Journal of Monetary Economics 60 (2013) 900–916

Contents lists available at ScienceDirect

Journal of Monetary Economics

journal homepage: www.elsevier.com/locate/jme

Precautionary money demand in a business-cycle model ☆

Irina A. Telyukova [a,*], Ludo Visschers [b,c]

[a] University of California, San Diego, 9500 Gilman Drive, 0508, La Jolla, CA 92093-0508, United States
[b] Universidad Carlos III de Madrid, Spain
[c] University of Edinburgh, United Kingdom

ARTICLE INFO

Article history:
Received 22 March 2011
Received in revised form
21 August 2013
Accepted 22 August 2013
Available online 31 August 2013

Keywords:
Precautionary money demand
Velocity of money
Business cycle
Idiosyncratic risk

ABSTRACT

Precautionary demand for money is significant in the data, and may have important implications for business-cycle dynamics of velocity and other nominal aggregates. Accounting for such dynamics is a standing challenge in monetary macroeconomics: standard business-cycle models that have incorporated money have failed to generate realistic predictions in this regard. In those models, the only uncertainty affecting money demand is aggregate. We investigate a model with uninsurable *idiosyncratic* uncertainty about liquidity need. The resulting precautionary motive for holding money produces substantial improvements in accounting for business-cycle behavior of nominal variables, at no cost to real variables.

1. Introduction

In monetary macroeconomics, it is an outstanding challenge to account for business-cycle behavior of nominal aggregates and their interaction with real aggregates. Previous models that have tried to incorporate money explicitly through, for example, cash-in-advance constraints, have done so while assuming that agents face only aggregate risk, which has resulted in the demand for money being largely deterministic, so that the cash-in-advance constraint almost always binds. Such models have unrealistic implications for the dynamics of nominal variables, as well as for the interaction between real and nominal variables, when compared to the data (Cooley and Hansen, 1995; Hodrick et al., 1991).

This paper presents a theoretical and quantitative investigation of aggregate business-cycle implications of the *precautionary* demand for money. Precautionary motive for holding liquidity appears strong in the data. Telyukova (2013) documents that the median household has about 50% more liquidity than it spends on average per month, and that controlling for observables, consumption of goods requiring a liquid payment method (e.g. cash or check) exhibits volatility consistent with the presence of significant idiosyncratic risk. This risk and the resulting precautionary money demand may have important implications for aggregate money demand and other nominal variables. The goal of this paper is to investigate whether precautionary demand for money can help account for business-cycle dynamics of the velocity of money, interest rates and inflation, and their interaction with real variables.

We study the relevant mechanisms qualitatively and quantitatively in a model that combines, in each period, two types of markets in a sequential manner, and where both aggregate and idiosyncratic uncertainty are present. The first-subperiod market, termed the "credit market", is Walrasian. It is close to a standard real business-cycle model, with the production

☆ First version: June 2008.

* Corresponding author. Tel.: +1 858 822 2097.
E-mail address: itelyukova@ucsd.edu (I.A. Telyukova).

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http://dx.doi.org/10.1016/j.jmoneco.2013.08.006

function subject to aggregate productivity shocks, but has two distinguishing features. First, households have to decide how much money to carry out of this market for future cash consumption. Second, part of the output in the credit market is carried into the cash market by retail firms, who buy these goods on credit and subsequently transform them into cash good. This introduces an explicit link between the real and monetary sectors of the economy, as credit-market capital becomes indirectly productive in the cash market.

The second market is also competitive, but in it, agents must consume with money; this is the "cash market".[1] At the start of this subperiod, households are subject to uninsurable idiosyncratic preference shocks which determine how much of the cash goods they want to consume, but the realization of the shock is not known at the time when agents make their portfolio decisions. This generates precautionary motive for holding money. We show analytically how the idiosyncratic shocks, and the resulting heterogeneity of households, result in amplified dynamics of velocity of money, and how in their absence, the model can produce counterfactual nominal dynamics under standard parameter values.

The calibration of the model is in itself a contribution. All the existing models of the type mentioned above that have looked at aggregate behavior of nominal variables have been calibrated to aggregate data. Instead, this paper also uses household-level data on liquid consumption from the Consumer Expenditure Survey, like in Telyukova (2013), to calibrate idiosyncratic preference risk in the cash market. In general, in the few contexts where precautionary liquidity demand has appeared, it has been treated as a free parameter (e.g. Faig and Jerez, 2006). The use of household data tightly disciplines measurement of the risk, and hence of the extent of precautionary money demand.

