
x_t &= -\frac{\kappa}{\lambda} \hat{\pi}^q d_t \\
&= -\frac{\kappa}{\lambda} (\pi_t - \hat{\pi}_{t-1}) \\
&= -\frac{\kappa}{\lambda} (\pi_t - (\gamma + \hat{\gamma}_m) \pi_{t-1}) \\
&= -\frac{\kappa}{\lambda} (\pi_t - \gamma \pi_{t-1}) + \hat{\gamma}_m \frac{\kappa}{\lambda} \pi_{t-1} \\
&= -\frac{\kappa}{\lambda} \pi^q d_t + \hat{\gamma}_m \frac{\kappa}{\lambda} \pi_{t-1}.
\end{align*}
\]

(5)

where we have defined the degree of misperception as \(\hat{\gamma}_m \equiv \hat{\gamma} - \gamma\). It is reasonable to assume that the perception is constrained to being in the zero-unity interval, i.e., \(\hat{\gamma} \in [0, 1]\), which implies that \(\hat{\gamma}_m \in [-\gamma, 1 + \gamma]\). The complete model now consists of the Phillips curve (1) and the optimality condition (5).

In order to understand why misperceptions may have welfare-improving effects, we draw upon the policy conclusion in Clarida et al. (1999). They show that in a model with a similar structure but with no inflation persistence, inflation is stabilized too little and the output gap too much in the discretionary policy equilibrium. The reason is that due to the policymaker’s inability to commit to future policies, the policymaker is not able to use the expectations channel efficiently in order to stabilize inflation expectations and hence inflation itself.\(^2\) In the current model with inflation persistence, this corresponds to the output gap responding too little to quasi-differenced inflation. It is welfare-improving to have the output gap respond stronger to quasi-differenced inflation. From equation (5), we see that the any degree of misperception offers a channel through which output can respond stronger to past inflation - which is highly correlated with quasi-differenced inflation rate. Misperceptions may thus improve on the discretionary equilibrium.

By numerical simulations of the model for \(\hat{\gamma}\) and \(\gamma\) each taking values between zero and unity, we find that the optimal perception of inflation persistence is \(\hat{\gamma} = 0\), regardless of the value of \(\gamma\). Optimal misperception is therefore \(\hat{\gamma}_m^* = -\gamma\). We used baseline parameter values of \(\kappa = 0.05\) and \(\lambda = 0.1\) in our numerical simulation. Sensitivity analysis suggests,\(^2\) Clarida et al. (1999) show that the discretionary equilibrium can be improved upon by appointing a Rogoff conservative governor with a greater dislike for inflation than that of society. This increases the response of the output gap to that of inflation and hence increases welfare up to some point.
Figure 1: The upper left panel show the percentage of the policy inefficiency removed when the central bank optimally perceives inflation not to be persistent. The other panels show social loss under the (no-misperceptions) discretionary and the timeless perspective equilibria and discretionary policy under optimal perceptions. All panels show results for different configurations of $\gamma$ and $\lambda$. $\kappa$ is set at baseline value of 0.05.

However, that the result does not dependent on the baseline parameter values of the model.

Figures 1 and 2 plot for different values of $\lambda$ and $\kappa$, respectively, the reduction in social loss achieved by assuming that there is no inflation persistence at different degrees of true inflation persistence. They show the percentage of the policy inefficiency removed (in the upper left panels) and compare the loss to the no-misperceptions discretionary and timeless perspective equilibria, in which loss is independent of $\gamma$. There are at least two important observations.

First, social loss falls more with a higher degree of inflation persistence. In other words, the higher $\gamma$, the larger effect does a given misperception have and the more does output respond to misalignments. If $\gamma = 1$, the optimality condition in the misperceptions equilibrium (5) is given by

$$x_t = -\frac{\kappa}{\lambda} \pi_t,$$  

(6)
and is consistent with the optimality condition in the timeless perspective equilibrium (see Woodford, 2003). All of the discretionary inefficiency is then removed.

Second, in Figure 1 we see that the greater $\lambda$ is, the smaller welfare-improving effects does a given misperception have on the optimality condition (5). If society values output gap stability greatly, the large variability in output induced to stabilize inflation comes at a higher cost. In Figure 2 we see that a higher value of $\kappa$ increases the efficiency of the solution as a stronger response to output can be made with a given degree of misperception.

4. Concluding remarks

We have shown that designing policy on the assumption that inflation does not persist always improves welfare in the discretionary equilibrium. Given the high uncertainty associated with the degree of inflation persistence, this seems like a convenient result for the monetary policymaker. If Giannoni and Woodford (2003) and Christiano et al. (2005) are right in arguing that a value of $\gamma = 1$ fit data best, the solution removes all
the inefficiency associated with discretionary policymaking.

The optimal policy conclusion of assuming no inflation persistence has an interesting correspondence to optimal policymaking under the timeless commitment policy perspective. Although misperceptions will never improve on the rational expectations policy in this policy equilibrium, Walsh (2005) argues that a policymaker that is uncertain about the degree of inflation persistence and follows a min-max approach to policy, will minimize the effects of inflation persistence being set to maximize loss, by behaving as inflation is relatively non-persistent. Hence, the underestimation of inflation persistence may be welfare improving under a wider set of assumptions.
References


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