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## Transmission lags and optimal monetary policy

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## ABSTRACT

The credibility problems of monetary policy are enlarged by transmission lags whenever the welfare criterion consists of arguments with differing transmission lags. If, as usually argued, prices react to monetary policy with a longer lag than output, the discretionary bias is substantially increased under a consumer welfare maximizing policy criterion (flexible inflation targeting) in the prototype New Keynesian model. Money growth targeting can significantly reduce the discretionary bias, but is not robust to other specifications of welfare with higher valuation of output stability.

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## 1. Introduction

Since [Kydland and Prescott \(1977\)](#) and [Barro and Gordon \(1983\)](#) we have known that an overly ambitious monetary policy which aims to bring output above the natural level is associated with inflation and stabilization biases. If the central bank tries to systematically exploit the short-run trade off between output and inflation, it will lead to higher inflation, and output and inflation being stabilized sub-optimally. Furthermore, due to the lack of commitment to future policies, discretionary policymaking is unable to appropriately influence expectations about the future. At the time policy is implemented, the advantages of the future commitment may already have been realized and the policymaker has incentives to deviate from the pre-announced policy. In the absence of commitment technology, the best thing a policymaker can do is to re-optimize policy in every period. Since people form expectations rationally, this will be anticipated and the only equilibrium is that of the time-consistent optimal discretionary equilibrium which may perform considerably worse than the optimal commitment policy.

This paper studies the impact of delayed effects of monetary policy on the economy in the discretionary equilibrium. Delayed effects are commonly referred to as the transmission lags of monetary policy. It is almost universally accepted that monetary policy is subject to rather long transmission lags and that they create various challenges for monetary policy. In this paper we show that if the transmission lags are caused by implementation lags in the private sector, the credibility problems of a welfare-maximizing policymaker that acts under discretion increase. Under the reasonable assumption that pricing decisions of the firms are subject to longer implementation lags than household consumption decisions, the discretionary

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policy involves no policy-induced stabilization of cost-push shocks in the canonical New Keynesian model.<sup>1</sup> The argument is simple: at the horizon the policymaker can affect output gap, inflation (and prices) are already predetermined. The best discretionary policy is then to fully stabilize the output gap. The implementation lags have a severe impact on the discretionary equilibrium in particular if the cost-push shocks are persistent.

We argue that when society attaches little weight on output stabilization, adopting a single target for monetary policy, thus having a strict (as opposed to flexible) monetary policy, eliminates the additional credibility problems caused by differing transmission lags. The central bank does not get tempted in deviating from the main nominal target. Our result confirms the results in Söderström (2005) who argues that there is a role for money growth targeting in reducing the discretionary bias. We also show that the relative benefits of money growth targeting over inflation increases when there is an implementation lag in prices. Our results support the Friedman (1960) conjecture that lags in the transmission mechanism could be a reason for adopting money growth targeting, yet this result is not robust to alternative specifications of welfare with higher valuation of output stability. Furthermore, the argument for money growth targeting should be balanced by the potential for instability of money demand.

The remainder of the paper is organized as follows. Section 2 present the canonical New Keynesian model and Section 3 derives the optimal discretionary policy strategies under both discretion and commitment. Section 4 discusses most important alternative policy regimes that offer a potential remedy to discretionary bias. Welfare comparisons are then made in Section 5. Section 6 concludes.

## 2. The model

The private-sector pricing decisions are carried out within the Calvo (1983) framework. In each period the firm has a fixed probability of changing its price. The firm set prices in order to maximize profits under the condition that it might not be able to adjust prices in the next period. In addition, we assume that there is a  $j$ -period implementation lag of prices, i.e. prices are set in advance of the actual implementation. This could be due to staggering of wage and/or price contracts or because of information delays.<sup>2</sup> This leads to the New Keynesian Phillips curve (see Roberts, 1995; Woodford, 2003) given by

