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« Monetary Policy with Uncertain Central Bank Preferences for Robustness »

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Monetary Policy with Uncertain Central Bank Preferences for Robustness

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Abstract

In this paper,we consider the transparency of monetary policy in a New Keynesian model with misspecification doubts. Model uncertainty allows us to identify a new source of central bank opacity, which refers to a lack of information about central bank's preference for model robustness. Thus, taking into account this lack of transparency, we study its impacts on macroeconomic variables. We show that greater transparency can reduce the variability of output gap, inflation as well as that of their expected values.

1 Introduction

The literature studying the effects of monetary policy transparency on macroeconomic performances (Cukierman (2001), Geraats (2002) and Eijffinger, Hoeberichts and Schaling (2000)) assumes that the policymakers and the private agents know the true model of the economy. Recent research (Levin and Williams (2003), Leitemo and Soderstrom (2004),Walsh (2003)) has illustrated a renewed interest in monetary policy decision-making by introducing model uncertainty. Policy makers want to make robust decisions against potential misspecifications surrounding the model. We assume that the private agents are aware of the fact that central bank sets its monetary policy according to its preference for robustness. However, the central bank does not reveal all the information to the private agents and they cannot, therefore, predict its preference for robustness. Thus, the lack of transparency arises from the fact that there is asymmetric information (poor communication) between the central bank and the private agents. In this context, we identify two sources of uncertainty: first, uncertainty concerning central bank preference about model robustness and second, model uncertainty which comes from ignorance of the true structure of the economy. In this framework, where the central bank faces uncertainty about its model, the question is whether it is beneficial to the policy maker to reveal the value of the parameter which denotes the model robustness.

By applying robust control approach (Hansen and Sargent (2005)), we find that greater monetary policy transparency reduces the variability of output gap and inflation expectations. More precisely, the central bank can stabilize better the impact of shocks to private agents' expectations by revealing more information about its preference for robustness. Therefore, output gap and inflation are less volatile.

1.1 The model

We consider a standard New-Keynesian model with sticky prices that summarizes the economy in two equations: a New-Keynesian Phillips curve for inflation and a forward-looking IS equation for output gap. According to Hansen and Sargent (2005), we incorporate robust control techniques by adding misspecification terms and obtain the worst case model as follows:

$$\pi_t = E_t\pi_{t+1} - ax_t + \varepsilon_t + h_t, \tag{1}$$

$$x_t = E_t x_{t+1} - b\left(i_t - E_t\pi_{t+1}\right) + \eta_t + w_t, \tag{2}$$

where π_t is the rate of inflation, x_t is the output gap, and i_t is the one-period nominal interest rate controlled by the central bank. $E_t\pi_{t+1}$ and $E_t x_{t+1}$ are respectively the expected inflation rate and the expected output gap of the next period based on the information available in period t. ε_t denotes a cost-push shock and η_t is a demand shock. Both shocks are assumed to be persistent and non correlated, following a first order autoregressive process:

$$\varepsilon_t = \rho\varepsilon_{t-1} + \xi_t, \tag{3}$$

$$\eta_t = \psi\eta_{t-1} + v_t, \tag{4}$$

with $0 \leq \rho,\, \psi \leq 1$. The terms ξ_t, v_t are i.i.d with zero mean and unity variance. h_t and w_t are additional deterministic disturbances which introduce model uncertainty. These disturbances are supposed to be controlled by a fictitious "evil agent" and represent the policy maker's worst fears concerning specification errors.

The budget constraints for the evil agent follow:

$$E_t \sum_{j=0}^{\infty} \delta^j h_{t+j}^2 \leq \chi^2, \tag{5}$$

$$E_t \sum_{j=0}^{\infty} \delta^j w_{t+j}^2 \leq \chi^2, \tag{6}$$

where the parameter χ can be considered as the budget allocated to the evil agent to create misspecifications. To hedge against the worst scenario, the policy maker sets the interest rate to minimize the value of its intertemporal loss function, while the evil agent seeks to maximize the central bank's loss, given both budget constraints. Incorporating the misspecifications concerns into the decision making problem, the design of a robust policy becomes a min-max problem subject to the linear constraints (1) and (2) as follows:

$$\min_{i_t} \max_{h_t, w_t} V_{cb} = E_t \sum_{j=0}^{\infty} \frac{1}{2} \delta^j \left(\phi \pi_{t+j}^2 + x_{t+j}^2 - \theta h_{t+j}^2 - \theta w_{t+j}^2 \right). \tag{7}$$

The parameter $\phi > 0$ measures the weight that policy makers attach to inflation stabilization relative to output stabilization and $\theta \in (1, \infty]$ is a parameter which reflects the central bank's preference for model robustness. [1].

The issue of transparency arises when the public's perception about the central bank's degree of model robustness $\bar{\theta}$ differs from the values that the bank itself actually considers θ. Thus, the stochastic behaviour of the parameter θ is given by

$$\theta = \bar{\theta} - \mu_t, \text{with } E_t(\mu_{t+1}) = 0 \text{ and } Var(\mu) = \sigma_\theta^2. \tag{8}$$

This implies that the public is correct on average, but may be mistaken when making guesses about the central bank preferences for robustness in individual cases or at certain points in time. σ_θ^2 measures the degree of opacity of the central bank. If the variance of the preference shock σ_θ^2 increases (decreases), the central bank becomes less (more) transparent respectively.

