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Monetary policy, parameter uncertainty and welfare

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ABSTRACT

This paper derives optimal robust monetary policy in a standard microfounded new Keynesian model with uncertainty about the degree of price stickiness and the autocorrelation of the cost-push shock. The uncertain degree of price stickiness spills over to the endogenous objective function pursued by the central bank. In a min–max approach, the model is solved under discretion and under a Taylor rule which implements the optimal robust equilibrium under discretion. It is shown that with a welfare-based loss function, robust optimal monetary policy can neutralize the uncertainty surrounding the relative weight to assign to output-gap stabilization. Moreover, welfare improves when the endogeneity of the loss function is recognized by the central bank. Under discretion, the central bank reacts more aggressively to uncertainty about the degree of price stickiness and the autocorrelation of the cost-push shock. On the other hand, if the central bank implements the optimal discretionary robust equilibrium with a Taylor rule, under uncertainty the interest rate reacts to inflation in a less aggressive way.

1. Introduction

Central banks typically deal with uncertainty about the key relationships describing the economy. Uncertainty leads to disagreement about the effects of monetary policy and, in turn, about the appropriate interest rate setting. As a consequence, it is important to look for a robust monetary policy which can do a good job even when the policymaker does not know the structure of the economy accurately.

This paper focuses on the consequences of uncertainty in the aggregate supply relationship. In a standard microfounded new Keynesian model, where the central bank's objective function is the expected present discounted value of a second-order approximation to the welfare of the representative household, parameter uncertainty in the aggregate supply relationship affects the structural model and the welfare criterion through 1) the degree of price stickiness and 2) the autocorrelation of the cost-push shock. There are good reasons to analyze uncertainty about these two parameters. Uncertainty about the degree of price stickiness is a concrete issue in academic research and policymaking. Bils and Klenow (2004) use US Bureau of Labor Statistics data and show the frequency of price adjustment for 350 categories of consumer goods and services which cover 70% of total consumer's expenditure. It turns out that the median firm in their dataset changes prices every 4.3 months. Galí and Gertler (1999) find an average price stickiness ranging from 1 year and a half to 2 years. Although the same authors argue that the estimation might be upward biased, these values are extremely far from 0.3, which implies an average duration slightly longer than four months, as pointed out in Bils and Klenow (2004). Uncertainty about the degree of price stickiness affects the central bank's perception about the slope of the aggregate supply and the relative weights assigned to the objectives in the loss function. Moreover, I assume that the autocorrelation of the cost-push shock is uncertain to take into account the mismatch between the theoretical Phillips curve and the empirical evidence about inflation persistence. Although the new Keynesian Phillips curve is a microfounded relationship, and for this reason it is exempt from the Lucas critique, it does not fit inflation dynamics very well when it is taken to data. For example, Galí and Gertler (2007) assume that the cost

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push shock follows a first-order autoregressive process with high autocorrelation (0.95) to capture the high degree of inflation persistence in the data. In this setup, I derive optimal robust monetary policy, namely the policy which minimizes the worst possible loss that could occur due to parameter misspecification, and I try to contribute to the debate as to whether uncertainty about the key parameters makes interest rate setting less or more aggressive.

A seminal and relevant work which analyzes the conduct of monetary policy under uncertainty is due to Brainard (1967). Brainard evaluates the consequences of uncertainty, expressed in terms of multiplicative parameter uncertainty, for monetary policy. He finds that if the policymaker is uncertain about the impact a policy instrument has on the economy, it will be optimal to respond more cautiously than would be the case in the absence of uncertainty. Therefore, the policymaker must reduce the magnitude of movements in the interest rate relative to the case without uncertainty. This policy prescription is referred to as the "Brainard principle". More recently, Giannoni (2002) assumes uncertainty about the slope of the Phillips curve and the Euler equation, and derives a robust minmax policy that is implemented by a simple instrument rule. Giannoni finds a result which contrasts with Brainard's one: Policymakers must respond more strongly to inflation than under certainty. Similar results are found by other contributions, eg Onatski and Williams (2003), Söderström (2002), and Onatski and Stock (2002), just to mention a few. Hence robust optimal policy should not obey the Brainard principle anymore. However, Tillmann (2009) shows that uncertainty in the cost channel can motivate an attenuated policy stance.

In contrast with these papers, I deal with optimal robust monetary policy in the presence of uncertainty that originates from the structural model but then spills over to the central bank's objective function. This is a novelty in the literature about optimal robust monetary policy[1]. I show that, even if uncertainty about price stickiness transmits to the slope of the aggregate supply and to the weight attached to the stabilization of the output gap, the optimal trade-off between inflation and the output gap remains unaffected by this kind of uncertainty. Welfare improves significantly if the central bank recognizes the endogeneity of the loss function. Furthermore, I find that uncertainty about price stickiness and the autocorrelation of the cost-push shock can motivate an attenuated interest rate response to fluctuations in inflation. When the central bank minimizes a loss function which has a tight link with the reference model, it should overestimate the quantitative importance of the cost-push shocks and this calls for a smaller interest rate response to inflation.

The paper is organized as follows. Section 2 describes the key properties of the theoretical model and presents the information structure. In Section 3 I derive the optimal monetary policy in a min–max approach. This policy is then implemented with a robust optimal Taylor rule in Section 4. Section 5 concludes.

2. The model

I use a standard version of a microfounded new Keynesian model featuring nominal rigidities and monopolistic competition. Since the model is standard, I present it here quite briefly.[2]

Households consume goods and provide labor. Firms set prices under monopolistic competition and are subject to a Calvo (1983) scheme of staggered price adjustment. The forward-looking Phillips curve (1) and the Euler Eq. (2) represent log-linearized equilibrium conditions:

$$\pi_t = \kappa x_t + \beta E_t \pi_{t+1} + u_t \tag{1}$$

$$x_t = E_t x_{t+1} - \frac{1}{\sigma}\left(i_t - E_t \pi_{t+1} - r_t^n\right) \tag{2}$$

where π_t is the inflation rate, x_t is the output gap, i_t is the nominal interest rate, and E_t is the expectations operator. In (1), the Phillips' curve slope κ is a function of the discount factor β, of the constant fraction of firms that cannot revise their prices every period θ (Calvo's parameter), of the coefficient of relative risk aversion σ and of the inverse of labor-supply elasticity φ:

$$\kappa \equiv \frac{(1-\theta)(1-\beta\theta)}{\theta}(\varphi + \sigma)$$

u_t and r_t^n are a cost-push shock and the natural interest rate that are distributed as a first-order autoregressive process:

$$u_{t+1} = \rho_u u_t + \eta_{t+1}$$
$$r_{t+1}^n = \rho_r r_t^n + \zeta_{t+1}$$

where η_{t+1} and ζ_{t+1} are uncorrelated white-noise processes, with zero mean and variances σ_u^2 and σ_r^2 respectively. The central bank is assumed to set interest rates in order to minimize the following loss function

$$\mathcal{L}_t = \frac{1}{2}\left(\pi_t^2 + \alpha x_t^2\right) \tag{3}$$

[1] Walsh (2005) investigates the role of endogenous objectives in the evaluation of monetary policy targeting rules without any implications in terms of optimal monetary policy under uncertainty.

[2] See Woodford (2003), Walsh (2010), and Galí (2008) for the complete derivation of new Keynesian models based on optimizing households and firms under monopolistic competition and nominal rigidities.