


Research Article

Monetary Policy and Borrowing Constraint of Housing Market-a Comparative Research Between China and U.S.A.

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Abstract

Since 2006, U.S.A. has witnessed the ups and downs of its economy caused by the bubble of the housing market. Due to China's unique law, only enterprises can use properties as collateral to borrow from banks, resulting in emphasis on borrowing constraint of the enterprises. When housing price can change value of the collateral and borrowing ability of the enterprises, monetary authority is motivated to stabilize the housing price. Studies show that if the Loan to Value ratio (LTV) of the enterprises' real estate loans is too high, risk would rise due to borrowing constraints. When housing price becomes lower, wrong monetary policy may continue to lower housing prices, causing great damages to enterprises' balance sheet in recession. We conduct simulation research of China by DSGE (Dynamic Stochastic General Equilibrium) model in comparison with that of U.S.A., finding that China's economy is more stable than economy of U.S.A.. One important reason is that the entrepreneurs in China are more constrained than those of USA which results in less risk in the economy. With negative monetary shock, besides markup, other economic variables fall, especially debt and housing price. This means that borrowing constraint is also a financial accelerator. Monetary authority should take into account the borrowing constraint of loans backed by real estate.

Keywords

Monetary Policy, Housing Price, DSGE Model, Borrowing Constraint of Entrepreneurs

1. Introduction

Since 2006, U.S.A. has witnessed the ups and downs of its economy caused by the bubble of the housing market. High loan to value (LTV) ratio represents high risk because the house owners have to face collateral constraint and their balance sheet is more vulnerable to housing price and monetary interest rate. The collateral constraint is one important reason for the sub-prime mortgage crisis in 2008. China, as part of the global economy, has experienced similar trajectory during its economic growth. In the past ten years, the housing

price in urban area has almost increased by ten times. More importantly, to stimulate spending in the housing market, the government is motivated to lower the down payment requirement for mortgage in 2016, a dangerous move for the economy. lowering the down payment requirement would attract more funds into the housing market, pushing up the housing market bubble, endangering the macroeconomy. In 2024, to save China's housing market, China's government has lowered the down payment requirement for mortgage to

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15%, hitting a record low, which probably put the economy at stake in the future. Not only households, but also entrepreneurs have to be prepared for exposure to financial risks because most entrepreneurs in China use property as collateral to finance their business. Without collateral, especially property, it is difficult to obtain loans from banks. With this background, we focus on entrepreneurs' loans backed by properties and the effect of borrowing constraint on China's macroeconomy. To further our understanding of the relationship between borrowing constraint of entrepreneurs and macroeconomy, comparative analysis is conducted between China and U.S.A.. The institutional differences between these two countries give rise to the different results of empirical research. With reference to the model of Iacoviello, we employ the data of two different countries to get in-depth insight into China's macrofinance.

Based on the economic reality of China, we focus on key characteristics in this paper: (1) private lending and heterogeneity, especially entrepreneurs; (2) mortgage restrictions of entrepreneurs. We conduct simulation research of China with the DSGE model set up by Iacoviello [9]. The remaining of the paper is organized as follows: Section 2, literature review; section 3 describes the model. The calibration and estimation of parameters are discussed and the impulsive response simulation is conducted to evaluate the monetary policy's effect on the macroeconomy. Section 4 concludes the paper.

2. Literature Review

2.1. Literature Review out of China

As for the research out of China, borrowing constraint has been studied by many scholars by means of the DSGE model. Bernanke et al. develops a dynamic general equilibrium model to clarify the role of financial accelerator, in that endogenous developments in credit markets work to amplify and propagate shocks to the macroeconomy [1]. Iacoviello develops a monetary business cycle model with nominal loans and collateral constraints tied to housing values. Collateral effects dramatically improve the response of aggregate demand to housing price shocks; and nominal debt improves the sluggish response of output to inflation surprises. But these papers do not focus on the borrowing constraint on entrepreneurs. What follows are some research with borrowing constraint on entrepreneurs [2].

