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Bubbles over the U.S. business cycle: A macroeconometric approach

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ABSTRACT

This paper builds a New Keynesian model with financial frictions and monetary and fiscal rules for the United States. We incorporate a rational bubble process in the (relative) price of capital. Our results show that bubbles account for a significant amount of variance in key macroeconomic variables and are as important as investment-specific shocks in explaining total variation. Further, we show that a bursting bubble creates large and long-lasting real effects. In particular, we find large effects on government debt that persist for several years.

1. Introduction

The recent turmoil in financial markets and the large adverse spill-over effects on the macroeconomy made it clear that the proper functioning of financial markets, and therefore, financial frictions play an important role in the economy.[2] This observation also implies that the prevailing view on the behavior of monetary and fiscal policy in response to shocks to the financial sector have to be reconsidered.

We estimate a dynamic stochastic general equilibrium model of the U.S. economy that has the financial accelerator model developed by Bernanke et al. (1999) (BGG, for short) at its core and further implements a government sector described by a fiscal rule. Within this framework, we hit our model economy with a non-fundamental shock to the capital arbitrage equation. In contrast to fundamental shocks, e.g. technology or mark-up shocks, this shock can be interpreted as a bubble, which

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[2] See Brunnermeier et al. (2012) for an overview of different financial friction approaches.

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is a persistent though temporary deviation of asset prices from fundamental values.[3] The fundamental value corresponds to the discounted future stream of dividends generated by holding the asset. This definition allows the model to account for bubbles for different reasons. Either, as in Bernanke and Gertler (2000) they can be interpreted as asset price bubbles,[4] or, they can be interpreted as bubbles in the price of physical capital. In general, we can think of our bubble as being generated by any factor that would create a wedge between the fundamental value of capital and the observed price.

The incorporation of bubble phenomena into macroeconomic models is the subject of a number of papers. Tirole (1982) shows under which conditions one is able to rule out bubbles in a macroeconomic model. Therefore, in the context of this paper, the reader should notice the approaches by Allen and Gorton (1993), Allen and Douglas (2000), and Barlevy (2008) allowing for speculative bubbles using agency problems. Here, economic agents form contracts with financiers while facing monitoring problems.

Although we estimate a fiscal policy rule, and therefore to some extend focus on fiscal policy, motivated by governments around the world using large fiscal packages to bail out endangered entities, we make use of the New Keynesian framework in order to generate a more realistic performance of our model. As shown by Carlstrom and Fuerst (1997), using the same financial friction, the external finance premium in a Real Business Cycle model varies procyclical, which is not in line with empirical observations. However, Bernanke et al. (1999) show that the New Keynesian model is in fact able to replicate the countercyclical response of the external finance premium. The demand side approach to model credit frictions follows the Modigliani–Miller theorem, implying that the capital structure of banks is irrelevant for lending decisions. In addition, it allows us to estimate the parameters from an interest rate rule.

Within the field of rational bubbles, initiated by Tirole (1982) and Weil (1987), a sequence of studies deal with bubbles in a general macroeconomic context. Key papers include Kocherlakota (2009) and Martin and Ventura (2011). Kocherlakota (2009) uses a modified Kiyotaki–Moore framework with stochastic investment opportunities and collateral-constrained borrowing, which allows the emergence of a price bubble. An important distinction lies in the underlying bubble asset, which is reproducible and not intrinsically useless. Martin and Ventura (2011) add an investor sentiment shock to the financial accelerator model by Gertler and Kiyotaki (2010). Additionally, their formal model shows how bubbles can emerge in equilibrium.

In order to analyze the contribution of financial shocks to business cycle volatility, we follow the literature and apply Bayesian estimation. Christiano et al. (2010) add a financial sector and nominal frictions to a DSGE model based on BGG. Their so-called risk shock affects the repayment of entrepreneurial loans and Bayesian estimation shows the empirical importance for economic fluctuations in the EU and the U.S. The importance of financial shocks is also found in Jermann and Quadrini (2012), who modify the model by Smets and Wouters (2007) according to equity and debt financing. Moreover they enhance the model with financial frictions and shocks. In their variance decomposition financial shocks account for almost 50% of output growth volatility.

Since we implement a bubble in a DSGE context and run a Bayesian estimation, our work is closely related to Miao et al. (2013). Their DSGE model comprises investment efficiency shocks and credit constraints (see Miao and Wang (2011)). The endogenously created rational bubble is driven by sentiment changes, which are determined by expectations of the relative bubble size. The related Bayesian estimation shows that the sentiment shock contributes notably to the variation of stock prices, investment, and output. Moreover, conducting a historical variance decomposition, they point out that sentiment shocks are important bubble formation drivers. Wang and Wen (2012) give conditions, in which bubbles can emerge in a DSGE context and show that a calibrated model matches U.S. data reasonably well.

2. The model

The model is based upon the seminal contribution by BGG. Within a standard New Keynesian framework, BGG embed asymmetric information and an agency problem in order to allow for financial accelerator effects. In their model, frictions on credit markets alter model dynamics to exogenous disturbances and amplify shocks to real variables.

Our economy features five agents, namely households, entrepreneurs, retailers, a monetary and a fiscal authority. Time is discrete and the length of a period is a quarter.

The most important role in the BGG model is dedicated to the behavior of entrepreneurs who are distinct from households to motivate lending and borrowing. Those are risk-neutral agents with finite horizons, i.e. they face a constant probability of surviving to the next period, while the birth rate is set such that the share of entrepreneurial agents stays constant. This assumption guarantees that entrepreneurs are not able to acquire enough financial wealth to fully self-finance capital purchases.

In every given period t entrepreneurs purchase homogeneous capital that will be used to produce wholesale goods in the consecutive period, $t+1$, jointly with labor services using a constant returns to scale production technology. Capital purchases are financed using wealth, or net worth, and by borrowing. Net worth is driven by two components, the labor income of entrepreneurial labor services and by profits from running the business. It plays a crucial role in the model as it impacts external financing costs. Suppose that an entrepreneur acquires more wealth, accordingly, she will be able to

[3] See Ratto et al. (2010) and In't Veld et al. (2011) for an application of this identification approach.

[4] In order to study the efficiency of central bank interest rate rules, Bernanke and Gertler (2000) include an exogenous asset price bubble process in the capital valuation mechanism.