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Optimal interest rate rule in a DSGE model with housing market spillovers[☆]

Xiaojin Sun[*], Kwok Ping Tsang

Department of Economics, Virginia Tech, Blacksburg, VA 24061, United States

HIGHLIGHTS

- The optimal interest rate rule in a DSGE model with housing market spillovers is examined.
- The optimal rule responds to house price inflation, even when stabilizing house price is not one of the goals of the policymaker.
- A higher response to house price inflation always results in a lower house price volatility.

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ABSTRACT

This paper studies the optimal interest rate rule in a DSGE model with housing market spillovers (Iacoviello and Neri, 2010). We find that the optimal rule responds to house price inflation even when the stabilization of house price is not among the objectives of the policymaker, and that the strength of the response depends crucially on a few structural parameters.

1. Introduction

Since Taylor (1993), there is an expanding literature on monetary policy rule from either a positive (what the central bank does) or a normative (what the central bank should do) perspective. One normative question that arises is how the central bank, if at all, should respond to movements in house prices (or asset prices in general).

House prices are related to a number of macroeconomic variables, such as consumption and investment, over the business cycle. Although house price contains information on economic activities, stabilizing house prices is not among the mandated objectives of central banks. In a large body of empirical work for models with a housing market, the monetary policy rule is usually specified to be responding only to money inflation and output gap (see Iacoviello (2005), Edge et al. (2007) and Iacoviello and Neri (2010)).

Should the central bank react to house prices? The two opposing answers to this question are "leaning against asset-price bubbles" versus "cleaning up after the bubble bursts". Some argue that central banks should lean against surges in asset prices to unsustainable levels in order to avoid macroeconomic and financial instability (see Cecchetti et al. (2000) and Borio and Lowe (2002)). Others argue that central banks should react to asset prices only to the extent that they contain information about future output growth and inflation. For example, Greenspan (2002) explains that, since it is very difficult to identify a bubble before its existence is confirmed by the bursting, the Federal Reserve does not directly react to financial imbalances. According to Bernanke and Gertler (1999), it is unnecessary for monetary policy to respond to changes in asset prices. Rules that directly target asset prices might have undesirable side effects of stifling the beneficial impact of the technology boom.

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* Corresponding author.
E-mail addresses: aaronsun@vt.edu (X. Sun), byront@vt.edu (K.P. Tsang).

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More recently, Kannan et al. (2012) incorporate a financial sector into the model of Iacoviello and Neri (2010) and combine the macroprudential instrument with an augmented Taylor rule that also reacts to the growth rate of nominal credit. They find that strong monetary reactions to credit growth and house prices increase macroeconomic stability. However, whether a macroprudential instrument should be employed depends on the source of house price booms. In this paper, we assume that the policymaker aims at minimizing an ordinary loss function – a weighted variability of money inflation, wage inflation, output growth, and nominal interest rate – as suggested by Giannoni and Woodford (2003). Our goal is to examine whether the implementation of an interest rate rule that also responds to house price inflation reduces the policymaker's loss and how robust the optimal rule is to changes in a list of structural parameters. Unlike Kannan et al. (2012), we investigate the optimal policy rule without assuming the central bank knowing the source of housing booms; we do not intend to identify whether the observed fluctuations in house price are driven by fundamentals or not. Instead, given the housing market spillovers, we study an interest rate rule that responds not only to money inflation and output growth but also to house price inflation.

2. The model

Iacoviello and Neri (2010) construct a DSGE model that allows for housing market spillovers to the broad economy. The model includes a consumption good sector and a housing sector. There are two types of households, patient and impatient, on the demand side that work, consume, and accumulate housing. The patient households own the capital of the economy and provide funds to firms and loans to the impatient households, who face the collateral constraints in equilibrium—their maximum borrowing is given by a fraction m (the loan-to-value ratio) of the expected present value of their home. On the supply side, the consumption sector combines capital and labor to produce consumption goods and business capital for both sectors. The housing sector combines business capital, labor, and land to produce new houses.

The model allows for sticky prices in the consumption sector and sticky wages in both sectors. In each period, a fraction θ_π of retailers are able to set prices optimally, while another fraction $1-\theta_\pi$ only index prices to the previous period inflation rate with an elasticity of ι_π. Hence, the consumption sector Phillips curve takes the following form:

$$\ln\pi_t - \iota_\pi \ln\pi_{t-1} = \beta G_C(E_t \ln\pi_{t+1} - \iota_\pi \ln\pi_t) - \frac{(1-\theta_\pi)(1-\beta G_C\theta_\pi)}{\theta_\pi}\ln\left(\frac{X_t}{X}\right) + u_{p,t}, \quad (1)$$

where β is the discount factor of the patient households; G_C is the growth rate of consumption in the balanced growth path; π_t is the money inflation in the consumption sector; X_t is a markup over the marginal cost charged by retailers and X is the steady-state value; $u_{p,t}$ is an independently and identically distributed cost shock that affects inflation.