Chawwa in his model put the borrowing constraint on entrepreneurs who is financed by collateral. He presents a model to capture the impact of the Basel III's Liquidity Coverage Ratio (LCR) and the reserves requirement regulation on the banking sector and the real economy. It employs a medium-scale Dynamic Stochastic General Equilibrium (DSGE) model with financial frictions and calibrated to match data for Indonesia. The study shows that the impact of changing the two liquidity requirements on lending and output are relatively similar. However, lowering the LCR has consequences

on the decline of demand for government bonds, so that it has a different impact on taxes, household deposits and bank's profit. This paper also found that Indonesian countercyclical liquidity regulations can improve welfare and reduce the volatility of bank loans [4].

A large literature has studied optimal regulatory policy in macroeconomic models with asset-based collateral constraints. A common conclusion is that agents 'over-borrow' and optimal policy reduces debt positions through taxes. The reason is that agents do not internalize the effects of their choices on asset prices [2]. However, recent empirical evidence shows that firms primarily borrow against their earnings rather than their assets. Drechsel et al. reaches the opposite conclusion to the previous literature. Agents 'over-save' (and 'under-borrow') relative to the social optimum, as they do not internalize changes in wages, which in turn affect firms' earnings. A numerical model exercise demonstrates that incorrectly rolling out a tax policy derived under the assumption of asset-based constraints in an economy where firms actually borrow based on earnings leads to a consumption equivalent welfare loss. Optimal macroprudential policy thus critically depends on the specific form of financial constraints [5].

The analysis of Emerging Markets (EM) economies generally assumes collateral borrowing constraints, i.e., firms access to debt is constrained by the value of their collateralized assets. Using credit registry data from Argentina for the period 1998-2020, Camara et al. show that less than 15% of firms debt is based on the value of collateralized assets, with the remaining 85% based on firms cash flows. Exploiting central bank regulations over banks capital requirements and credit policies, they argue that the most prevalent borrowing constraints is defined in terms of the ratio of their interest payments to a measure of their present and past cash flows, akin to the interest coverage borrowing constraint studied by the corporate finance literature. EMs exhibit a greater share of interest sensitive borrowing constraints than the US and other Advanced Economies. In terms of policy implications, this greater amplification leads to managed exchange rate policy being more costly in the presence of an interest coverage constraint, given their greater interest rate sensitivity, compared to the standard collateral borrowing constraint [3].

Some scholars study borrowing constraint out of China without using the DSGE model.

Macro-finance analyses commonly link firms' borrowing constraints to the liquidation value of physical assets. For U.S. nonfinancial firms, Lian Chen et al. show that 20% of debt by value is based on such assets (asset-based lending in creditor parlance), whereas 80% is based predominantly on cash flows from firms' operations (cash flow-based lending). A standard borrowing constraint restricts total debt as a function of cash flows measured using operating earnings (earnings-based borrowing constraints). These features shape firm outcomes on the margin: first, cash flows in the form of operating earnings can directly relax borrowing constraints; second, firms are less vulnerable to collateral damage from asset price

declines, and fire sale amplification may be mitigated. Taken together, our findings point to new venues for modeling firms' borrowing constraints in macro-finance studies [13].

Fishman et al. find out that if banks face asymmetric information about loan quality, endogenous borrowing constraints which restrict the size of new firms may emerge in equilibrium. High quality firms reduce financing costs by starting off small and increasing their size over time [7].

2.2. Literature Review in China

As for the research in China, borrowing constraint has been also studied by the DSGE model many scholars.

By constructing a dynamic stochastic general equilibrium model with mortgage borrowing constraint on households and entrepreneurs, He Qing deeply analyzes the relationship between the Chinese property market and macroeconomic fluctuations in the past 20 years. The results show that the impact of the real estate market, such as the mortgage rate shock and the preference impact of the real estate market, profoundly affect the Chinese macro-economy. Among them, the government's administrative means of macro-control (such as credit regulation, restriction policy, etc.) intensified the mortgage impact and real estate preference impact for housing prices and the influence of the macro economy. The real estate market and borrowing constraints enlarge the impact of various economic shocks. This paper suggests that the government should implement the differentiated policy to avoid inhibiting the rigid purchase demand of residents and the speculative purchase demand; reduce the administrative power of macro-control; and adjust the real estate market through the countercyclical mortgage rate policy [8]. Eric (2015) uses a dynamic stochastic general equilibrium model to study housing market fluctuations in China. More than one-third of the volatility of housing prices is driven by housing preference shocks. Monetary shocks explain 12-32% of variance in housing prices and residential investments [6].

