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Money and output causality: A structural approach

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ABSTRACT

Using a new methodology, this paper revisits the question of whether money causes output and inflation. The causality between money and output is studied conditional on estimated DSGE models which allow for consideration of various channels where money and output interact. The causality tests are also conditioned on the structural shocks affecting both money and output. The results show that causality from money to either inflation or output at various horizons and for various specifications can be influenced by the preference, technological or interest rate shocks. It further shows that causality between money and output is not dependent on money demand shocks, though when money demand shocks are absent, there is no causality between money and inflation. Further robustness tests indicate that the results are also influenced by the filtering method used, although most of them are robust to the alternative filtering methods used before estimating the models.

1. Introduction

Does money cause output? This is one of the key questions in macroeconomics that is still disputed. The research on this question dates back to the contributions by Sims (1972, 1980). Sims (1972) found that, for the case of postwar US data, there is a Granger causality from money to output. However, later research has emphasized that this finding is sensitive to the data sample, the choice of money measure and econometric specification, see for example Christiano and Ljungqvist (1988) or Stock and Watson (1989).

More recent research has approached this issue based on alternative econometric methodologies. For example, Ravn, Psaradakis, and Sola (2005) used VAR models with time-varying parameters. They found that the causality between money and output varies in time. Berger and Österholm (2009) used out-of-sample forecasts of Bayesian VARs either including or excluding the M2 monetary aggregate. For the case of the US, their results suggested causality from money to output.

A rather different route has been taken by using DSGE models augmented with money. This recent literature has been motivated by the fact that while the standard New Keynesian model, as presented by Woodford (2003, 2008) or Galí (2008), does not include any measure of money, empirical research rather suggests that money matters for the fluctuations of output, see for example Favara and Giordani (2009). At the same time, the literature builds on the earlier work by Nelson (2002); Ireland (2004) or Andrés, López-Salido, and Valles (2006), which suggested that money has a significant role for business cycles in a dynamic general equilibrium setting.

Andrés, López-Salido, and Nelson (2009) considered a model that embedded the previous specifications due to Nelson (2002) or Ireland (2004). Their main result was that the portfolio-adjustment costs channel was favored for the particular cases of the US and the Eurozone.

Castelnouvo (2012) used a DSGE model with money inspired from the more general specification in Andrés et al. (2009). He showed that such a model was better able to reproduce the dynamics of US output than a typical New Keynesian model.

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International evidence as to the role of money was provided by Canova and Menz (2011). They used a small-scale New Keynesian model which was estimated for the US, the Eurozone, Japan and the United Kingdom. Their main finding was that monetary aggregates made a significant contribution to explaining the dynamics of the output.

Finally, the literature on the role of money in DSGE models is not only large but also growing fast. Some of the most significant recent research includes work by Benchimol and Fourçans (2012, 2015).

The present paper contributes to the previous body of work in several ways. First of all, it studies whether money causes output conditional on a structural model. While there is a developed literature, using various econometric approaches, on whether money causes output, whether this causality holds or not conditional on a DSGE model under different specifications remains less studied. At the same time, a sizable recent literature asks whether money has any effects on output by using evidences from estimated DSGE models augmented with money. Thus, a second contribution is to link this literature to the wider literature on money-income causality based on econometric methods. Thirdly, while the DSGE literature usually studies the impact of money on output based on the estimated parameters of the model related to money, variance decomposition as well as impulse response functions, this paper links the money-output causality not only on a structural model but also according to the shocks affecting the two variables. As far as I am aware, this issue has not as yet been addressed in the literature.

This paper's fundamental question is therefore whether money causes output conditional on both a structural model and the structural shocks affecting the two variables. To provide an answer, a New Keynesian model featuring various channels for the role of money on output is estimated on US data. The paper proceeds by performing Granger causality tests between money and output and money and inflation using simulated data from the estimated models. The tests are performed conditional on both the model and the shocks affecting the variables of interest (money, on the one hand, and output and inflation on the other).

The main findings of this paper are as follows. Generally, causality from money to output or inflation was found when all shocks were considered, irrespective of the specification used, which is in line with what the filtered series indicate. When preference, technological or interest rate shocks were absent, there were some departures from the findings for the aggregate case, depending on the specification or horizon considered. For the particular case of monetary shocks, not only did their absence not negatively influence the causality of money to output, such causality was even stronger. In the case of inflation, by contrast, no causality between money and inflation was found in the absence of money shocks, suggesting a different causality mechanism from money depending on the macroeconomic variable considered. When moving to robustness exercises with alternative approaches to filtering, some differences emerged, although the main findings remained about the same.

2. The model

The reference models in DSGE modeling are the medium-scaled models by Christiano, Eichenbaum, and Evans (2009) and Smets and Wouters (2007). Alongside the basic ingredients of standard models in the DSGE literature, see for example Woodford (2003) or Galí (2008), they consider other key features that improve the fit of the models, such as wage rigidities, habit formation or capital adjustment costs. The model in this section does not build on the aforementioned medium-scale DSGE models, but rather addresses the issue of the lack of a role for money in standard New Keynesian models such as Woodford's (2003). There are several reasons for doing this. First of all, this paper relates to a whole line of research, beginning with Ireland (2004), including money in conventional models. Comparability with previous papers on this topic was therefore key. Secondly, the paper focuses on the specific role of money, while avoiding other features of standard DSGE models, in order to focus on the channels through which money works and not on finding the model that fits best. Third, given that various channels for the role of money are considered here, the model results in complicated equations for IS curve or for marginal costs, which would be further complicated by adding other features, making the estimation and interpretation harder.

It is well known that there are three different channels through which money affects the output, the nonseparability channel, the direct channel and the policy channel. This paper builds on the more recent specification in Andrés et al. (2009), which encompasses all three effects, while earlier researches have emphasized one or other of these channels.

There is a representative household which optimally chooses consumption C_t, labor supply (or the hours worked) N_t, money supply M_t. and bond holdings B_t so that the lifetime utility is maximized:

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

Here, a_t represents the preference shocks, and e_t the money demand shocks. The discount factor is given by β, φ is the inverse of Frisch labor elasticity. This specification of the utility function implies a nonseparability across consumption and real balances in the preferences. This leads to the emergence of the nonseparability channel that consists of the IS curve being characterized by the presence of money.

The specification above includes a $G()$ function which is presented below:

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