



# Robust monetary policy with imperfect knowledge<sup>☆</sup>

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## Abstract

We examine the performance and robustness properties of monetary policy rules in an estimated macroeconomic model in which the economy undergoes structural change and where private agents and the central bank possess imperfect knowledge about the true structure of the economy. Policymakers follow an interest rate rule aiming to maintain price stability and to minimize fluctuations of unemployment around its natural rate but are uncertain about the economy's natural rates of interest and unemployment and how private agents form expectations. In particular, we consider two models of expectations formation: rational expectations (RE) and learning. We show that in this environment the ability to stabilize the real side of the economy is significantly reduced relative to an economy under RE with perfect knowledge. Furthermore, policies that would be optimal under perfect knowledge can perform very poorly if knowledge is imperfect. Efficient policies that take account of private learning and misperceptions of natural rates call for greater policy inertia, a more aggressive response to inflation, and a smaller response to the perceived unemployment gap than would be optimal if everyone had perfect knowledge of the economy. We show that such policies are quite robust to potential misspecification of private sector learning and the magnitude of variation in natural rates. Published by Elsevier B.V.

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## 1. Introduction

To paraphrase Clausewitz, monetary policy is conducted in a fog of uncertainty. Our understanding of many key features of the macroeconomic landscape remains imperfect, and the landscape itself evolves over time. As emphasized by [McCallum \(1988\)](#) and [Taylor \(1993\)](#), a crucial requirement for a monetary policy rule is that its good performance be robust to various forms of model misspecification. In this view, it is not enough for a monetary policy rule to be optimal in one specific model, but instead it must be “stress tested” in a variety of alternative model environments before one can conclude with any confidence that the policy is likely to perform well in practice.<sup>1</sup> In this paper, we examine the performance and robustness of monetary policy rules in the context of fundamental uncertainty related to the nature of expectations formation and structural change in the economy. Our goal is to identify characteristics of policy rules that are robust to these types of imperfect knowledge, as well as to identify those that are not.

The first form of uncertainty facing the policymaker that we consider relates to the way in which agents form expectations. There is a growing literature that analyzes a variety of alternative models of expectations formation. The key conclusion we take from our reading of this literature is that there is a great deal of uncertainty regarding exactly how private expectations are formed. In particular, the standard assumption of rational expectations (RE) may be overly restrictive for monetary policy analysis, especially in the context of an economy undergoing structural change. But, the available evidence does not yet provide unequivocal support for any other single model of expectations formation. Therefore, fundamental uncertainty about the nature of expectations formation appears to be an unavoidable aspect of the policy environment facing central banks face today.

In this paper, we consider two popular alternative models of private expectations formation. Our approach can easily be extended to incorporate other alternative models of expectations as well, but for reasons of tractability, we leave this for future research. One model is RE, which assumes that private agents know all the parameters of the model and form expectations accordingly. This, of course, is the model used in much of the recent monetary policy rule literature. The second model is perpetual learning, where it is assumed that agents do not know the true parameters of the model, but instead continuously reestimate a forecasting model (see [Sargent, 1999](#); [Evans and Honkapohja, 2001](#) for expositions of this model). This form of learning represents a relatively modest, and arguably realistic, deviation from RE. An advantage of the perpetual learning framework is that it allows varying degrees of deviations in expectations formation relative to the RE benchmark, which are characterized by variation in a single model parameter. As shown in [Orphanides and Williams \(2005a,b,c\)](#), perpetual learning on the part of economic agents introduces an additional layer of interaction between monetary policy, expectations, and economic outcomes.

The second source of uncertainty that we consider is unobserved structural change, which we represent in the form of low-frequency variation in the natural rates of unemployment and interest. The equilibrium of our model economy is described in terms of deviations from these natural rates. In particular, the inflation rate is in part determined by the unemployment gap, the deviation of the unemployment rate from its natural rate.

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<sup>1</sup>For past applications of this approach, see [Levin et al. \(1999, 2003\)](#), who study the characteristics of monetary policy rules that are robust to model uncertainty related to macroeconomic dynamics.

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