Some papers only use DSGE model to study borrowing constraint on enterprises. Wang Ren et al. aim to quantify the implication of the borrowing constraints on the transmission mechanism of monetary and fiscal policy, using a DSGE model with a heterogeneous production side of private and state-owned sectors. They fit their model to China's quarterly data from 2005 to 2014 and conduct several experiments. The main findings are as follows. First, a monetary policy shock interacts with private firms' borrowing constraint, resulting in reallocation effect. Second, intensified borrowing constraints of the private firms reduce the efficacy of a tax rate cut shock for private firms and lessen the tightening effects on the state-owned firms of such shock. Third, intensified borrowing constraints on the private firms reduce the efficacy of an expansionary monetary policy shock for private firms and enhance its effectiveness for the state-owned firms [15].

3. The Model Section

We introduce the heterogeneity of firms and households, which is mainly explained here by the difference in subjective discount rates. In turn, private credit was introduced. We rely mainly on the basic model of Iacoviello, but we use Chinese data to study monetary policy, collateral constraint and the cyclical fluctuations in China's housing market and conduct comparative research.

Iacoviello assumes in the base model that all mortgaged properties are owned by entrepreneurs and households do not have mortgages, and he goes on to argue that in reality financial frictions exist not only in the entrepreneur sector but also in the household sector, so the base model is unrealistic and needs to be transformed [9]. But to our surprise, the basic model here is exactly in line with China's national conditions. The low risk of household loans in China, and the comparatively higher risk of real estate developer loans and other entrepreneurs' loans allow us to ignore household mortgages when modeling. Iacoviello also believes that the basic model should include households with poor patience in order to be in line with the national conditions of the United States [9]. In China, households' mortgage of poor patience can also be ignored when modeling. On the one hand, Chinese families face a down payment requirement of at least 30%, and on the other hand, China's traditional culture of frugality and relatively poor social security have greatly strengthened the family's patience for consumption.

The basic model describes the relationship between the interest rate transmission mechanism, the housing price transmission mechanism, and the debt transmission mechanism. If there is a negative currency shock, because of price stickiness, monetary policy affects real interest rates, interest rates rise, consumption falls, and output falls. The decline in the economy has been exacerbated by the decline in real estate prices, as the value of collateral has fallen and entrepreneur investment has fallen. The impact of deflation on debt also plays an important role, with deflation raising the cost of debt and further suppressing consumption and investment.

3.1. Patient Households

China's households are forbidden to get loans from banks with property as collateral. Thus borrowing constraint concerning property is ignored here and is studied when we examine the borrowing constraint of entrepreneurs. It is reasonable to assume that households in an economy consume durable and non-durable goods and save money, because in China, the price of a house accounts for a large proportion of a resident's income, and even the savings of three generations are spent to buy a house, so the financial position of a household can be revealed when we look at consumption and savings. In addition to buying durable and non-durable goods, households also save money, which is a simplification of the reality.

In equilibrium, the optimal strategy for borrowers and savers is to engage in credit activities, as a result of which borrowers obtain loans, durable goods purchases and investments in the economy increase, lenders buy house and consume.

The households (denoted with a prime) incorporate housing into the utility function. Households maximize a lifetime utility.

$$E_0 \sum_{t=0}^{\infty} \beta^t (\ln c'_t + j \ln h'_t) - (L'_t)^\eta / \eta + \chi \ln(M'_t / P_t) \quad (1)$$

subject to:

$$c'_t + q_t \Delta h'_t + R_{t-1} b'_{t-1} / \pi_t = b'_t + W'_t L'_t + F_t + T'_t - \Delta M'_t / P_t \quad (2)$$

c'_t is consumption, patient households consuming final products produced by entrepreneurs. h'_t denotes the holdings of housing. L'_t denotes hours worked by patient households (households work for the entrepreneurs) and M'_t / P_t are real money balances. $q_t = Q_t / P_t$ is the real housing price, with $w'_t = W'_t / P_t$ the real wage. Entrepreneurs are assumed to be less patient than patient households, both of them being heterogeneous agents of the market.