Once calibrated, the model's equilibrium is computed to investigate the effects of real productivity shocks and monetary policy shocks. The main finding is that precautionary demand for money makes a dramatic difference for a variety of dynamic moments of nominal aggregates in the data, relative to a version of the model with the idiosyncratic risk shut down. The key factor is to break the link between aggregate money demand and aggregate consumption. In deterministic monetary business-cycle models, the cash-in-advance constraint in practice always binds, so that aggregate money demand is equivalent to aggregate cash-good consumption. This tightly links the volatilities of money demand and aggregate consumption; the latter, in turn, is not volatile enough in the data to generate observed volatility of money demand (or its inverse, velocity) and other nominal aggregates. In contrast, in the model with precautionary money demand, agents generally hold more money than they spend, so that total money demand is now linked only to the consumption of agents whose preference shock realizations make them spend all of their money in trade. Velocity of money is significantly more volatile in this heterogeneous-agent setting, thanks to the agents whose cash constraint does *not* bind, who are absent in models with only aggregate risk. In other words, idiosyncratic risk in this context does not average out in a way that can be captured by a representative agent model (see the discussion in Hodrick et al., 1991). In addition, the magnitude of idiosyncratic volatility is much higher than aggregate volatility: the standard deviation of aggregate consumption is 0.5%; the standard deviation of household-level cash consumption turns out to be around 19%.

Introducing uninsurable idiosyncratic risk into the model also changes the nature of the inflation tax, and thus has an impact on welfare costs of inflation. In any cash-credit goods model, the nominal interest rate drives a wedge between the marginal rate of transformation and the marginal rate of substitution between cash and credit goods. Without idiosyncratic shocks, this wedge affects all households equally, since all have a binding cash constraint. The cost of a positive nominal interest rate is in having to hold the money to transact in the cash market, but the allocation equates the marginal utilities across households. Instead, with uninsurable idiosyncratic risk, the additional inefficiency is that the allocation of total cash-good consumption among households is also unequal. The agents whose idiosyncratic shock realization causes their cash constraint to bind have marginal utility that is higher than that of the unconstrained agents, and thus, ex post, bear more of the cost of inflation. This raises the welfare cost of inflation. The nature of the inflation tax in the model with idiosyncratic risk also depends on whether inflation increases are anticipated. A surprise increase in inflation can exacerbate this last distortion.

These results suggest that in many monetary contexts, especially those aimed at accounting for aggregate data facts, it is important not to omit idiosyncratic uncertainty that gives rise to precautionary demand for money. As one example, we demonstrate that omitting this empirically relevant mechanism may cause the standard practice of calibrating monetary models to the aggregate money demand equation, as has been done in many cash-in-advance models and monetary search models, to produce misleading results for parameters and counterfactual quantitative implications.

This paper is related to several strands of literature. On the topic of precautionary demand for liquidity,[2] the key mechanism in this model is close to Telyukova (2013), Telyukova and Wright (2008) and Faig and Jerez (2006). In Telyukova and Wright (2008) and Telyukova (2013), the idiosyncratic uncertainty about liquidity need is shown, respectively, theoretically

[1] This setup is consistent with both cash-credit goods models in the manner of Lucas and Stokey (1987) and monetary search models in the style of Lagos and Wright (2005). In theory, money-search-style idiosyncratic matching shocks could be interpreted as a type of idiosyncratic preference shock (Wallace, 2001). However, with matching shocks, agents spend all or none of their money, while a crucial part of the argument here is that a preference shock may cause a household to spend only part of their money holdings. The natural empirical counterparts of the two types of shocks are also different.

[2] The subject of precautionary money demand goes back to at least Keynes (1936), who defined its reason as "to provide for contingencies requiring sudden expenditure and for unforeseen opportunities of advantageous purchases". Precautionary demand for money is often modeled in Baumol–Tobin-style inventory-theoretic models, from Whalen (1966) to fully dynamic stochastic models such as Alvarez and Lippi (2009). Uninsurable idiosyncratic liquidity shocks are also an essential element of models based on Diamond and Dybvig (1983). Lucas (1980) studies the equilibrium in a cash-in-advance model with precautionary demand for money.