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# Optimal monetary policy in a micro-founded model with parameter uncertainty

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## Abstract

In this paper, we structurally model uncertainty with a micro-founded model, and investigate its implications for optimal monetary policy. Uncertainty about deep parameters of the model implies that the central bank simultaneously faces both uncertainty about the structural dynamic equations and about the social loss function. Considering both uncertainties with cross-parameter restrictions based on the micro-foundations of the model, we use Bayesian methods to determine the optimal monetary policy that minimizes the expected loss. Our analysis shows how uncertainty can lead the central bank to pursue a more aggressive monetary policy, overturning Brainard's common wisdom. As the degree of uncertainty about inflation dynamics increases, the central bank should place much more weight on price stability, and should respond to shocks more aggressively. We also show that combining a more aggressive policy response with a highly inertial interest rate policy reduces Bayesian risk.

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## 1. Introduction

In spite of its great popularity in recent monetary policy studies, the New Keynesian Phillips curve has been criticized for failing to match the short-run dynamics exhibited by inflation.<sup>1</sup> Specifically, inflation seems to respond sluggishly and display significant persistence in the face of shocks, while the New Keynesian Phillips curve allows current inflation to be a jump variable that can respond immediately to any disturbance. In order to solve this empirical defect of the New Keynesian Phillips curve, several studies have proposed a hybrid Phillips curve while keeping a micro-foundation.<sup>2</sup> This Phillips curve is a modified inflation adjustment equation which incorporates endogenous persistence by including the lagged inflation rate in the New Keynesian Phillips curve. That is, it nests the purely forward-looking Phillips curve as a particular case, and allows for a fraction of firms that use a backward-looking rule to set prices.

Although increasing attention has been recently given to the estimation of the hybrid Phillips curve, the estimation results vary greatly among studies.<sup>3</sup> That is, there has not been any empirical consensus about what fraction of firms follow a rule of thumb. This implies that the central bank faces uncertainty about the degree of inflation persistence, which the existing literature has identified as one of the most critical parameters affecting the performance of monetary policy.<sup>4</sup>

In this study, we first investigate how the central bank should conduct monetary policy under uncertainty about inflation persistence. We use Bayesian methods to determine the optimal monetary policy that minimizes the expected social welfare loss, given a prior distribution of some uncertain parameters. This approach, initially started by Brainard (1967), has recently been followed by Estrella and Mishkin (1999), Hall et al. (1999), Martin and Salmon (1999), Svensson (1999), Sack (2000), among others. These studies support Brainard's results that optimal policy should be less aggressive in the face of parameter uncertainty.<sup>5</sup> One notable exception is Söderström (2002), who finds that uncertainty about inflation persistence leads the central bank to pursue a more aggressive monetary policy.<sup>6</sup> His analysis is based on a backward-looking model of Svensson (1997) type with the Old Keynesian Phillips curve.

<sup>1</sup>See, for example, Fuhrer (1997), Mankiw (2001), and Estrella and Fuhrer (2002).

<sup>2</sup>See Galí and Gertler (1999), Amato and Laubach (2003), Steinsson (2003), and Giannoni and Woodford (2005).

<sup>3</sup>See, for example, Fuhrer (1997), Galí and Gertler (1999), Rudebusch (2002), Roberts (2001), Galí et al. (2001), Kimura and Kurozumi (2004), and Giannoni and Woodford (2005).

<sup>4</sup>When inflation dynamics can be described as the purely forward-looking New Keynesian Phillips curve, price-level targeting performs very well. (See Vestin, 2000). But, Walsh (2003a) suggests that, when current inflation is affected by both expected future inflation and lagged inflation, the performance of price-level targeting deteriorates significantly as the weight on lagged inflation increases. Similarly, Rudebusch (2002) finds that nominal income targeting does well when inflation is forward-looking but poorly when it is more backward-looking.

<sup>5</sup>See Walsh (2003b) for a recent survey about monetary policy under uncertainty.

<sup>6</sup>Craine (1979) also shows that uncertainty about the dynamics of the economy leads to a more aggressive policy, albeit in a univariate model.

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