Because loans are calculated on nominal terms, monetary policy can affect the net worth of borrowers by changing the true value of outstanding loans. Assume that households save money and lend money in real terms $-b'_t = \frac{B'_t}{P}$ to less patient entrepreneurs and retrieve $-R_{t-1} B'_{t-1} / P_t$ from entrepreneurs. Denoting with Δ the first difference operator, the flow of funds is equation (2).

As mentioned above, the households, as stipulated by China's law, do not face borrowing constraint concerning property, such as consumption loans. The left side of equation 2 refers to the spending of the households and the right side refers to the earnings of the households.

$\pi_t = \frac{P_t}{P_{t-1}}$ is the gross inflation rate. F_t denotes lump-sum profits received from the retailers and the last two terms are net transfers from the central bank being financed by printing money. Solving these two equations, we get first order conditions for consumption (3), labor supply (4) and housing demand (5).

$$\frac{1}{c'_t} = \beta E_t \{ R_t / \pi_{t+1} c'_{t+1} \} \quad (3)$$

$$w'_t = (L'_t)^{\eta-1} / c'_t \quad (4)$$

$$\frac{q_t}{c'_t} = \frac{j}{h'_t} + \beta E_t (q_{t+1} / c'_{t+1}) \quad (5)$$

Since savers are not bound to borrow, as perpetual income consumers, savers equalize the marginal rate of substitution between durable consumption at time t and consumption at $t+1$.

3.2. Entrepreneurs

In China, according to financial laws, the households are forbidden to use self-owned houses as collateral to borrow money from the financial institutions, while entrepreneurs are allowed to finance using properties as collateral. Based on the reality of China, we study the LTV ratio of the entrepreneurs, to understand the mechanism of borrowing constraint amplification effect on macroeconomy.

In our model, the presence of a mortgage leads to the wealth utility of the borrower for the purchase of houses. In order to expand investment returns, borrowers need to increase houses purchases to finance new mortgages. This kind of wealth utility is more obvious in China, mainly because of the financing behavior of entrepreneurs, especially real estate developers which has obvious wealth utility. Because the purchase of land in China only requires the payment of a security deposit, which is a down payment by the nature, a small amount of money can be used to obtain land for constructing real estates. And then the real estate developer can mortgage houses and land, obtain funds, and engage in more real estate development to obtain investment income. In this paper, we do not study real estate developers specifically, but attention should be paid to the special industry which should be studied in the future.

Entrepreneurs use real estate and labor as inputs. They produce an intermediate good Y_t according to:

$$Y_t = A(h_{t-1})^\nu L_t^{1-\nu} \quad (6)$$

where h is real estate input, L is the labor input. Retailers purchase the intermediate goods from entrepreneurs at the wholesale price P_t^w and transform it into a composite final goods, whose price index is P_t . $X_t = P_t / P_t^w$ denotes the markup of final over intermediate goods. If borrowers refuse to pay back their debt obligations, the lenders or the households can repossess the borrowers' assets by paying a proportional transaction cost $(1-m)E_t(q_{t+1}h_t)$. The maximum amount B_t that a creditor or the entrepreneurs can borrow is bound by $mE_t(Q_{t+1}h_t / R_t)$. In real terms: $b_t \leq mE_t(q_{t+1}h_t \pi_{t+1} / R_t)$. Jappelli and Pagano linked the share of liquidity-constrained entities to the total population and the structural characteristics of credit markets, and found that countries with low loan-to-valuation ratios had a higher pro-

portion of liquidity-constrained entities in the total population [10].

