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The gains from commitment when inflation persistence and data uncertainty coexist

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Abstract

This paper investigates how the gains from commitment are large when inflation persistence and data uncertainty coexist. We consider two types of data uncertainty: measurement errors of potential output and inflation. We show that under a situation where data uncertainty exists, there are large gains from commitment as long as inflation is not extremely forward-looking or backward-looking. In particular, an increase in measurement error of inflation reduces the gains from commitment when forward-looking inflation is important, whereas there are large gains from commitment as long as inflation is not extremely backward-looking.

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1 Introduction

The central bank faces data uncertainty associated with a situation where the central bank has difficulty in forecasting the natural rate of output and the natural interest rate since these variables contain measurement errors. Aoki (2003) shows that in the forward-looking sticky price model, the central bank implements its monetary policy more cautiously when data uncertainty is present. In addition, several studies find that inflation dynamics depends on both past and future inflation. A commitment policy generally leads to preferable outcomes to a discretionary policy in a pure forward-looking sticky price model. This is because the central bank, which conducts a commitment policy, can create policy inertia into the economy by manipulating the expectations of the private sector. The gains from commitment might decrease, however, when inflation persistence is present. How should the central bank conduct its monetary policy when inflation persistence and data uncertainty coexist?

This paper examines optimal monetary policy when inflation persistence and data uncertainty coexist. It is the New Keynesian Phillips Curve (NKPC) that plays an important role in the New Keynesian model. Empirical studies show that the standard NKPC is a forward-looking structure, whereas inflation persistence is an important element in economic dynamics. Inflation persistence also plays an important role in theoretical analysis. As noted above, in a purely forward-looking model, a commitment policy leads to preferable outcomes to a discretionary policy. On the contrary, Amato and Laubach (2003) investigate optimal monetary policy with inflation persistence, and show that the welfare loss is larger as inflation is highly persistent. Steinsson (2003) shows that there are gains from commitment as long as inflation is not predominately backward-looking.

Svensson and Woodford (2003) attempt to explore optimal monetary policy with measurement errors, and show that under symmetric information between the central bank and private sector, the central bank can separate the estimation of unobservable variables from the derivation of optimal monetary policy. This is referred to as the separation theorem. They find that commitment is different from discretion in that under a commitment policy, the model estimation and prediction depend on the past Lagrange multiplier associated with forward-looking variables. Svensson and Woodford (2003) point out that in such a case, there are gains from employing a commitment policy.

Our purpose is to investigate whether it is important to consider a situation where inflation persistence and data uncertainty coexist in monetary policy analysis. As far as we know, there are no studies that investigate optimal monetary policy that includes both inflation persistence and data uncertainty. We guess that even if inflation persistence and data uncertainty coexist, there are additional gains from commitment. We show that under a situation where data uncertainty exists, there are large gains from commitment as long as inflation is not extremely forward-looking or backward-looking. In particular, an increase in measurement error of inflation reduces the gains from commitment when forward-looking inflation is important, whereas there are large gains from commitment as long as inflation is not extremely backward-looking.

The remainder of this paper is organized as follows. In Section 2, we describe the model used in this paper. Section 3 describes the calibration, and Section 4 reports simulation results. Section 5 briefly concludes.

2 Model

Our model is based on the framework of Amato and Laubach (2003). We use lower case variables to denote a log deviation from the steady state. Specifically, a log-linearized variable around the steady state is expressed by $h_t = \log(H_t/\bar{H})$.

The expectational IS curve, which is derived from the representative household's Euler equation for optimal consumption, is given by

$$x_t = E_t x_{t+1} - \sigma\left(r_t - E_t \pi_{t+1}\right) + e_t, \tag{1}$$

where the output gap is defined by $x_t = y_t - \bar{y}_t$, y_t represents the log-deviation of actual output, and $\bar{y}_t$ is the log-deviation of potential output. Also, r_t represents the nominal interest rate, π_t is the rate of inflation and e_t represents the natural rate of interest that holds under the efficient level of output. Finally, σ is the positive parameter. We assume that there are measurement errors of potential output and inflation, which are given as follows:

$$\bar{y}_t^o = \bar{y}_t + \varepsilon_{\bar{y}t}, \tag{2}$$

$$\pi_t^o = \pi_t + \varepsilon_{\pi t}, \tag{3}$$

where $\bar{y}_t^o$ and π_t^o are measurable variables and the measurement errors $\varepsilon_{\bar{y}t}$ and $\varepsilon_{\pi t}$ are i.i.d.

