



# Learning about monetary policy rules when labor market search and matching frictions matter

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## ABSTRACT

This paper examines the implications of labor market search and matching frictions for determinacy and E-stability of rational expectations equilibrium (REE) in a sticky price model with interest rate policy. When labor adjustment takes place solely at the extensive margin, forecast-based policy that meets the Taylor principle is likely to induce indeterminacy and E-instability, regardless of whether it is strictly or flexibly inflation targeting. When labor adjustment takes place at both the extensive and intensive margins, the strictly inflation-forecast targeting policy remains likely to induce indeterminacy, but it generates a unique E-stable fundamental REE as long as the Taylor principle is satisfied. Therefore, the presence of search and matching frictions changes the determinacy properties of a strictly inflation-forecast targeting policy, and alters its E-stability properties when only an extensive margin is present but not when labor adjustment takes place at both margins.

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## 1. Introduction

Recent monetary policy literature has incorporated labor market search and matching frictions along the lines of Mortensen and Pissarides (1994) into a sticky price model and has studied their implications for optimal monetary policy (e.g., Thomas, 2008; Faia, 2009; Ravenna and Walsh, 2011; Tang, 2010) and for determinacy of equilibrium under interest rate policy (Kurozumi and Van Zandweghe, 2010).<sup>2</sup> In the latter paper, we find that strictly inflation-forecast targeting interest rate policy almost always induces indeterminacy of equilibrium in a sticky price model with only the extensive margin (i.e., variation in employment) when it meets the Taylor principle.<sup>3</sup>

In the present paper, we examine the implications for both determinacy and E-stability of rational expectations equilibrium (REE) under interest rate policy not only in a sticky price model with only the extensive margin but also in the

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<sup>2</sup> For the implications for business cycles, see Walsh (2005), Krause and Lubik (2007), Sveen and Weinke (2009), Trigari (2009), and Van Zandweghe (2010) among others.

<sup>3</sup> After the working-paper version of this paper (Kurozumi and Van Zandweghe, 2008) was released, two related works emerged, both of which employ the Blanchard and Galí (2010) sticky price model with hiring costs. Tesfaselassie and Schaling (2009) show the importance of the size of the hiring costs for the policy response to unemployment that ensures determinacy and E-stability. Rannenberg (2009) introduces skill decay during unemployment into the model and analyzes its implications for the Taylor principle.

one with both the extensive and intensive margins (i.e., changes in both employment and hours per worker). As [McCallum \(2007\)](#) points out, E-stability is very closely linked with least-squares learnability (i.e., stability under least-squares learning), and this learnability is arguably a necessary property for an REE to be plausible as an equilibrium for the model at hand. For a broad class of linear models with expectations (including the model of this paper), an REE is least-squares learnable when it is E-stable and non-explosive. If an REE is not E-stable, it is not stable under least-squares learning. Therefore, E-stability is an essential condition for an REE to be regarded as plausible.

This paper has two main results. First, when labor adjustment takes place solely at the extensive margin, the strictly inflation-forecast targeting interest rate policy is likely to induce E-instability as well as indeterminacy. Specifically, this policy generates a unique E-stable fundamental REE only if the Taylor principle is satisfied and the policy coefficient on the inflation forecast is either not large or very large.<sup>4</sup> Only a policy coefficient in these two intervals succeeds in guiding temporary equilibria under non-rational expectations toward the unique E-stable REE. Because the intermediate interval that yields indeterminate E-unstable REE contains all empirically plausible values of the policy coefficient, the equilibrium multiplicity induced by the strictly inflation-forecast targeting policy is a critical issue even from the perspective of E-stability or least-squares learnability of REE.<sup>5</sup> Moreover, when the forecast-based interest rate policy is flexibly inflation targeting (i.e., it responds to an unemployment forecast in addition to the inflation forecast), it remains very unlikely to generate a determinate E-stable REE or a unique E-stable fundamental REE.<sup>6</sup> This result is in contrast to that of [Bullard and Mitra \(2002\)](#), who show that, in the absence of labor market frictions, forecast-based policy yields a determinate E-stable REE or a unique E-stable fundamental REE as long as the Taylor principle is satisfied, regardless of whether it is strictly or flexibly inflation targeting.