Entrepreneurs maximize

$$E_0 \sum_0^{\infty} \gamma^t \ln c_t, \quad \gamma < \beta \quad (7)$$

Entrepreneurs are less patient than the households and they borrow money from the patient households. The borrowing constraint and the following flow of funds:

$$Y_t / X_t + b_t = c_t + q \Delta h_t + R_{t-1} b_{t-1} / \pi_t + w_t' L_t \quad (8)$$

The biggest difference between an entrepreneur and a saver in the economy is his less patience, so he has to borrow money from the saver to spend and invest. The biggest difference between savers and entrepreneurs is that the former are patient and can control themselves to save their surplus money. After borrowing money, the borrower mainly invests the money mainly in intermediate goods and then sell them to the final product manufacturers, who provide final goods to the market. Thus, in the process of manufacturing intermediate goods, the households or provides funds to the entrepreneurs or producers of intermediate goods and receives interest; Savers provide labor to producers of intermediate for wages. In this way, intermediate producers obtain capital and labor factors of production and use production technologies to produce them.

$R_{t-1} b_{t-1} / \pi_t$ in (8) means that debt contracts are set in nominal terms, so that price changes between $t-1$ and t can affect the realized real interest rate. Define λ_t as the time t shadow value of the borrowing constraint. The first-order conditions are the consumption Euler equation, real estate demand and labor demand:

$$\frac{1}{c_t} = E_t \left(\frac{\gamma R_t}{\pi_{t+1} c_{t+1}} \right) + \lambda_t R_t \quad (9)$$

$$\frac{q_t}{c_t} = E_t \left(\frac{\gamma}{c_{t+1}} \left(v \frac{Y_{t+1}}{X_{t+1} h_t} + q_{t+1} \right) + \lambda_t m \pi_{t+1} q_{t+1} \right) \quad (10)$$

$$w_t' = (1 - v) Y_t / (X_t L_t) \quad (11)$$

The steady state consumption Euler equation for the household implies that $R = 1/\beta$. Combining this result with the steady state entrepreneurial Euler equation for consumption yields: $\lambda = (\beta - \gamma) / c > 0$. Therefore, the borrowing constraint will hold with equality:

$$b_t = m E_t (q_{t+1} h_t \pi_{t+1} / R_t) \quad (12)$$

If the net asset value of borrowers has risen, the demand for borrowing increases further in order to finance new con-

sumption and investment. Higher demand for collateral further drives up durable goods (real estate prices) prices. The mortgage effect refers to the acceleration of borrowing and consumption by mortgages, a concept similar to the “credit cycle” proposed by Kiyotaki and Moore [11]. Changes in real estate prices are essential to changes in borrowing and consumption. When there is a borrowing effect, the rise in real estate, mortgages, and investment is much higher than when there is no borrowing effect. Another important issue is that if the leverage ratio (LTV ratio) of the enterprise is too high, once it encounters macroeconomic fluctuations or poor management, the borrower will face the risk of bankruptcy, and once it fails, it will affect the lender, so that the macro economy is exposed to huge risks. Many of China’s companies operate with high debt, i.e., LTV ratio relatively high. In this way, the risk of insolvency and bankruptcy of the enterprise is high when faced with various risks.

What is important is the accelerator effect of the collateral on borrowers’ consumption and investment. The internal logic is as follows: the real price of real estate rises, which directly affects the value of collateral, and the marginal value of borrowing decreases. In other words, rising real estate prices have increased borrowers’ borrowing capacity, and lending constraints have been relaxed. In China, the rise in the price of real estate has directly increased the borrowing capacity of companies, and with the new loans, companies can continue to expand reproduction and increase the consumption. For the borrower, the decline in the marginal utility of current consumption relative to intertemporal consumption must be compensated for by an increase in consumption or investment, and in order to increase consumption or investment, the borrower must increase borrowing. In order to increase borrowing, borrowers need more real estate, real estate prices rise. With this logic, the economy is accelerated by the collateral leverage effect, but acceleration has its limit, that is, the borrowing constraint. Conversely, a decline in the value of collateral will accelerate the pace of economic downturn, especially in terms of the amount and price of collateral.