$$\pi_{t+j} = \delta \pi_{t+j+1|t} + \gamma x_{t+j|t} + \varepsilon_{t+j}, \quad (1)$$

where  $\pi_{t+j} \equiv p_{t+j} - p_{t+j-1}$  is inflation at time  $t+j$ ,  $x_{t+j|t}$  is the output gap at time  $t+j$ ,  $\delta$  is the representative agent's discount factor and  $\varepsilon_{t+j}$  is a cost-push shock that represents other factors that influence price setting at time  $t+j$ , not considered at time  $t$ .<sup>3</sup> These factors can be surprise movements in the mark-up of prices.<sup>4</sup> The parameter  $\gamma$  is a convolution of the model's deep parameters and it captures a sensitivity of inflation to output gap.

The Euler consumption equation, when combined appropriately with the households' labor supply choice and product market equilibrium condition, gives rise to an expectational IS-curve of the form (see, e.g., Rotemberg and Woodford, 1997; McCallum and Nelson, 1999; Woodford, 2003)

$$x_{t+m} = x_{t+m+1|t} - \sigma(i_{t+m|t} - \pi_{t+m+1|t} - r_{t+m}^n), \quad (2)$$

in case where there is an  $m$ -period implementation lag in consumption decisions.<sup>5</sup>  $r_{t+m}^n$  denotes the natural real interest rate at time  $t+m$  and is taken as exogenous process by households.  $\sigma$  is the intertemporal elasticity of substitution. Consumption and pricing decisions being predetermined for some period of time implies that inflation and output are less forward looking than in the standard NK model.

The model has been extensively studied by Woodford (2003) and Clarida et al. (1999), and by Svensson and Woodford (2005) in the case of  $j=m=1$  period implementation lags. Furthermore, Woodford (2003, Chapter 8) studies the case with  $j=m=s$ , where  $s$  is any arbitrary, positive number. In this paper, we assume that  $j \geq m$ , i.e. that the implementation lag of prices may be either longer or equal to that of output gap. Based on evidence from VAR models (e.g., Christiano et al., 2005) and other empirical models (e.g., Rudebusch, 2002a,b), it is in fact reasonable to assume that inflation and output gap respond to changes in monetary policy with different delays. Such differences in delays are also featured in several theoretical models of the monetary transmission mechanism (see, e.g., Svensson, 1997). The traditional forward-looking New Keynesian Phillips curve without implementation lags suggests that inflation responds simultaneously with changes in output gap. Considering the empirical evidence, such a feature seems unrealistic and any policy advice hinging on this could be problematic. By

<sup>1</sup> See Goodfriend and King (1997), Rotemberg and Woodford (1997), McCallum and Nelson (1999) and Clarida et al. (1999).

<sup>2</sup> An alternative way of introducing inertia in pricing behavior is to combine Calvo (1983) framework with indexation. In this approach, firms that are not allowed to optimize, set their prices on the basis of lagged aggregate prices (e.g. Galí and Gertler, 1999), or own lagged prices (e.g. Christiano et al., 2005), plus the product of an indexing parameter and lagged inflation. This gives rise to a lagged inflation term in the NK Phillips curve. Our framework emphasizes information delays as another and possibly complementing explanation of the lagged effect of monetary policy on prices.

<sup>3</sup> For any variable  $z$ , we use the notation that  $z_{t+d|t} \equiv E_t z_{t+d}$ , where  $E_t$  is the mathematical expectation operator,  $t$  denotes the time when expectations are formed and  $d$  is the time forward operator.

<sup>4</sup> We follow Svensson and Woodford (2005) in assuming that the cost-push shock has an immediate influence on pricing. Note that this assumption is not important for the conclusions regarding the credibility problems of monetary policy in this paper.

<sup>5</sup> Woodford (2003, Chapter 5) provides detailed discussion on complications that may arise from combining the models where consumption and pricing behavior are subject to decision lags in NK framework. Our setup here is consistent with microfoundations to the extent that we have assumed  $j \geq m$ .

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