Second, when labor adjustment takes place at both the extensive and intensive margins, the strictly inflation-forecast targeting policy remains likely to induce indeterminacy. Despite the existence of multiple fundamental REE, however, this policy generates a unique E-stable fundamental REE as long as the Taylor principle is satisfied, in line with the result of [Bullard and Mitra \(2002\)](#). Therefore, in the presence of both margins, the equilibrium multiplicity induced by the strictly inflation-forecast targeting policy is not a critical issue from the perspective of E-stability or least-squares learnability of fundamental REE.<sup>7</sup> Moreover, the flexibly inflation-forecast targeting policy is likely to generate a determinate E-stable REE.

These two results suggest that the presence of the labor market search and matching frictions changes the determinacy properties of the strictly inflation-forecast targeting interest rate policy, and that it alters the E-stability properties of the policy when only an extensive margin is present but not when labor adjustment takes place at both margins.

The remainder of the paper proceeds as follows. [Section 2](#) describes a sticky price model with labor market search and matching frictions. [Section 3](#) presents the analysis of E-stability as well as determinacy under interest rate policy. [Section 4](#) conducts a sensitivity analysis with respect to values of structural parameters of the model. [Section 5](#) concludes.

## 2. A sticky price model with labor market search and matching frictions

The model is a sticky price model with search and matching frictions in the labor market. It is in line with the models used in recent business cycle studies, such as [Walsh \(2005\)](#), [Krause and Lubik \(2007\)](#), [Sveen and Weinke \(2009\)](#), [Trigari \(2009\)](#), and [Van Zandweghe \(2010\)](#), and in recent monetary policy studies, such as [Thomas \(2008\)](#), [Faia \(2009\)](#), [Ravenna and Walsh \(2011\)](#), [Tang \(2010\)](#), and [Kurozumi and Van Zandweghe \(2010\)](#).

The model economy is inhabited by four types of agents. First, the representative household consists of a continuum of members. Some members are employed and others search for jobs, but all members provide each other with insurance against unemployment risk by making joint consumption and saving decisions. Second, the representative wholesale firm hires workers in the matching market and uses a labor-only technology to produce homogeneous goods. Third, retail firms differentiate the wholesale goods at no cost and set prices of their products on a staggered basis as in [Calvo \(1983\)](#) and [Yun \(1996\)](#). Last, the monetary authority sets its policy rate according to a [Taylor \(1993\)](#) style rule.

### 2.1. Labor market

The labor market is characterized by search and matching frictions along the lines of [Mortensen and Pissarides \(1994\)](#). Unemployed workers search for jobs, and firms pay a flow cost  $P_t\gamma$  to maintain a job opening in period  $t$ . At the beginning of the period, a proportion  $\rho \in (0, 1)$  of existing matches  $n_{t-1}$  is exogenously destroyed before matching starts. Newly

<sup>4</sup> Throughout the paper, the term “fundamental” refers to [Evans and Honkapohja’s \(2001\)](#) minimal state variable (MSV) solutions to linear RE models to distinguish them from [McCallum’s \(1983\)](#) original MSV solution.

<sup>5</sup> When interest rate policy targets the current inflation rate or its contemporaneous expectations, a determinate E-stable REE is generated as long as the Taylor principle is satisfied.

<sup>6</sup> A sufficiently high degree of interest rate smoothing, with a policy coefficient on the inflation forecast that meets the Taylor principle, yields a determinate E-stable REE.

<sup>7</sup> This paper does not examine E-stability of non-fundamental REE such as sunspot equilibria, which may exist in cases of indeterminacy. For E-stability analysis of these REE, see, e.g., [Honkapohja and Mitra \(2004\)](#), [Carlstrom and Fuerst \(2004\)](#), and [Evans and McGough \(2005\)](#), who all study the case of no labor market frictions.

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