Inflation adjustment is described by the NKPC. Following Amato and Laubach (2003), we employ the rule-of-thumb hypothesis. A fraction $1-\alpha$ of all firms adjusts their price while the remaining fraction of firms α do not. Moreover, amongst firms that can adjust price, a fraction ω sets price optimally, while a fraction $1-\omega$ sets price based on a rule-of-thumb, which is given as follows:

$$P_t^r = P_{t-1}^* \left(\frac{P_{t-1}}{P_{t-2}}\right), \tag{4}$$

where P_t^r is the price for firms that use the rule-of-thumb pricing rule, and P_t^* is the optimal price index in period $t-1$. Under these conditions, we obtain the following hybrid NKPC:

$$\pi_t = \gamma_f E_t \pi_{t+1} + \gamma_b \pi_{t-1} + \delta x_t + u_t, \tag{5}$$

where

$$\gamma_f \equiv \frac{\alpha\beta}{\alpha + (1-\omega)(1-\alpha(1-\beta))}, \gamma_b \equiv \frac{1-\omega}{\alpha + (1-\omega)(1-\alpha(1-\beta))},$$
$$\delta \equiv \frac{\omega(1-\alpha)(1-\alpha\beta)}{\alpha + (1-\omega)(1-\alpha(1-\beta))} \frac{\psi + \sigma^{-1}}{1+\psi\bar{\theta}}.$$

Also u_t is a cost-push shock associated with time-varying mark-up. β, ψ, and $\bar{\theta}$ are positive parameters. The parameter ω plays an important role in the NKPC. The smaller the value of ω is, the more backward-looking the NKPC is. Moreover, it follows that the smaller ω is, the flatter the slope of the NKPC is.

Next, we consider the central bank's objective function with a micro-foundation when inflation is persistent. As shown in Amato and Laubach (2003), under the case where inflation persistence exists, the central bank's objective function becomes as follows:

$$L_t = -\frac{\Omega}{2} \sum_{t=0}^{\infty} \beta^t \left(\pi_t^2 + \lambda_x x_t^2 + \lambda_{\Delta\pi} \Delta\pi_t^2 \right), \tag{6}$$

where

$$\Omega = u_c \bar{Y} \frac{\alpha}{(1-\alpha)(1-\alpha\beta)} (1+\psi\bar{\theta})\bar{\theta}, \lambda_x = \frac{(1-\alpha)(1-\alpha\beta)}{\alpha} \frac{\psi + \sigma^{-1}}{(1+\psi\bar{\theta})\bar{\theta}}, \lambda_{\Delta\pi} = \frac{1-\omega}{\alpha\omega}.$$

