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Trend inflation, sticky prices, and expectational stability

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ABSTRACT

Micro evidence indicates that each period a fraction of prices is kept unchanged under a positive trend inflation rate. In a sticky price model based on this evidence, recent research shows that high trend inflation is a serious cause for indeterminacy of rational expectations equilibrium under the Taylor rule. This paper examines implications of trend inflation for expectational stability of the equilibrium. An empirically plausible calibration of the model demonstrates that a fundamental rational expectations equilibrium is likely to be expectationally stable even in cases of indeterminacy induced by high trend inflation.

1. Introduction

Recent studies have investigated implications of trend inflation for sticky price models.[1] Ascari (2004), Bakhshi et al. (2007), and Cogley and Sbordone (2008), for instance, derive a generalized New Keynesian Phillips curve from a Calvo (1983)-style sticky price model on the basis of micro evidence that each period a fraction of prices is kept unchanged under a positive trend inflation rate.[2] These studies find that higher trend inflation reduces the slope of the generalized New Keynesian Phillips curve. Focusing on this finding, Ascari and Ropele (2009) analyze its implications for determinacy of equilibrium under the Taylor (1993) rule.[3] Their main conclusion is that high trend inflation is a serious cause for indeterminacy.[4]

This paper examines implications of trend inflation for expectational stability (or E-stability) of rational expectations equilibrium (REE) under the Taylor rule in a Calvo-style sticky price model based on the micro evidence. As McCallum (2007) indicates, E-stability is very closely linked with least-squares learnability (i.e., stability under least-squares learning),

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[1] See Ascari and Sbordone (2013) for a review of this strand of literature.

[2] For recent micro evidence on price changes, see, e.g., Bils and Klenow (2004), Klenow and Kryvtsov (2008), and Nakamura and Steinsson (2008).

[3] Another paper of Ascari and Ropele (2007) examines determinacy of equilibrium under an inflation-targeting monetary policy regime in which a monetary authority seeks to minimize a loss function given by a weighted sum of expected squared deviations of inflation and output from their trend levels.

[4] Kiley (2007) obtains a similar result of equilibrium indeterminacy in a Taylor (1980)-style sticky price model.

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and this learnability is arguably a necessary property for an REE to be plausible as an equilibrium for the model at hand. In a broad class of linear models with expectations (including the log-linearized model of the present paper), a non-explosive fundamental REE is least-squares learnable if it is E-stable; otherwise, it is not least-squares learnable (Evans and Honkapohja, 2001).[5] Therefore, E-stability is an essential condition for an REE to be regarded as plausible.

In the paper an empirically plausible calibration of the model demonstrates that a fundamental REE is likely to be E-stable even in cases of indeterminacy induced by high trend inflation.[6] The model and the calibration of model parameters are based on Ascari and Ropele (2009), and high trend inflation then induces indeterminacy of REE in line with their result and generates at least one E-stable fundamental REE within a sufficiently wide range of the Taylor rule's coefficients. This E-stability is obtained because a finite elasticity of labor supply causes price distortion to affect inflation dynamics represented by a generalized New Keynesian Phillips curve, and the persistence of price distortion then generates endogenously persistent inflation dynamics. For the REE in question, E-stability examines whether an associated equilibrium in which agents form expectations under adaptive learning reaches over time the REE. Under such expectation formation, the endogenous persistence of inflation dynamics through price distortion helps agents form inflation expectations. Consequently, a fundamental REE is likely to be E-stable.[7] Moreover, a higher probability of price adjustment, a lower price elasticity of demand for differentiated goods, and a lower elasticity of labor supply are all more likely to ensure E-stability of a non-explosive fundamental REE. With a higher probability of price adjustment or a lower price elasticity of demand, REE is more likely to be determinate and E-stable, since a key condition for determinacy and E-stability is more likely to be satisfied. This condition is the long-run version of the Taylor principle: in the long run the interest rate should be raised by more than the increase in inflation. By contrast, a lower elasticity of labor supply makes this Taylor principle less likely to be met and hence leaves REE indeterminate or explosive, while it generates at least one E-stable fundamental REE in cases of indeterminacy induced by high trend inflation. This is because it strengthens the influence of price distortion on inflation dynamics and hence the endogenous persistence of inflation dynamics through price distortion, which further helps agents form inflation expectations under adaptive learning. Therefore, a lower elasticity of labor supply makes a non-explosive fundamental REE more likely to be E-stable.

