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Learning and the central bank ☆

Charles T. Carlstrom[a,*], Timothy S. Fuerst[a,b]

[a] Research Department, Federal Reserve Bank of Cleveland, P.O. Box 6387, Cleveland, OH 44101, USA
[b] Bowling Green State University, Bowling Green, OH 43403, USA

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Abstract

It is well known that sunspot equilibria may arise under an interest rate operating procedure in which the central bank varies the nominal rate with movements in future inflation (a forward-looking Taylor rule). This paper demonstrates that these sunspot equilibria may be learnable in the sense of E-stability.

JEL classification: E31; E52

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1. Introduction

The celebrated Taylor rule (1993) posits that central bank behavior can be described by a fairly simple rule linking nominal rate movements to movements in inflation and output. This seminal paper has spawned a large literature concerned with issues of stability: under what situations can a Taylor-rule formulation of monetary policy create real indeterminacy and thus sunspot[1] fluctuations in the model economy? (see for example, Benhabib et al., 2001; Bernanke and Woodford,

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*Corresponding author.
E-mail address: charles.t.carlstrom@clev.frb.org (C.T. Carlstrom).

[1] The term "sunspot" is in one sense misleading since these shocks are accommodated by monetary policy. But we use the term since the central bank introduces real indeterminacy by responding to forecasts which can be driven by sunspots.

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1997; Carlstrom and Fuerst, 2000a, 2001a, b; Clarida et al. (2000); Kerr and King, 1996). As forcefully argued by Evans and Honkapohja, 2001, sunspot equilibria are compelling only if they are not "fragile" to reasonable assumptions about "learning". We follow Evans and Honkapohja (2001), and interpret "learning" as E-stability, so that an equilibrium is "fragile" if it is not E-stable. The issue raised in this paper is whether the sunspot equilibria induced by some Taylor rules are E-stable.[2],[3]

A robust result of the papers on indeterminacy is that sunspots are most likely in cases in which the central bank responds to forecasted inflation. We will thus focus on Taylor rules in which the central bank responds to forecasted inflation. Honkapohja and Mitra (2001) analyze the basic monetary model considered here, and conclude that the sunspot equilibria arising from a forward-looking monetary policy are not E-stable.[4] They show that the only equilibria that are E-stable are the minimum state vector (msv) solutions where inflation depends only on fundamental shocks. McCallum (2001) concludes from this that only the msv solution is empirically relevant.

In this paper, we consider two variants of the analysis in Honkapohja and Mitra (2001) and demonstrate the existence of E-stable sunspot equilibria. Our first modeling variation is a different assumption on the nature of learning. Honkapohja and Mitra (2001) examine a model in which there is symmetric learning by both the public and the central bank. That is, both the central bank and private sector have common expectations. This can be interpreted as the private sector learning, and the central bank operating off of private sector forecasts. In contrast, this paper examines a case in which the forecasts of the central bank and private sector differ, and coincide only in the long run. There are many possible differential learning scenarios. Here we take one extreme: We assume that only the central bank is subject to a learning process, while private sector expectations are always rational.

This assumption is analogous to the assumption in Sargent's (1999) analysis of *The Conquest of American Inflation*. The principle contribution of this paper is to demonstrate that in the case of central bank learning the sunspot equilibria are typically E-stable. If the monetary authority believes in a particular sunspot, rational expectations on the part of the public dictate that they too will believe in that sunspot. In essence, central bank policy can lead the public to believe in sunspots.

Our second modeling variation on the Honkapohja and Mitra analysis is a different timing scenario. In Honkapohja and Mitra, money balances at the end of goods market trading are assumed to aid in transactions. Carlstrom and Fuerst (2001a) refer to this as "cash-when-I'm-done" (CWID) timing. But CWID is a

[2] E-stability typically implies that least-squares learning converges to the rational expectations equilibrium, although there are some technical issues in the case of a continuum of equilibria (as is the case with the sunspot equilibria examined below). See Evans and Honkapohja (2001) for a detailed discussion.

[3] Woodford (1990) was the first to demonstrate the learnability of stationary sunspot equilibria in an overlapping generations model.

[4] However, Honkapohja and Mitra (2001) demonstrate that "resonant frequency" sunspot equilibria may be learnable under certain policy rules.