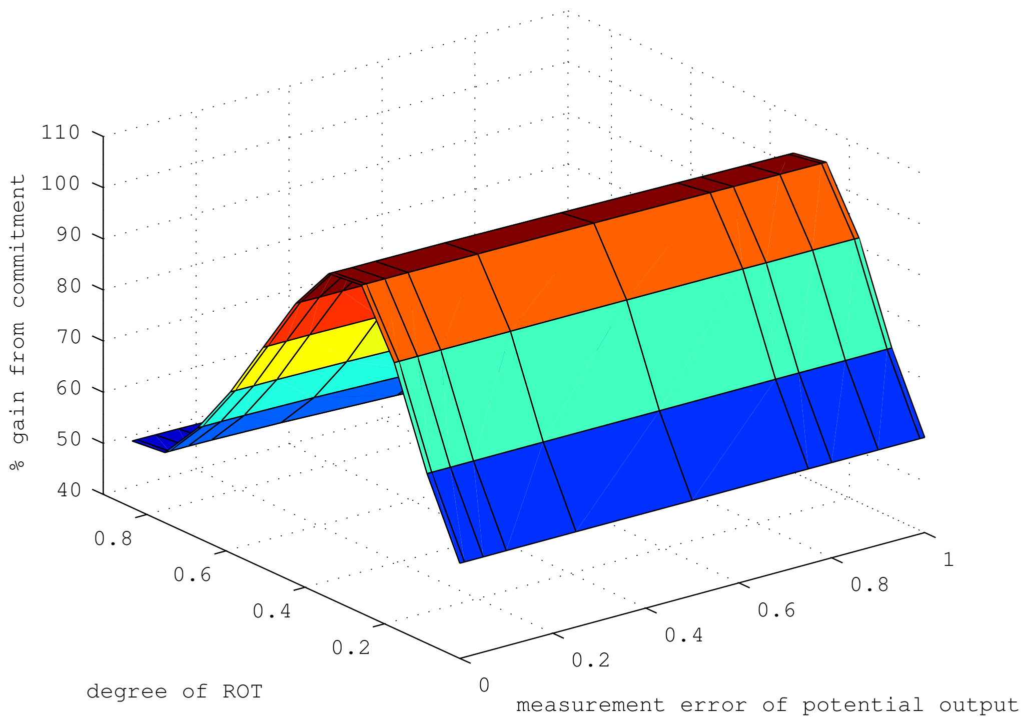
where $\Delta\pi_t$ denotes change in inflation. A stabilization term for change in inflation emerges when inflation persistent is present. This indicates that the more persistent inflation is (small ω), the larger the value of the stabilization term of change in inflation, $\lambda_{\Delta\pi}$ is. Inversely, the more forward-looking the NKPC is (large ω), the smaller the value of $\lambda_{\Delta\pi}$ is.

3 Calibration

In this section, we describe the parameters used in this paper.[1] With the exception of stadard deviations and coefficients for serial correlation, the parameters used in this paper are based on Chapter 5 in Woodford (2003). We set the degree of price rigidity α to 0.66, the discount factor β to 0.99, and the price elasticity of demand for individual goods θ to 7.88. Next, we set the relative risk aversion coefficient for consumption σ to 6.0 and the elasticity of labor supply ψ to 0.47. Following Ehrmann and Smets (2003), we set standard deviations σ_u, $\sigma_{\bar{y}}$, and σ_e to 0.13, 0.63, and 0.42, respectively. Also, the standard deviation of the mesurement error of potential output is set to 0.06. Finally, we assume that the coefficients for serial correlation, $\rho_{\bar{y}}$ and ρ_e, are 0.95 and 0.5, respectively.

[1] We examine whether the changes in several parameters affect the gains from commitment, and check that the results were unaffected. We also find that an increase in the standard error of measurement error for inflation reduces the gain from commitment, but the results of the paper are still robust to the change in measurement error of inflation.

Figure 1: The gains from commitment when inflation persistence and measurement error of potential output change



