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Monetary policy, indeterminacy and learning

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Abstract

Forward-looking monetary models with Taylor-type interest rate rules are known to generate indeterminacies, with a potential dependence on extraneous 'sunspots,' for some structural and policy parameters. We investigate the stability of these solutions under adaptive learning, focusing on 'common factor' or 'resonance frequency' representations in which the observed sunspot has a suitable time-series structure. We consider specifications incorporating both lagged and expected inflation in the Phillips Curve, and both expected and inertial elements in the policy rule. We find that some policy rules can indeed lead to learnable sunspot solutions and we investigate the conditions under which this phenomenon arises.

JEL classification: E52; E32; D83; D84

Keywords: Monetary policy; Sunspots; Expectations; Learning; Stability

1. Introduction

The development of tractable forward looking models of monetary policy, together with the influential work of Taylor (1993), has lead to an explosion of research on the implications of adopting Taylor-type interest rate rules. These rules take the nominal interest rate as the policy instrument and direct the central bank to set this rate according to some simple (typically linear) dependence on current,

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lagged, and/or expected inflation and output gap, and possibly on an inertial term to encourage interest rate smoothing.

While these simple policy rules for many reasons are advantageous to both researchers and policy makers, it has been noted by some authors, e.g. Bernanke and Woodford (1997), Woodford (1999) and Svensson and Woodford (1999), that the corresponding models exhibit indeterminate steady states for large regions of the reasonable parameter space. This presence of indeterminacy is thought undesirable because associated with each indeterminate steady state is a continuum of sunspot equilibria, and the particular equilibrium on which agents ultimately coordinate may not exhibit wanted properties.

Though having their informal origins in Keynes' notion of animal spirits, analysis of sunspots has, in the past, been couched principally in the theoretical literature. However, applied macroeconomists began to take notice when, in the mid nineties, Farmer and Guo (1994) showed that calibrated real business cycle models, modified to include externalities or other non-convexities, exhibited sunspots; and furthermore, these sunspots could be used to explain fluctuations at business cycle frequencies. This applied interest has spread to the literature on monetary policy, and, in an empirical sense, has culminated with the argument of Clarida et al. (2000) that the volatile inflation and output of the seventies may have been due to sunspot phenomena. In particular, they combine a standard forward-looking 'New Keynesian' IS–AS model[1] with a simple estimated forward-looking Taylor rule, using data from the 1960s and 1970s, and find that the corresponding steady state is indeterminate; they conclude that the fluctuations in output gap and inflation may be well explained by agents coordinating on a volatile sunspot equilibrium.

The existence of sunspot equilibria raises the question of whether it is plausible that agents will actually coordinate on them. One natural criterion for this is that the sunspot equilibria should be stable under adaptive learning.[2] Although it has been shown by Woodford (1990) that stable sunspots can exist in simple overlapping generations models,[3] the sunspots in many calibrated applied models are lacking this necessary stability. For example Evans and Honkapohja (2001) show that sunspots in the Farmer–Guo model are unstable, and Evans and McGough (2002a) describe a stability puzzle surrounding the lack of stable indeterminacies in a host of non-convex RBC-type models.[4]

The existence of indeterminacies in monetary models, together with the instability of indeterminacies in RBC-type models, raises a natural question: Are sunspot equilibria in the New Keynesian models stable under learning? This specific question

[1]This model has also been called the 'New Phillips Curve' or 'optimizing IS–AS' model, and is obtained as a linearization of an optimizing equilibrium model with 'Calvo' pricing. For discussion, derivation and citations to the earlier literature, see Clarida et al. (1999), Woodford (1999) and Woodford (2003).

[2]Eductive approaches could also be considered. See, for example, Guesnerie (1992), Evans and Guesnerie (2003) and Desgranges and Negroni (2001). Stability under eductive learning appears to be somewhat more stringent than stability under adaptive learning.

[3]For the local stability conditions see Evans and Honkapohja (1994, 2003b).

[4]Other examples of stable sunspot equilibria include Howitt and McAfee (1992), Evans et al. (1998, 2001) and Evans and McGough (2005).