2 The solution of the model under discretion

Taking the first order conditions for eq.(7) subject to equations (1) and (2), we can derive the optimality conditions for inflation, output and the worst case misspecification as follows:

$$x_t = -a\phi\pi_t, \tag{9}$$

$$h_t = \frac{\phi}{\theta}\pi_t, \tag{10}$$

[1]The second order condition of Eq.(7) with respect to h shows that the evil agent's problem is well defined and concave iff $\theta > 1$ Thus, $\theta = 1$ is a lower bound for θ or a breakdown point(see Hansen and Sargent, 2005).

$$w_t = 0. \tag{11}$$

First, these optimality conditions show that the preference for robustness does not affect the optimal trade off between inflation and output in eq.(9). Second, the optimal misspecification in the IS equation is always zero since the central bank is able to neutralize any specification errors in the output equation by an appropriate adjustment of the interest rate. These interest rate movements do not affect the central bank loss and therefore, the central bank does not fear such specification errors (see Leitemo and Soderstrom (2004)).

Substituting now optimality conditions (9), (10) and (11) in the misspecified Phillips curve (1), we obtain:

$$\pi_t = \left[\frac{\theta}{(a^2\phi + 1)\theta - \phi}\right] (E_t \pi_{t+1} + \varepsilon_t). \tag{12}$$

In order to determine the inflation rate, π_t, we use the technique of undetermined coefficients [2]. Since the relevant state variable in equation (12) is ε_t, it is apparent that π_t will be of the form:

$$\pi_t = \beta_0 \varepsilon_t. \tag{13}$$

Thus, using (3), we obtain the following expression for the expected futur inflation:

$$E_t \pi_{t+1} = E(\beta_0)\rho\varepsilon_t, \tag{14}$$

and then applying (14) into (12) yields

$$\pi_t = \frac{\theta}{(a^2\phi + 1)\theta - \phi} (1 + E(\beta_0)\rho)\varepsilon_t. \tag{15}$$

Comparing the above equation with (13), we can derive the following expression:

$$\beta_0 = \frac{\theta}{(a^2\phi + 1)\theta - \phi} (1 + E(\beta_0)\rho). \tag{16}$$

To calculate the expected value of the coefficient β_0, we take expectations across expression (16)

$$E(\beta_0) = E\left[\frac{\theta}{(a^2\phi + 1)\theta - \phi}\right] (1 + E(\beta_0)\rho). \tag{17}$$

Using a second order Taylor series expansion in the above equation and replacing the expression $E(\beta_0)$ into (16), we obtain the solution for β_0:

$$\beta_0 = \frac{\theta}{(a^2\phi + 1)\theta - \phi} \frac{G^3}{G^3 - \rho(\bar{\theta}G^2 + \phi(a^2\phi + 1)^2\sigma_\theta^2)} \tag{18}$$

where $G = (a^2\phi + 1)\bar{\theta} - \phi$.

So, the complete solution of the model is given by

$$\pi_t = \frac{\theta}{(a^2\phi + 1)\theta - \phi} \frac{G^3}{G^3 - \rho(\bar{\theta}G^2 + \phi(a^2\phi + 1)^2\sigma_\theta^2)} \varepsilon_t, \tag{19}$$

[2] See full description in **?**).

$$x_t = -\frac{a\phi\theta}{(a^2\phi+1)\theta-\phi}\frac{G^3}{G^3-\rho(\bar{\theta}G^2+\phi(a^2\phi+1)^2\sigma_\theta^2)}\varepsilon_t, \tag{20}$$

$$h_t = \frac{\phi}{(a^2\phi+1)\theta-\phi}\frac{G^3}{G^3-\rho(\bar{\theta}G^2+\phi(a^2\phi+1)^2\sigma_\theta^2)}\varepsilon_t. \tag{21}$$

The central bank faces a trade-off between inflation and output stabilization. In the case of a positive cost-push shock $\varepsilon_t > 0$, output will be contracted and inflation will be raised. In our model, the misspecification term h_t is considered as an endogenous variable that worsens the inflation deviations. The worst scenario here is represented by h_t, a second type of shock which strengthens the positive cost-push shock.

From (19), we derive the expected future inflation:

$$E_t\pi_{t+1} = \frac{\bar{\theta}G^2+\phi\left(a^2\phi+1\right)\sigma_\theta^2}{G^3-\rho\left[\bar{\theta}G^2+\phi\left(a^2\phi+1\right)\sigma_\theta^2\right]}\rho\varepsilon_t. \tag{22}$$

In a general case, as a positive cost-push shock (i.e. $\varepsilon_t > 0$) hits the economy, the private agents will anticipate an increase in the inflation rate. In order to ensure $E_t\pi_{t+1} > 0$, we require that $G^3 - \rho\bar{\theta}G^2 - \phi\left(a^2\phi+1\right)\sigma_\theta^2 > 0$. By rearranging the terms, we get

$$\sigma_\theta^2 < \frac{G^2\left(G-\rho\bar{\theta}\right)}{(1+a^2\phi)\phi\rho}. \tag{23}$$

To some extend, this inequality allows us to define an upper bound of the degree of central bank's opacity σ_θ^2.

