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The role of money in DSGE models: a forecasting perspective

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ABSTRACT

This paper studies the importance of money in a New Keynesian model by considering the forecasting performance of DSGE models both without and with money. While the estimation results are in line with previous studies, favoring the inclusion of money mostly in the form of portfolio adjustment and policy effects, a few interesting results emerge with respect to the accuracy of forecasts. Along with the various filtering methods and forecasting methods used (both recursive and rolling), in many cases money tends to improve the forecasts, either for point forecasts, density forecasts or both. However, the detrending method seems to influence the particular findings. Paradoxically, the absence of a portfolio adjustment costs channel tends to generally improve the accuracy of forecasts.

1. Introduction

How important is money in a New Keynesian model? Leading monetary scholar Woodford's seminal papers and works, see for example Woodford (2003) or Woodford (2008), suggest that money does not matter for the conduct of monetary policy.

Recent research, however, has contradicted this thesis. Sims and Zha (2006) and Favara and Giordani (2009) used SVAR models to show that LM shocks matter for output and prices.

Structural models used to study the impact of money can be traced back to the seminal work by Nelson (2002) and Ireland (2004), with the latter relaxing the usual assumed nonseparability between consumption and real money balances. Ireland (2004) suggests that there exists evidence favoring the assumption of separability, although the role of money is not significant. Further work has been done by Andres et al. (2006) using a model with habit formation and price indexation, which confirms the results by Ireland on a dataset from the Euro zone. Furthermore, Andres et al. (2009) extend the earlier work by Nelson (2002), Ireland (2004) and Andres et al. (2006) by using a model that embeds the previous specifications as particular cases. Their most important finding is that their model favors the portfolio adjustment costs channel, at least for the US and the Euro zone.

With the help of a DSGE model, Arestis et al. (2010) found that money can significantly influence the estimates of potential output. Within an SVAR framework, according to them, money also influences monetary shocks.

Work looking for international evidence on the role of money in New Keynesian models has been carried out by Canova and Menz (2011), who estimated a simple New Keynesian model for four developed economies, the US, the Eurozone, the UK and Japan. They found strong evidence in favor of a positive role for money in explaining the business cycles of these economies (in the form of nonseparability).

In contrast to previous work, Castelnuovo (2012) contributed to the literature by considering the dynamic role of money in time through recursive estimations along a sliding window. Through Bayesian estimation, he was also able to discriminate

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between the models with the help of Bayes factors. According to him, the role of money was important during the 1970s but has diminished since. Further significant research has also been carried by Benchimol and Fourçans (2012, 2015).

The present paper contributes to the previous body of work in several ways. First of all, it is based on the state-of-art model by Andres et al. (2009). This model is estimated with Bayesian techniques as in Castelnuovo (2012). In contrast to previous studies, however, the role of money is evaluated not only based on Bayes factors and estimated values of the key parameters related to money, but also on the forecasting performance of models with and without money. Furthermore, as Castelnuovo (2012) argued, it is important to have a grasp on the time-varying role of money, which, in our case, is done by recursively estimating and forecasting the models. Second, in evaluating the role of money in the forecasting accuracy for key variables like output, inflation and interest rate, we also contribute to the forecasting literature by studying how certain micro-foundations (money, in this case) influence forecasting accuracy, using both point and density forecasts. Unfortunately, few papers in the literature have studied the effects of certain micro-foundations on forecasting accuracy. A few examples are Kolasa and Rubaszek (2014), who studied the effects of financial frictions on forecasting accuracy during both moderate times and turbulent times, or Del Negro and Schorfheide (2013) who studied whether extending the Smets–Wouters model with financial frictions can improve forecasting accuracy for the American economy during the Great Recession.

Thus, this paper asks three fundamental questions: does extending a stylized New Keynesian model with money in any way improve forecasting accuracy for key macroeconomic variables? What specifications (or combinations of forecasts) provide the best accuracy? How do the Great Moderation and the Great Recession influence forecasting accuracy?

The main findings of this paper are as follows. The estimation results confirm the findings in previous papers, favoring both portfolio adjustment and policy effects. Although the estimate of the coefficient corresponding to nonseparability is positive, the credible sets nevertheless include the value zero. Besides the model with no money effects along the model with money featuring all three effects, three further models are considered in the forecasting exercises, each one excluding one effect at a time. The forecasts are compared both for point forecasts and density forecasts. We find that including money generally tends to lead to better forecasts, although the filtering method, the type of forecast (rolling or recursive) and the measure of money used tend to influence forecast accuracy. Nevertheless, while the forecasts obtained by models featuring money do offer some advantages, they appear to be generally inefficient and have badly calibrated forecast densities.

2. The model

The paper built on the state-of-art model was proposed by Andres et al. (2009). The main advantage of this model is that it encompasses all of the most significant previous alternatives, as seen in Nelson (2002), Ireland (2004) or Andres et al. (2006). More specifically, the model encompasses the nonseparability effect, the direct effect and the policy effect. I use the standard strategy generally followed for this particular line of research, that is, I consider a small-scale DSGE model that specifically focuses on the role of money. While such models are not well-developed medium-scale models, such as those by Smets and Wouters (2007), they nevertheless allow a focus on the essential channels through which money affects output and inflation.

The problem of the representative household consists of finding the optimal choice of consumption C_t, labor supply (or the hours worked) N_t, money supply M_t and bond holdings B_t in order to maximize the lifetime utility given by:

$$\max_{C_t,N_t,M_t,B_t} E_0 \sum_{t=0}^{\infty} \beta^t a_t \left[\psi\left(\frac{C_t}{C_{t-1}^h}, \frac{M_t}{e_t P_t} \right) - \frac{N_t^{1+\phi}}{1+\phi} \right] - G(\bullet) \tag{1}$$

The variable a_t stands for the preference shocks, e_t for the money demand shocks. The parameter β stands for the discount factor, φ is the inverse of Frisch labor elasticity and h is the degree of habit formation. There is nonseparability across consumption and real balances in the preferences which results in allowing for money to enter the IS equation through the so-called nonseparability channel.

The function $G(.)$ is given by:

$$G(\bullet) = \frac{d}{2}\left\{ \exp\left(c\left\{ \frac{M_t/P_t}{M_{t-1}/P_{t-1}} - 1 \right\} \right) + \exp\left(-c\left\{ \frac{M_t/P_t}{M_{t-1}/P_{t-1}} - 1 \right\} \right) - 2 \right\} \tag{2}$$

Here the parameters c and d stands for portfolio adjustment costs. This allows for the direct effects of money through portfolio adjustment costs channel as proposed by Nelson (2002).

The intertemporal budget constraint is given by:

$$\frac{M_{t-1} + B_{t-1} + W_t N_t + T_t + D_t}{P_t} = C_t + \frac{B_t/r_t + M_t}{P_t} \tag{3}$$

where T_t are the lump-sum transfers, D_t stand for the firms' dividends, W_t are the nominal wages, P_t the prices and, finally, r_t is the gross interest rate.

C_t stands for the CES aggregator of the different goods which are consumed, and is given by:

$$C_t = \int_0^1 \left(C_t(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right)^{\frac{\varepsilon}{\varepsilon-1}} \tag{4}$$

I turn now to the production side. There is a continuum of producing firms which are indexed by $j \in [0, 1]$.