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Asset pricing in the production economy subject to monetary shocks☆

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ABSTRACT

This paper derives approximate analytical solutions for various financial assets in the production economy with monetary shocks. Both technology and monetary shocks drive the dynamics of various financial assets. Special cases of permanent and transitory shocks are considered. The solutions based on the loglinear approximation framework allow for a decomposition of risk that comes from real and monetary sides of the economy. Equity premium, volatility of the risk-free rate, Sharpe ratio, and inflation risk premium are calibrated to quarterly historical U.S. data. The model produces a realistic Sharpe ratio and inflation risk premium for empirically reasonable values of the relative risk aversion parameter, but results in the low equity premium. Overall, the results suggest that qualitatively the real business cycle model with monetary shocks has an advantage over the real business cycle model with respect to matching the key asset pricing facts.

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1. Introduction

In this paper I study the asset pricing implications of the real business cycle (RBC) model with monetary effects. The goal is to reexamine the most notorious puzzles in the asset pricing theory,

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namely, the *equity premium puzzle*, the fact that stock market returns consistently outperform Treasury bills by nearly six percent on average, and the *risk-free puzzle*, the fact that Treasury bills offer too low returns on average. Up to date research on the RBC models has mostly focused on the models that did not allow for any role for money. Plosser (1989) has shown that such models are empirically problematic.[1] Several studies show that standard RBC models have also problems matching important features of the dynamics of U.S. asset prices (Lettau, 2003; Lettau & Uhlig, 2002; Rouwenhurst, 1995). Other authors document some success by introducing various frictions such as capital adjustment costs (Jermann, 1998), habit formation (Boldrin, Christiano, & Fisher, 2001; Jermann, 1998), labor market frictions (Danthine & Donaldson, 2002), limited stock market participation (Guvenen, 2009), and idiosyncratic risk (Cárceles-Poveda, 2005).

Despite some progress has been made towards studying asset pricing implications in the RBC models, it is clear that explaining asset prices in production economies remains challenging. One of the omitted economic variables in the analysis is money. Some researchers, including King and Plosser (1984), Eichenbaum and Singleton (1986) and Cooley and Hansen (1995) build RBC models with money, but they do not study implications for asset pricing. On the other hand, research that explores key asset pricing facts in the RBC framework, does not include monetary variables. This paper aims to fill this significant gap in the literature. One exception is a recent paper by Buraschi and Jiltsov (2005), who consider a structural monetary version of a real business cycle model with taxes and endogenous monetary policy. However, they examine bond pricing implications only.

Monetary variables play important role in the asset pricing. In particular, Marshall (1992) shows that real returns are positively correlated with the growth rate of money in the economy, while Patelis (1997) finds that monetary policy variables are significant in predicting future excess returns. Recent empirical evidence suggests that unexpected monetary policy shocks have a significant impact on equity prices. Bernanke and Kuttner (2005) show that a hypothetical 25-basis point cut in the Federal Reserve funds target rate leads to about a 1% increase in broad stock indices. Challe and Giannitsarou (2010) provide similar empirical evidence of the adverse effect of the unexpected monetary shock on the stock market: they show that 1% unexpected increase in the nominal short rate results in the negative impact ranging from −2% to −9% in US and European countries. My work is also related to Bakshi and Chen (1996) who solve simultaneously for the price level, inflation, asset prices, and derive real and nominal term structures in the monetary asset pricing model. However, neither of the above papers discusses the direct effect of the monetary shocks to the equity premium and the risk-free rate puzzles, which is the focus of this paper.

Money can be introduced in the RBC model in two ways. One can model it via defining cash-in-advance economy where money is held to facilitate consumption transactions (see, e.g., Alvarez, Atkeson, & Kehoe, 2002; Christiano & Eichenbaum, 1992, 1995; Fuerst, 1992; Giovanni & Labadie, 1991; Grossman & Weiss, 1983; Marshall, 1992). Another way to model money is to define preferences over consumption and real monetary holdings (see, e.g., Brock, 1974, 1975; Bakshi & Chen, 1996). The rationale for the latter approach is the assumption that money is held to provide a transaction service to consumption.[2] Feenstra (1986) shows that including real cash balances in the utility function is equivalent to including money as liquidity cost in the budget constraint (cash-in-advance economies). I follow the second approach in the paper. Mechanically, money-in-the-utility modeling is beneficial for dealing with asset prices.

In the model, a representative agent has non-separable preferences over consumption and real cash balances.[3] A representative agent invests in nominal bonds, real bonds, and equity shares. Firms

[1] Although these models produce sample means that are very close to the observed output, consumption, and hours data, they are too low for investment and too high for wages. Besides, the RBC models generate the same volatility rankings for output, consumption, and investment, but the absolute standard deviation of investment is slightly lower and that for consumption is slightly higher than in the actual data. This suggests that while the basic neoclassical growth model provides an important framework for developing and understanding economic fluctuations, it is not entirely satisfactory.

[2] In addition, aggregate consumption and monetary aggregates are positively correlated in the data. Cooley and Hansen (1995) provide an excellent treatment of stylized facts regarding comovements of the real and monetary aggregates in the economy.

[3] In this case the stochastic discount factor (SDF) depends on imperfectly correlated growth rates of aggregate consumption and real monetary holdings. As such, the SDF becomes more volatile than in the case of additive preferences. In the latter case,

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