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The effects of monetary policy on stock market bubbles at zero lower bound: Revisiting the evidence

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HIGHLIGHTS

- We revisit the results in Gali and Gambetta (2015) using the shadow rate for an alternative estimation.
- In the alternative estimation, the response of asset to monetary policy shocks becomes negative.
- Bubbles respond positively, but the response is significantly lower as compared to the baseline estimation using the federal funds rate.

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ABSTRACT

We revisit the results in Gali and Gambetta (2015) by reestimating their time-varying Bayesian VAR model including the shadow rate of Wu and Xia (2016). We found some significant differences when looking at the results during and in the aftermath of the crisis: with the shadow rate, the impact of monetary policy shocks on asset prices becomes negative. There is also a much lower positive impact of monetary policy shocks on bubbles when using the shadow rate. The impact is lower by almost three percentage points.

1. Introduction

Before the last financial crisis of 2008–2009, the conventional wisdom in terms of monetary policy was that central banks should aim to preserve price stability. However, in the aftermath of the crisis, there has been a consistent debate on if and how should central banks respond to accelerated increases in asset prices (that may suggest bubble phenomena). It has been argued that monetary policy should respond to asset prices increases, an approach which has been named "leaning against the wind".

However, two recent contributions contest this position, on theoretical grounds, see Gali (2014), and on empirical grounds, see Gali and Gambetti (2015). In the former contribution, there is a theoretical connection between positive monetary policy shocks and increases in bubbles, while in the latter contribution, using a time-varying Bayesian VAR model for United States, it is shown that monetary policy shocks have a positive impact on bubble formation.

In this context, this paper extends the research in Gali and Gambetti (2015) by taking into account recent data related to the period of unconventional monetary policy.

2. Theoretical background

2.1. A theoretical framework for analysis

Following Gali (2014) and Gali and Gambetti (2015), we assume the existence of an economy with risk neutral agents, where the real interest rate is denoted by R_t, the price of assets by Q_t and the dividend stream by D_t. In this context, we assume that the asset prices Q_t are given by a fundamental component and a bubble component as in Eq. (1):

$$Q_t = Q_t^F + Q_t^B. \tag{1}$$

The fundamental component derives from the present discounted value of future dividends and can be expressed as in Eq. (2) and

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log-linearized to achieve the formulation in Eq. (3):

$$Q_t^F = E_t\{\sum_{k=1}^{\infty}(\prod_{j=0}^{k-1}\frac{1}{R_{t+j}})D_{t+k}\} \tag{2}$$

$$q_t^F = c + \sum_{k=0}^{\infty}\lambda^k[(1-\lambda)E_t\{d_{t+k+1}\} - E_t\{r_{t+k}\}] \tag{3}$$

where c represents a constant, and $\lambda = \frac{\Gamma}{R}$, while Γ stands for the gross dividend growth rate. In order to investigate the impact of monetary policy shocks on asset prices we differentiate Eq. (1) with respect to the shocks denoted by ϵ_t^m and reach the relation found in Eq. (4):

$$\frac{\partial q_{t+k}}{\partial \epsilon_t^m} = (1-\gamma_{t-1})\frac{\partial q_{t+k}^F}{\partial \epsilon_t^m} + \gamma_{t-1}\frac{\partial q_{t+k}^B}{\partial \epsilon_t^m}. \tag{4}$$

We regard $\gamma_t = Q_t^B/Q_t$ as the fraction of the bubble component of the asset price at moment t. Based on Eq. (2), we write the reaction of the fundamental component as follows:

$$\frac{\partial q_{t+k}}{\partial \epsilon_t^m} = \sum_{j=0}^{\infty}\lambda^j((1-\lambda)\frac{\partial d_{t+k+j+1}}{\partial \epsilon_t^m} + \frac{\partial r_{t+k+j}}{\partial \epsilon_t^m}). \tag{5}$$

The conventional wisdom argues in favor of a negative reaction of the fundamental component such that $\frac{\partial q_{t+k}^F}{\partial \epsilon_t^m} \leq 0$. Moreover, the same conventional perspective hints to a negative reaction of bubbles to monetary policy shocks such that $\frac{\partial q_{t+k}^B}{\partial \epsilon_t^m} \leq 0$. Under these specifications we expect a negative effect of monetary shocks on asset prices, which can be written as:

$$\frac{\partial q_{t+k}}{\partial \epsilon_t^m} \leq 0. \tag{6}$$

Gali (2014) proposes an alternative theoretical framework. Let us consider the perspective of Gali (2014) within a partial equilibrium:

$$Q_t R_t = E_t\{D_{t+1} + Q_{t+1}\} \tag{7}$$

and the specification in the following equation for the fundamental component.