The higher the loan-to-value (LTV) ratio, the greater the economic impact. Important economic variables in the economy, such as consumption, investment, employment, etc., have been hit relatively harder. The existence of a loan-to-collateral value (LTV) ratio can both promote economic growth and potentially increase the risk of economic volatility. Therefore, the central bank should increase the monitoring of the loan-to-value ratio (LTV) and attach great importance to the huge magnification effect of financial leverage on monetary policy.

3.3. Retailers

To make the monetary effective, we have to incorporate price stickiness into the market. Thus we assume monopolistic competition at the retail level. A continuum of retailers of mass 1, indexed by z , buy intermediate goods Y_z from entre-

preneurs at P_t^w in a competitive market, differentiate the goods at no cost into $Y_t(z)$ and sell $Y_t(z)$ at the price $P_t(Z)$.

The final goods are

$$Y_t^f = \left[\int_0^1 Y_t(Z)^{\frac{(\varepsilon-1)}{\varepsilon}} dz \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

The price index is $P_t = \left[\int_0^1 P_t(Z)^{1-\varepsilon} dz \right]^{\frac{1}{1-\varepsilon}}$, so that each retailer faces an individual demand curve of $Y_t(Z) = \left[\frac{P_t(Z)}{P_t} \right]^{-\varepsilon} Y_t^f$. The sale price can be changed in every period only with probability $1-\theta$. The higher the parameter θ , the more difficult it is to adjust the nominal price of the sector. $\theta=0$, the price is fully elastic. $P_t^*(z)$ refers to the “reset” price and $Y_{t+k}^*(z) = (P_t^*(z) / P_{t+k}^*) Y_{t+k}$ the corresponding demand. The optimal $P_t^*(z)$ solves:

$$\sum_{k=0}^{\infty} \theta^k E_t \left\{ \Lambda_{t,k} \left(\frac{P_t^*(z)}{P_{t+k}} - \frac{X}{X_{t+k}} \right) Y_{t+k}^*(z) \right\} = 0 \quad (13)$$

$$\Lambda_{t,k} \equiv \beta \left(\frac{C_t}{C_{t+k}} \right)$$

As a fraction θ of prices stays unchanged, the aggregate price level evolution is

$$P_t = [\theta P_{t-1}^{1-\varepsilon} + (1-\theta)(P_t^*)^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}} \quad (14)$$

Combining (12) and (13) and linearizing yields a forward-looking Phillips curve, which states that inflation depends positively on expected inflation and negatively on the markup X_t of final goods over intermediate goods. When optimal monetary policy considers inflation stability, price stickiness distortions play an important role.

3.4. Central Bank Policy and the Interest Rate Rule

Taylor uses simple linear monetary policy rules to measure the relationship between interest rates and inflation and output gaps. This theory is in good agreement with the US data. In view of the model structure and experimental needs of this paper, we mainly use Taylor’s rule to simulate the impact of monetary policy on economic variables. In the theoretical discussion, the political significance and policy effect of monetary policy are emphasized, and the Taylor rule is used in the simulation experiment. In China, this means that the higher the inflation rate and the lower the interest rate, the less debt the borrower bears and the more

loss the saver bears. Conversely, the lower the inflation rate, the higher the interest rate, the greater the pressure on borrower debt, and the greater the benefit for savers.

The monetary rule follows the Taylor Rule and takes the form

$$R_t = (R_{t-1})^{r_R} (\pi_{t-1}^{1+r_\pi} (Y_{t-1} / Y)^{r_Y} \tilde{r} \tilde{r})^{1-r_R} e_{R,t} \quad (15)$$

where Y and \tilde{r} are steady state real rate and output respectively. Here, monetary policy responds systematically to past inflation and past output. $e_{R,t}$ is a white noise shock process with zero mean and variance σ_e^2 . This Taylor Rule manifests that the central bank focuses on inflation and output. Note that interest rate and inflation rate influence real debt and real housing price. Hence the borrowing constraint is affected by the monetary policy of the central bank. The results in this paper are similar to those of Schmitt-Grohe and Uribe [14]. In the Ramsey equilibrium scenario, the change in inflation is generally small. The cost of inflation is high because of price stickiness. Because central banks can redistribute wealth by controlling inflation, they have a choice between distortions caused by price stickiness and reducing borrower mortgage constraints.