In the literature, the most closely related studies have been done by Bullard and Mitra (2002) and Kobayashi and Muto (2013). In the case of the zero trend inflation rate, Bullard and Mitra analyze E-stability of fundamental REE under four specifications of the Taylor rule, i.e., forward expectations, contemporaneous expectations, and lagged data, in addition to contemporaneous data examined in the present paper. They show that a non-explosive fundamental REE is likely to be E-stable under all the four specifications if the long-run version of the Taylor principle is satisfied. Like Bullard and Mitra, the present paper shows that for low trend inflation, the long-run version of the Taylor principle is the relevant, necessary and sufficient condition for E-stability.[8] For high trend inflation, however, it is not necessarily an E-stability condition. Indeed, the paper finds a range of the Taylor rule's coefficients that do not satisfy the long-run version of the Taylor principle but generate at least one E-stable fundamental REE. Kobayashi and Muto (2013) use a Calvo-style sticky price model based on Sbordone (2007) and Cogley and Sbordone (2008) and investigate implications of trend inflation for E-stability of fundamental REE under the four specifications of the Taylor rule. The analysis of Kobayashi and Muto is complementary to the present paper in that they examine the other three specifications of the Taylor rule as well as the contemporaneous-data one but their model follows Sbordone (2007) to assume that real marginal cost does not reflect cost arising from price distortion.[9] Due to this assumption, price distortion never affects inflation dynamics represented by their generalized New Keynesian Phillips curve. Consequently, Kobayashi and Muto reach the conclusion that when trend inflation is high, all fundamental REE are likely to be E-unstable under each of the four specifications of the Taylor rule.

The remainder of the paper proceeds as follows. Section 2 presents a Calvo-style sticky price model with a non-negative trend inflation rate. In this model, Section 3 analyzes implications of trend inflation for E-stability of fundamental REE. Section 4 concludes.

2. The sticky price model with a non-negative trend inflation rate

The model is a Calvo-style sticky price model based on Ascari and Ropele (2009). The economy consists of a central bank, a representative household, a representative final-good firm, and a continuum of intermediate-good firms. In each period a fraction $\alpha \in (0,1)$ of intermediate-good firms keeps prices of their differentiated products unchanged. The trend inflation

[5] Throughout the paper, the term " fundamental" refers to Evans and Honkapohja's (2001) minimal-state-variable (MSV) solutions to linear rational expectations models to distinguish them from McCallum's (1983) original MSV solution.

[6] This paper does not examine E-stability of non-fundamental REE (e.g., sunspot equilibrium), which exists in cases of indeterminacy. For E-stability analysis of non-fundamental REE, see, e.g., Honkapohja and Mitra (2004), Carlstrom and Fuerst (2004), and Evans and McGough (2005). There are several possible reactions to the result of the present paper. One reaction would be that indeterminacy induced by high trend inflation is not important because a fundamental REE is likely to be E-stable. Another would be that there may exist an E-stable non-fundamental REE in addition to the E-stable fundamental REE. The result of the paper thus indicates that E-stability of non-fundamental REE should be investigated in future research.

[7] When the elasticity of labor supply is infinity, high trend inflation is a serious cause for not only indeterminacy but also E-instability.

[8] The long-run version of the Taylor principle is a key necessary condition for determinacy of equilibrium, regardless of the level of trend inflation, as shown by Ascari and Ropele (2009) and Kurozumi (2011).

[9] This assumption holds for the model of the present paper only in the empirically implausible case of an infinite elasticity of labor supply.