$$Q_t^F R_t = E_t\{D_{t+1} + Q_{t+1}^F\}. \tag{8}$$

We can deduce the following relationship for the bubble component:

$$Q_t^B R_t = E_t\{Q_{t+1}^B\}. \tag{9}$$

Using the last two equations and Eq. (1) and log-linearizing we find that:

$$E\{\Delta q_{t+1}^b\} = r_t. \tag{10}$$

The above equation states that an increase in the interest rate will be associated with an enlargement of the bubble fraction of the asset prices which falls against classical economic thinking. However (Gali and Gambetti, 2015) show that interest rates influence bubbles through more than this channel. By evaluating Eq. (10) at $t-1$ and eliminating the expectations we obtain:

$$\Delta q_t^b = r_{t-1} + \epsilon_t. \tag{11}$$

This eventually leads to the logic that the reaction of the bubble component to shocks is indeterminate in terms of both sign and size and therefore the reaction (using a coefficient ψ) is:

$$\frac{\partial q_{t+k}^B}{\partial \epsilon_t^m} = \begin{cases} \psi_t \frac{\partial r_t}{\partial \epsilon_t^m}, & \text{for } k = 0 \\ \psi_t \frac{\partial r_t}{\partial \epsilon_t^m} + \sum_{j=0}^{k-1}\frac{\partial r_{t+j}}{\partial \epsilon_t^m}, & \text{for } k = 1, 2, \ldots. \end{cases} \tag{12}$$

2.2. A Bayesian time-varying VAR model

We incorporate a time-varying Bayesian VAR for capturing the impact of monetary policy shocks on bubbles which is inspired by the framework of Primiceri (2005). Following Gali and Gambetti (2015) we use the identification scheme provided by Christiano et al. (2005). Our time-varying Bayesian autoregressive model has the following specification:

$$x_t = A_{0,t} + A_{1,t}x_{t-1} + \cdots + A_{p,t}x_{t-p} + u_t. \tag{13}$$

$A_{0,t}$ is assumed to be vectors of time-varying intercepts, while the matrices $A_{i,t}$ stand for the time-varying coefficients. A further assumption is that u_t is a white noise Gaussian process with a zero mean and a covariance matrix given by Σ_t. The innovations in the reduced form of the BVAR are linear transformations of the structural shocks and we can formally write: $u_t = S_t\epsilon_t$. Furthermore, it also holds that $E\{\epsilon_t\epsilon_t'\} = I$ and $E\{\epsilon_t\epsilon_{t-k}'\} = 0$. Additionally, we also have $S_tS_t' = \Sigma_t$.

3. Data

We extend the original dataset from Gali and Gambetti (2015) to a sample between 1960Q1 and 2016Q4. We collected data for the following variables for the case of the US: GDP, GDP deflator, federal funds rate, the stock market index $S\&P500$, dividends and a non-energy commodity price index. We use the log-differences multiplied by 100 for real GDP (nominal GDP deflated by GDP deflator), GDP deflator, World Bank commodity price index, the $S\&P500$ and the corresponding dividends (deflated by GDP deflator), as well as the effective Federal Funds rate. To run an alternative estimation, we also use the shadow interest rate introduced by Wu and Xia (2016).

4. Results

4.1. Estimation

We estimate a Bayesian time-varying VAR model for the sample between 1960Q4 and 2016Q4. The settings are similar to those in Gali and Gambetti (2015). To estimate the model, we use the Gibbs sampling algorithm put forward by Del Negro and Primiceri (2015). As for the prior distributions, it is presumed that the covariance matrices Ω, Ξ, Ψ and the initial states θ_0, ϕ_0, $log\sigma_0$ are independent, and that the prior distributions for the initial states are set as normal distributions, while for Ω^{-1}, Ξ^{-1}, Ψ^{-1} we use Wishart distributions. For the normal distributions, the prior means and variances are derived from an estimated time-invariant VAR on a sub-sample. We use 22 000 draws for the estimation of the model, but discard the first 20 000 to keep 2000 draws.

We perform two estimations: one on the extended original data sample provided by Gali and Gambetti (2015), and an alternative estimation using the shadow rate instead of the effective Federal Funds rate.