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Inflation and output dynamics in a model with labor market search and capital accumulation ☆

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ABSTRACT

In a sticky-price model with labor market search and habit persistence, Walsh (2005) shows that inertia in the interest rate policy helps to reconcile the inflation and output persistence with empirical observations for the US economy. We show that this finding is sensitive with regard to the introduction of capital formation. While we are able to replicate the findings for the inflation inertia in a model with capital adjustment costs and variable capacity utilization, the output response to an interest shock is found to be too large and no longer hump-shaped in this case. In addition we find that the response of output to a technology shock can only be reconciled with empirical findings if either the adjustment of the utilization rate is very costly or there is only a modest amount of nominal rigidity in the economy.

1. Introduction

There is ample evidence from structural vector autoregressions using different identification schemes and data sets that a sudden increase of the short term nominal interest rate produces a persistent and hump-shaped response of output and inflation.[1] In recent studies, labor market imperfections have been introduced into monetary business cycle models in order to replicate these findings. Christiano et al. (2005) model nominal rigidities in the form of both price and wage staggering in order to explain the observed inertia in inflation after a monetary expansion. Walsh (2005), Trigari (2006, 2009), and Christoffel et al. (2009) consider search and matching frictions in the labor market. Walsh (2005) finds that the inertia of the interest rate policy itself is an important contributing factor for the explanation of the inflation and output inertia. Trigari (2006, 2009) considers the effects of the wage bargaining process on the variation of both inflation and real wages following a monetary shock, while Christoffel et al. (2009) study the sensitivity of her results with regard to the introduction

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[1] See, among others, Sims (1992), Leeper et al. (1996), and Christiano et al. (1999, 2005).

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of wage rigidity, on-the-job search, and endogenous separation. In addition to Walsh (2005), the latter two studies also allow for the variation of labor at both the intensive and the extensive margin.[2]

In this paper, we consider the sensitivity of these recent studies with respect to the introduction of capital. Our economy is based upon the model of Walsh (2005) in which we introduce capital as a second production factor besides labor. The reasoning why capital may introduce a different dynamic response of inflation and output to a monetary shock is as follows: In the model of Walsh (2005) the marginal costs of price setters equal the relative price of intermediate goods in terms of the final good. Intermediate good firms adjust their nominal price immediately while wholesale firms respond only sluggishly to a demand or supply shock. Thus, marginal costs of price setters decrease in response to a negative demand shock. The size of this shock depends on the response of the household sector to an increase of the nominal interest rate. Without capital and with habit persistence in consumption this effect is small. However, if capital allows for intertemporal substitution, overall demand can decrease significantly. Obviously, the adjustment of capital as a second factor of production also affects the dynamics of output.

As one of our main results, our model with capital is able to generate inflation dynamics following an interest rate shock that is in accordance with empirical observations. Therefore, we are able to confirm this finding of Walsh (2005) who considers a model without capital. Similar to Christiano et al. (2005), we also find that the introduction of variable capital utilization is an important factor for the modelling of the inertia in the inflation dynamics. In this case, rather the capacity than the investment demand increases after a fall in the interest rate so that the real interest rate displays a smaller variation. In the model with capital, however, an unexpected rise in the nominal interest rate does not trigger a hump-shaped response of output, quite contrary to the model without capital.

The main reason why the model of Christiano et al. (2005) is able to generate a more persistent and hump-shaped response of output than our model is the introduction of real wage rigidity in their model. In their Fig. 4, Christiano et al. (2005) show that, in the case of flexible rather than sticky wages, the impulse response of output also peaks in the first period following the monetary shock. With sticky wages, however, marginal costs do not surge in the period after the shock and output does not return quickly to its steady state value. In a standard labor market model with search frictions, however, the real wage plays no allocational role but splits the rents associated with a successful match between the firm and the worker. It requires additional assumptions, as in Trigari (2006) and Christoffel et al. (2009) where the firms decide about working hours after the wage bargain, to create a channel from wages to marginal costs. In this setting sticky wages can generate a more inertial response of inflation (Christoffel et al., 2009).

In addition to the studies, we also analyze the effects of a technology shock on the output-inflation dynamics. Most studies including Walsh (2005), Christiano et al. (2005), or Trigari (2006, 2009) neglect this question. We consider it an interesting problem because a researcher is ultimately aiming for a monetary general equilibrium model that is able to match the empirical responses to various kinds of supply, demand, and policy shocks simultaneously. As one prominent example, consider the analysis of optimal monetary policy and to what extent the monetary authority should respond to a productivity shock. Here, too, we find that while the inflation dynamics is insensitive to the assumption of fixed capital services the output dynamics is not. In line with empirical evidence, we get a protracted hump-shaped decline of the rate of inflation in response to a productivity shock in our model with capital accumulation and a variable utilization rate of capital. However, this model also implies a significant immediate decrease of output that is not observed in estimated impulse response functions. We can reconcile the model with empirical evidence if we either assume that it is very costly to adjust the utilization rate of capital or that the degree of nominal rigidity in our model economy is small.

The remainder of the paper is structured as follows. Section 2 introduces the model. In Section 3, we describe the calibration and computation of the model. Sections 4–6 present our results. In Section 4 we study the second moments of the model. In Sections 5 and 6, we analyze the impulse responses of the model following an interest rate and a technology shock, respectively, and compare them to empirical estimates. Section 7 concludes. Technical Appendices A–D document details of our computation and estimation procedures.

2. The model economy

In this section, we describe our model that is based upon Walsh (2005). Three different sectors are depicted: firms, households, and the monetary authority.

2.1. Firms

2.1.1. Retail sector

A final goods or retail sector buys differentiated goods Y_{jt} distributed over the unit interval, $j \in [0, 1]$, from wholesale firms and assembles the final output Y_t according to

[2] Subsequently, the labor market search model has also been prominently applied to the analysis of the Ramsey policy as, e.g., in Faia (2008), or the study of the business-cycle dynamics of wages as in Rotemberg (2006).