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Flexible prices, labor market frictions and the response of employment to technology shocks☆

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HIGHLIGHTS

- This paper shows that labor market frictions enable a standard RBC model to match this stylized fact.
- The analysis develops and estimates a RBC model with labor market frictions using Bayesian methods.

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ABSTRACT

Recent empirical evidence establishes that a positive technology shock leads to a decline in labor inputs. Standard RBC models fails to replicate this stylized fact, while recent papers show that augmenting the model with implementation lags, or habit formation, or shock persistence in growth rates among others accounts for this fact. In this paper, we show that a standard flexible price model with labor market frictions that allows hiring costs to depend on technology shocks may also lead to the same negative impact on labor inputs. Labor market frictions are therefore able to account for the fall in labor inputs. However, the elasticity of hiring costs to technology shocks is large, suggesting that additional extensions to the model are needed.

1. Introduction

Galí (1999) and a number of subsequent studies show that technology shocks have a contractionary effect on employment.[2] In a standard flexible price model, a positive technology shock increases employment since output rises on impact and additional labor inputs are required to keep pace with higher technology.

This paper investigates whether a standard flexible price model enriched with labor market frictions is able to generate the negative response of employment to a technology shock.[3] In order to investigate this issue, we set up a standard flexible price model that allows, but does not require, labor market frictions to generate a negative response of employment to technology shocks. We estimate the model using Bayesian methods and find that the data strongly prefer the version of the model in which labor market frictions generate a negative response of employment to technology shocks.

As mentioned, the presence of labor market frictions overturns the positive reaction of employment to a technology shock in the standard flexible price model. The intuition is straightforward. In the standard flexible price model, households supply labor until the marginal disutility from supplying an additional unit of labor equals its marginal contribution to production. An increase in productivity induces the household to supply more labor in response to a technology shock. In a labor market characterized by search and matching frictions, workers and firms

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[2] See Mumtaz and Zanetti (2012a) and references therein for a recent review of the literature on this topic.

[3] As detailed below, a number of recent studies propose alternative mechanisms to generate the negative response of employment to a positive technology shock in the context of flexible price models. This paper is the first study that addresses the issue using labor market frictions, modeled as in Thomas (2008) and Blanchard and Galí (2010), which are empirically relevant and theoretically appealing.

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face a cost in forming a match, and therefore the optimal choice of labor units also depends on the cost of hiring an additional worker. Depending on how the cost of hiring reacts to productivity, the response of employment to a technology shock can be either positive or negative. For instance, if hiring costs co-move positively with productivity, a technology shock increases the marginal product of labor (as in the standard flexible price model), but it also increases the cost of recruiting an extra worker. If the latter effect is sufficiently strong, employment reacts negatively to a technology because hiring costs reduce the marginal contribution to production of an additional unit of labor. In principle, as Yashiv (2000) and Rotemberg (2006) point out, hiring costs can be either pro- or counter-cyclical. On one hand, recessions represent times of low opportunity costs, thereby implying more re-structuring of the workforce so that firms devote more resources to screening and lead to counter-cyclical hiring costs. On the other hand, recessions also are times when, due to the high availability of workers looking for jobs, the cost of advertising is low, encouraging hiring costs to be pro-cyclical. In this paper, we internalize both mechanisms by allowing hiring costs to react directly to productivity and leaving the data to establish whether the reaction is pro- or counter-cyclical. The estimation of the model reveals that labor market frictions enable a flexible price model to generate a decline in labor inputs in response to a positive technology shock.

Before proceeding with the analysis, we relate this work to studies that develop real business cycle (RBC) models able to replicate the negative response of labor input to a positive technology shock and we then position the paper in the broader context of the literature. Hairault et al. (1997) embed implementation lags in the adoption of new technology into a standard RBC model to make future productivity higher than the current level, thereby decreasing current labor supply for a given increase in labor demand and, consequently, generating a negative response of employment to a technology shock. Francis and Ramey (2005) introduce habit formation in consumption together with adjustment costs on investment and Leontief technology with variable utilization to match the negative effect of a technology shock on employment. Lindé (2009) observes that if the permanent technology shock is persistent in growth rates, labor inputs fall on impact. Collard and Dellas (2007), using an international RBC model, show that if the degree of substitution between domestic and foreign goods is low, the reaction of employment to a technology shock is negative. Finally, Wang and Wen (2011) demonstrate that a RBC model with firm entry and exit, in which firms need time-to-build before earning profits, also delivers a negative response of employment to a technology shock. All of these works show that by appropriately modifying the standard RBC model, the underlying framework matches the empirical negative response of employment to productivity shocks. Unlike these studies, our paper is the first to address the issue with a RBC model enriched with labor market frictions. This framework is empirically relevant and theoretically appealing. Empirically, Rogerson and Shimer (2010) show that labor markets are characterized by frictions that prevent the competitive market mechanism from determining labor market equilibrium allocations, thereby suggesting that their presence is important for a realistic description of the functioning of the labor market. Theoretically, labor market frictions introduce the extensive margin of labor (i.e. (un)employment) into the model, whereas this dimension is absent in standard models of the labor market. Importantly for the analysis in the paper, labor market frictions enable the model to replicate the negative reaction of employment to a positive technology shock.