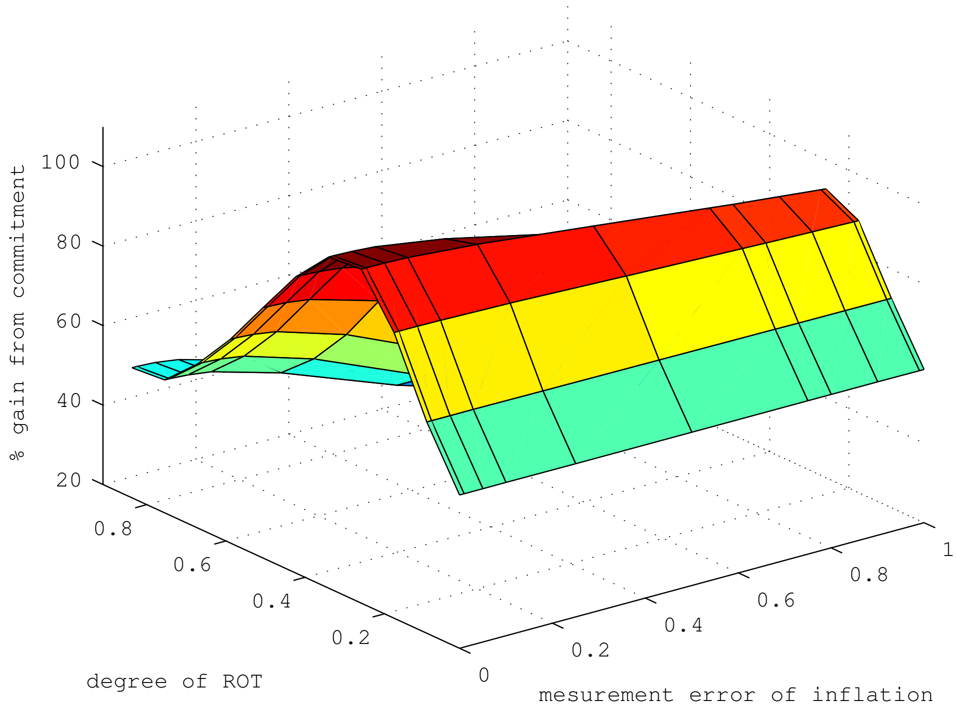
4 Results

As our model includes data uncertainty, we cannot derive optimal monetary policy by solving the standard linear rational expectation model. Gerali and Lippi (2008) construct the solution methods for Linear-Quadratic problems with data uncertainty. Therefore, we derive optimal policy under both discretion and commitment by using Gerali and Lippi's (2008) methods.

Figure 1 shows the gains from commitment when inflation persistence and measurement error of potential output change. It follows from Figure 1 that there are large gains from commitment as long as inflation is not extremely forward-looking or backward-looking. In particular, the gains attain the maximum value when ω takes 0.5. We also find that the degree of uncertainty about potential output does not change the gains from commitment. This indicates that the degree of measurement error of potential output is independent of that of inflation persistence.

Figure 2 illustrates how the gains from commitment change when inflation persistence and measurement error of inflation increase. We find that an increase in uncer-

Figure 2: The gains from commitment when inflation persistence and measurement error of inflation change



tainty about inflation reduces the gains from commitment when inflation is forward-looking. The interpretation of this result is as follows. In a forward-looking model, the central bank can introduce policy inertia, and therefore induce negative impacts on inflation. As a result, compared to monetary policy under discretion, commitment policy can reduce welfare losses through the expectations of the private sector. However, the central bank produces less policy inertia in the forward-looking model with large measurement error of inflation than in that without data uncertainty. In other words, the central bank conducts its monetary policy more cautiously as measurement error of inflation becomes larger. This means that the measurement error of inflation weakens the effectiveness of the commitment policy. Consequently, the gains from commitment are smaller as uncertainty about measurement error of inflation becomes larger.

Figure 2 shows, however, that the gains from commitment are large as long as inflation is not predominately backward-looking. As shown in Steinsson (2003), the gains from commitment decrease as inflation becomes persistent. On the other hand, the welfare losses generated from measurement error of inflation also decrease as inflation becomes persistent. This implies that there are large gains from commitment as long as the latter effect dominates the former effect. Indeed, the gains from commitment is large when inflation is not predominately forward-looking or backward-looking. Thus, Figure 2 reveals that the gains from commitment are large when ω takes the values from 0.2 to 0.5. Several empirical studies report that the coefficient for lagged inflation ranges from 0.2 to 0.6. For instance, Galí and Gertler (1999) find that the coefficient for lagged inflation is roughly 0.2. Recently, according to Lindé (2005) and Kurmann (2007), the coefficient for backward-looking inflation becomes 0.5. The range supported by several empirical research corresponds to that where ω takes the values from 0.2 to 0.5. We conclude, therefore, that when the central bank conducts its monetary policy, it should at least take into account a situation where inflation persistence and data uncertainty coexist.

5 Concluding remarks

This paper examines how the gains from commitment are large when endogenous inflation persistence and data uncertainty coexist. We consider two types of data uncertainty: measurement errors of potential output and inflation. We find that under a situation where unobservable variables contain noisy information, there are large gains from commitment as long as inflation is not extremely forward-looking or backward-looking. From empirical and practical aspects of monetary policy, the assumption that inflation persistence and data uncertainty coexist might be plausible. Therefore, this paper contributes to the conduct of monetary policy under a situation where the central bank faces both inflation persistence and data uncertainty.

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