According to (22) and (9), we obtain the expected future output gap as:

$$E_t x_{t+1} = -a\phi E_t\pi_{t+1} = -a\phi\frac{\bar{\theta}G^2+\phi\left(a^2\phi+1\right)\sigma_\theta^2}{G^3-\rho\left[\bar{\theta}G^2+\phi\left(a^2\phi+1\right)\sigma_\theta^2\right]}\rho\varepsilon_t. \tag{24}$$

3 Transparency and macroeconomic performance

It is of interest to investigate how the lack of transparency about central bank's preference for robustness affects the macroeconomic variables. At a first stage, we analyze the impact of greater opacity on inflation expectations variability. Thus, we derive the following proposition:

Proposition 1 *Greater central bank opacity about its preference for robustness induces higher variability of expected future inflation.*

Proof. Differentiating twice (22) with respect to the supply shock and the degree of opacity yields

$$\frac{\partial^2 E_t\pi_{t+1}}{\partial\sigma_\theta^2\partial\varepsilon_t} = \frac{\phi\left(a^2\phi+1\right)\rho G^3}{\left\{G^3-\rho\left[\bar{\theta}G^2+\phi\left(a^2\phi+1\right)\sigma_\theta^2\right]\right\}^2}. \tag{25}$$

Unambiguously, the sign of the above expression is positive. ■

Future inflationary expectations are increased due to the uncertainty about the central bank's preference for robustness. Therefore, if the central bank shares more information on its preferences with private agents, the latter tends to reduce their inflationary expectations.

We now analyse the impact of opacity on output gap expectations. Higher expected future inflation, induced by a higher level of opacity about the central bank's preference for robustness, leads to a larger fall in expected future output. Consequently, the variability of the output gap expectations is increased. This can be shown by the following equation:

$$\frac{\partial^2 E_t x_{t+1}}{\partial \sigma_\theta^2 \partial \varepsilon_t} = \frac{-a\phi^2 \left(a^2\phi + 1\right) \rho G^3}{\left\{G^3 - \rho\left[\bar{\theta} G^2 + \phi\left(a^2\phi + 1\right)\sigma_\theta^2\right]\right\}^2}. \tag{26}$$

The above equation allows us to get the following proposition:

Proposition 2 *Greater central bank opacity about preference for robustness induces higher variability of expected future output gap.*

Proof. From (26) , it is straightforward that

$$\frac{\partial^2 E_t x_{t+1}}{\partial \sigma_\theta^2 \partial \varepsilon_t} < 0. \tag{27}$$

■

Concerning the impact of central bank's opacity on current inflation and output gap, we can derive the following proposition:

Proposition 3 *An increase in central bank's opacity about preference for robustness leads to higher variability of inflation and output gap.*

Proof. Differentiating twice eq.(20) with respect to the supply shock and the degree of opacity yields:

$$\frac{\partial^2 x_t}{\partial \sigma_\theta^2 \partial \varepsilon_t} = -\frac{a\phi\theta}{(a^2\phi+1)\theta - \phi} \frac{G^3 \phi\rho(a^2\phi+1)^2}{(G^3 - \rho\theta G^2 - \phi\rho(a^2\phi+1)^2\sigma_\theta^2)^2} < 0. \tag{28}$$

Similarly, differencing twice eq.(19) with respect to the supply shock and the degree of opacity yields:

$$\frac{\partial^2 \pi_t}{\partial \sigma_\theta^2 \partial \varepsilon_t} = \frac{\theta}{(a^2\phi+1)\theta - \phi} \frac{G^3 \phi\rho(a^2\phi+1)^2}{(G^3 - \rho\theta G^2 - \phi\rho(a^2\phi+1)^2\sigma_\theta^2)^2} > 0. \tag{29}$$

■

Greater preference uncertainty leads to a more aggressive response from the private agents. It induces higher variation of the current output as the latter depends positively on expected future output gap (cf.(2)). Therefore, current inflation will be stabilised at the price of larger falls in output gap when facing positive cost-push shocks. As a consequence, the inflation-output trade-off is worsened. In other words, uncertainty about central bank's preference for robustness strengthens the impact of the shock to the economy. This result is in accordance with the literature studying central bank transparency in the absence of model uncertainty.

4 Concluding remarks

In our paper, we addressed the issue of central bank transparency in a New Keynesian framework where the central bank does not know the true structure of the economy. We examined the impacts of opacity concerning central bank preference about model robustness on macroeconomic performance. First, we showed that the higher the variance of the central bank's preference shock σ_θ^2 , the higher the inflation expectations. Second, future output gap expectations vary more with higher opacity about the central bank's preference for robustness. Finally, when the central bank reveals less information about its preference for robustness there is an increase in the variability of inflation and output gap.

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