In the broader context of the literature, the empirical results in Galí (1999) have generated significant interest as they contradict the fundamental prediction of the neoclassical real business cycle framework (i.e. employment reacts positively to neutral technology shocks).[4] Such evidence not only challenges the real business cycle paradigm, but points to the New-Keynesian sticky-price model as suitable framework to deliver the negative response of employment to technology shocks. Several papers have challenged Gali's findings, generating a remarkable and still unsettled debate. Christiano et al. (2003) use the identifying assumptions of Galí (1999) and establish that results reverse when the estimation is conducted with data of hours worked in levels rather than in differences. Alexopoulos (2011) also challenges Gali's results and finds a positive response of hours to changes in technology when the measure of technical change is based on books published in the field of technology. Similarly, Christiano et al. (2004) also find results contradicting Gali when they use estimates of technological innovations from the Solow residual using the methodology in Basu et al. (1998) to identify the effect of technological innovations on labor input. However, in a subsequent study Kimball et al. (2006) show that a refined measure of the Solow residual that accounts for increasing returns, imperfect competition and varying capital utilization produces results that are consistent with Galí (1999). Similarly, Francis and Ramey (2005) provide further support to Gali's findings using a variety of robustness checks and alternative over-identifying restrictions.

The remainder of the paper is organized as follows. Section 2 lays out the theoretical model. Section 3 describes the solution, data and estimation. Section 4 investigates the role of labor market frictions, and Section 5 concludes.

2. The model

A standard flexible price model is enriched to allow for labor market frictions of the Diamond–Mortensen–Pissarides model of search and matching, as in Thomas (2008) and Blanchard and Galí (2010). As in Galí's (1999) original study, our setting abstracts away from investment and capital accumulation and, in addition, assumes that the processes of job searching and recruitment are costly for both the firm and the worker.[5]

The economy is populated by a continuum of infinite-living identical households that produce goods by employing labor. Members of the household are either employed or searching for a job while unemployed. During each period, a constant fraction of jobs is destroyed and labor is employed through hiring, a costly process. Each household maximizes the utility function:

$$E\sum_{t=0}^{\infty}\beta^t\varepsilon_t^b\left(lnC_t-\varepsilon_t^l\frac{N_t^{1+\phi}}{1+\phi}\right), \tag{1}$$

where C_t is consumption, N_t is the fraction of household members who are employed, β is the discount factor such that $0 < \beta < 1$ and ϕ is the inverse of the Frisch intertemporal elasticity of substitution in labor supply such that $\phi \geq 0$. In this model we assume full participation, such that the members of a household can be either employed or unemployed, which implies $0 < N_t < 1$. Eq. (1), similar to Smets and Wouters (2003), contains two preference shocks: ε_t^b represents a shock to the discount rate that affects the intertemporal rate of substitution between consumption in different periods, and ε_t^l represents a shock to the labor supply. Both shocks are assumed to follow a first-order autoregressive process with i.i.d. normal error terms such that $\varepsilon_{t+1}^b = \left(\varepsilon_t^b\right)^{\rho_b} exp\left(\eta_{b,t+1}\right)$, where $0 < \rho_b < 0$, $\eta_b \sim N(0,\sigma_b)$, and similarly,

[4] The appendix discusses the role of investment-specific technology shocks.

[5] This paper does not focus on investment-specific technology shock for two reasons. First, there is no clear consensus on their importance. For instance, Fisher (2006) finds them important in the context of a SVAR model. However, Schmitt-Grohe and Uribe (2012) and Mandelman et al. (2011) find that they play a minor role when the full-information Bayesian approach strategy is implemented to estimate business cycle models with investment-specific technology shocks. Second, and more important, the focus of the paper is different. Our objective is not to replicate the SVAR facts, or to take a particular stance on the importance of investment-specific technology shocks. We instead aim to show that a standard flexible price real business cycle model is compatible with Gali's original results once it incorporates labor market frictions. It would be certainly be valuable extension for future research.