Similarly, the wage Phillips curves can be written as:

$$\ln\omega_{i,t} - \iota_{wi}\ln\pi_{t-1} = \beta G_C(E_t \ln\omega_{i,t+1} - \iota_{wi}\ln\pi_t) - \frac{(1-\theta_{wi})(1-\beta G_C\theta_{wi})}{\theta_{wi}}\ln\left(\frac{X_{wi,t}}{X_{wi}}\right), \quad (2)$$

$$\ln\omega'_{i,t} - \iota_{wi}\ln\pi_{t-1} = \beta' G_C(E_t \ln\omega'_{i,t+1} - \iota_{wi}\ln\pi_t) - \frac{(1-\theta_{wi})(1-\beta' G_C\theta_{wi})}{\theta_{wi}}\ln\left(\frac{X_{wi,t}}{X_{wi}}\right), \quad (3)$$

where $i = c, h$ (c and h denote the consumption sector and the housing sector, respectively). θ_{wi} characterizes the wage stickiness in sector i; $X_{wi,t}$ is the corresponding wage markup; $\omega_{i,t}$ is the nominal wage inflation in each sector, i.e. $\omega_{i,t} = \pi_t w_{i,t}/w_{i,t-1}$, where $w_{i,t}$ is the real wage. Parameters and variables with a prime refer to impatient households.

To close the model, the central bank sets the nominal interest rate, R_t, as a contemporaneous version of the Taylor rule that responds to money inflation, π_t, and GDP growth, $GDP_t/(G_C GDP_{t-1})$:

$$\text{Rule (I):}\quad R_t = R_{t-1}^{r_R}\pi_t^{(1-r_R)r_\pi}\left(\frac{GDP_t}{G_C GDP_{t-1}}\right)^{(1-r_R)r_Y} \times \left(\frac{q_t}{G_Q q_{t-1}}\right)^{(1-r_R)r_Q}\overline{rr}^{1-r_R}\frac{u_{R,t}}{s_t}, \quad (4)$$

i.e., the parameter r_Q that corresponds to house price inflation, $q_t/(G_Q q_{t-1})$, is fixed at zero.[1] In Eq. (4), G_Q is the growth rate of house price in the balanced growth path; $\overline{rr}$ is the steady-state real interest rate; $u_{R,t}$ is an independently and identically distributed monetary shock; s_t is an AR(1) stochastic process that captures long-lasting deviations of inflation from its steady-state level, i.e. $\ln s_t = \rho_s \ln s_{t-1} + u_{s,t}$.

Besides $u_{p,t}$ in Eq. (1) and $u_{R,t}$, $u_{s,t}$ in Eq. (4), the model specifies a number of shocks, including intertemporal preference shock $u_{z,t}$, housing demand shock $u_{j,t}$, labor supply shock $u_{\tau,t}$, productivity shocks $u_{C,t}$ and $u_{H,t}$ in the two sectors, and the investment-specific technology shock $u_{K,t}$. Among them, the housing demand shock and the housing technology shock account for more than half of the volatilities of housing investment and house price (see Iacoviello and Neri (2010)).

Based on this model, we examine whether the optimal monetary policy reacts to house price inflation, under the assumption that the policymaker seeks to minimize an ordinary expected loss criterion as in Giannoni and Woodford (2003):

$$\mathfrak{L} = \lambda_\pi var(\ln\pi_t - \iota_\pi\ln\pi_{t-1}) + \lambda_w var(\ln\pi_{wc,t} - \iota_{wc}\ln\pi_{t-1}) + \lambda_y var(\ln GDP_t - \ln(G_C GDP_{t-1})) + \lambda_r var(\ln R_t - \ln\overline{rr}), \quad (5)$$

where $\pi_{wc,t} = \pi_t(w_{c,t} + w'_{c,t})/((w_{c,t-1} + w'_{c,t-1}))$ is the nominal wage inflation in the consumption sector.[2] Under the objective $\mathfrak{L}$, the policymaker minimizes the weighted variability of money inflation, wage inflation, output growth, and nominal interest rate, but does not put any weight on house price inflation.

3. Optimal monetary policy

The baseline model is estimated for the period 1965:Q1–2006:Q4 by fixing r_Q at zero (see Iacoviello and Neri (2010) for details) and the loss function related parameters are taken from Giannoni and Woodford (2003) (see Table 1). We conduct a 4-dimensional optimization over $(r_R, r_\pi, r_Y, r_Q) \in [0, 1] \times [0, 15] \times [0, 5]^2$ and find the combination that minimizes the loss function $\mathfrak{L}$ in Eq. (5) as well as the region that satisfies the Blanchard–Kahn condition for determinacy.

3.1. Determinacy and uniqueness

According to Blanchard and Kahn (1980), the rational expectations equilibrium has a unique solution if and only if the number of unstable eigenvectors is exactly equal to the number of

[1] Most related work specify a Taylor rule that responds to output gap, instead of output growth, beyond money inflation. Compared to output gap, output growth is first of all much easier to observe. Secondly, Sims (2013) suggests that responding to the growth rate of output is often welfare-improving.

[2] We do not consider the wage inflation in the housing sector, since both types of households contribute most of their labor to the production of consumption goods.