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Adaptive learning and the use of forecasts in monetary policy

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ABSTRACT

This paper investigates monetary policy design when central bank and private-sector expectations differ. Private agents learn adaptively; the central bank has a possibly misspecified model of the economy. Successful implementation of optimal policy using inflation targeting rules requires the central bank to have complete knowledge of private agents' learning behavior. If the central bank mistakenly assumes private agents to have rational expectations when in fact they are learning, then policy rules frequently lead to divergent learning dynamics. However, if the central bank does not correctly understand agents' behavior, stabilization policy is best implemented by controlling the path of the price level rather than the inflation rate.

1. Introduction

How should forecasts be incorporated into optimal monetary policy design? The recent literature on implementing optimal monetary policy—see Svensson and Woodford, 2005; Svensson, 2003; Giannoni and Woodford, 2002; Woodford, 2003, Chapter 7—characterizes the central bank's decision procedure in terms of specific targeting rules: such rules specify a relationship between one or more target variables that must be checked each time an interest-rate decision is made. The instrument setting is deemed appropriate if the specified 'target criterion' is satisfied. Since the target variables that appear in the criterion are usually not directly observable, to determine the instrument setting in any period the central bank requires a completely specified model of the economy to solve for the equilibrium path of endogenous variables. The targeting rule approach appears to be an effective way

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to implement optimal monetary policy and is argued to be robust to a range of assumptions concerning the nature of economic disturbances that affect the economy.

To date, the literature on specific targeting rules rests on the assumption that the central bank is able to exploit the true structure of the economy—that it understands the true structural relations, and therefore the expectations held by private agents, when determining the instrument setting that is consistent with implementing its objectives.[1] Furthermore, the literature typically rests on the assumptions of rational expectations and common information on the part of private agents and the central bank. This implies that both these economic actors necessarily hold common expectations about future macroeconomic conditions. But suppose the central bank does not know the true model of the economy. Or that the central bank and private agents hold differing beliefs about the future evolution of the economy—does this hinder the usefulness of specific targeting rules? And given uncertainty as to the true model, should optimal monetary policy be conditioned on private agents' expectations and if so in what way? Or is it sufficient for the central bank's instrument choice to be conditioned solely on internally constructed forecasts using whatever model it may have at its disposal?

This paper addresses these questions in a simple New-Keynesian model of output gap and inflation determination in which private agents must learn about the probability laws governing the evolution of state variables exogenous to their decision problems. Rational expectations are a nested special case of the proposed beliefs, and the analysis is centrally concerned with the conditions under which agents' beliefs converge to those predicted by a rational expectations equilibrium analysis of the model. Introducing learning in this way permits the central bank and private agents to have differing beliefs about the evolution of the macroeconomy and allows examination of its implications for the design of optimal monetary policy. Because all economic actors will only hold identical believes if and when the learning process converges, the framework serves to coherently analyze robustness of rational expectations policy prescriptions to departures in underlying model assumptions; and specifically expectations formation.

Following Giannoni and Woodford (2002), candidate targeting rules are variants of the consolidated first-order condition to the solution to the optimal commitment problem under the so-called "timeless perspective" of Woodford (1999) of a standard linear-quadratic policy problem. Two representations are analyzed. The first is a particular linear restriction on the inflation rate and the *change* in the output gap. The second, is an equivalent restriction on the price level and the contemporaneous output gap.[2] If the central bank can arrange for either of these relations to be met in all periods it will successfully implement the optimal monetary policy. The former will be referred to as the *inflation targeting rule* and the latter the *price-level targeting rule*. A policy is robust if agents' beliefs converge to the rational expectations equilibrium associated with the policy. To implement such targeting criteria, the central bank requires a model of the economy. It follows that the central bank's knowledge of the economy will have consequences for its projection of the future path of economic variables and therefore the implementation and efficacy of any given targeting rule.

Three decision procedures are considered that are equivalent in terms of the rational expectations equilibria they imply. Each represents the central bank's beliefs about the evolution of the economy. Of particular interest is whether learning dynamics provide ground for choosing among alternative approaches to implementing optimal monetary policy. First, the central bank implements the target criterion incorrectly assuming agents to have rational expectations and observing only lagged aggregate variables and fundamental disturbances. Thus the evolution of the economy is projected using a rational expectations model—that would obtain if agents' solved their decision problems under rational expectations—and this implies a reaction function for the nominal interest rate that is

[1] A simple example of this type of monetary policy arrangement is inflation forecast-targeting (see Svensson, 1999): the monetary authority is charged with maintaining its inflation forecast over some horizon equal to a fixed inflation objective. If the inflation forecast deviates from the target, the central bank must adjust its instrument setting to ensure its projected evolution of the economy is consistent with the forecast target.

[2] This equivalence is in terms of the rational expectations equilibrium each policy implies, and will be formally defined in Section 3.