3.5. Equilibrium

The equilibrium conditions of the market require that the production of the final product should be equal to the sum of expenditures and resources spent on price adjustments.

The equilibrium is an allocation $\{h_t, h_t^*, L_t, L_t^*, Y_t, c_t, c_t^*, b_t, b_t^*\}_{t=0}^{\infty}$, with $\{w_t^*, R_t, P_t, P_t^*, X_t, \lambda_t, q_t\}_{t=0}^{\infty}$ satisfying equations (2) to (15) and the market clearing conditions for labor $L_t = L_t^*$; real estate $h_t + h_t^* = H$; goods $c_t + c_t^* = Y_t$; and loans $b_t + b_t^* = 0$, given $\{h_{t-1}, R_{t-1}, b_{t-1}, P_{t-1}\}$.

3.6. Calibration and Transmission Mechanism

The basic model shows the key links between the interest rate, house price and the debt deflation channel. With a negative monetary shock and sticky prices, monetary policies affect the real rate, and its increase works by discouraging current consumption and hence output. The effect is reinforced through the fall in house prices which leads to lower borrowing and lower entrepreneurial housing investment. Debt deflation plays a role too. As obligations are not indexed, deflation raises the cost of debt service, further depressing entrepreneurial consumption and investment.

The low frequency quarterly data of macroeconomy is used here. The time period is a quarter. Data are accessible on internet of Wind, People’s Bank of China and National Bureau of Statistics of China. In this model, the parameters

that need to be calibrated are divided into two categories: one is the steady-state value of the endogenous variables of the model, and the other is the structural parameters of the quantitative relationship between the endogenous variables of the model. In determining the latter value, Bayesian estimation was used. To prioritize the monetary policy shock on the variables, Bayesian estimation is simplified here, the mean of which is used here. We can get the mean of Bayesian estimation from the other scholars, which will be used if necessary.

Key parameters' calibration is discussed here.

Some of the parameters are calibrated based on Chinese data. The average annual loan-to-value (LTV) ratio for residential mortgages in China is about 0.3, which is much lower than the average annual loan-to-value (LTV) ratio for residential mortgages in the United States, which is about 0.75. This is the average for the United States from 1952 to 2005. Because the households' mortgage is ignored in our model, as discussed previously, the value is only for reference.

This article examines the debt situation of entrepreneurs in China, and according to the Measures for the Administration of Urban Real Estate Mortgages, the mortgage ratio of real estate collateral shall not exceed 70%. So we set the loan-to-value ratio (LTV) of entrepreneurs to $(1-\chi)=0.70$, which is $\chi=0.30$, that is, $m=0.7$ in this article. The entrepreneurial "loan-to-value" ratio m in U.S.A. is set to 0.89,

which is higher than that of China [9]. This means that the entrepreneurs in China are more constrained than those of U.S.A..

The probability of not changing prices θ of China is set to 0.5884 [12]. The probability of not changing prices θ of U.S.A. is set to 0.75 [9]. With reference to Li Cheng et al., household labor supply schedule η of China is assumed to be 1.8183 in comparison with 1.01 of U.S.A. [12]. From 1992 to 2005, the ratio of China's household disposable income to national disposable income is changed from 68.3% to 59.4%, a decrease of 8.9%. So C is set lower than that of U.S.A.. Because it is difficult to calibrate some parameters due to the lack of data in China, some calibrations used by Iacoviello are employed in this paper. β is set 0.99; γ is set 0.98; j is set 0.1 [9]. For the Taylor rule, $r_y=0.13$, $r_\pi=0.37$, $r_R=0.73$. Imposing $r_y=0$ amplifies the financial accelerator since the Central Bank does not intervene when output falls.

3.7. Impulsive Response Function (IRF)

The impulse response diagram based on the model Housing DSGE can depict the dynamic response of each macro variable in 20 quarters under the exogenous shock of 1% positive interest rate.

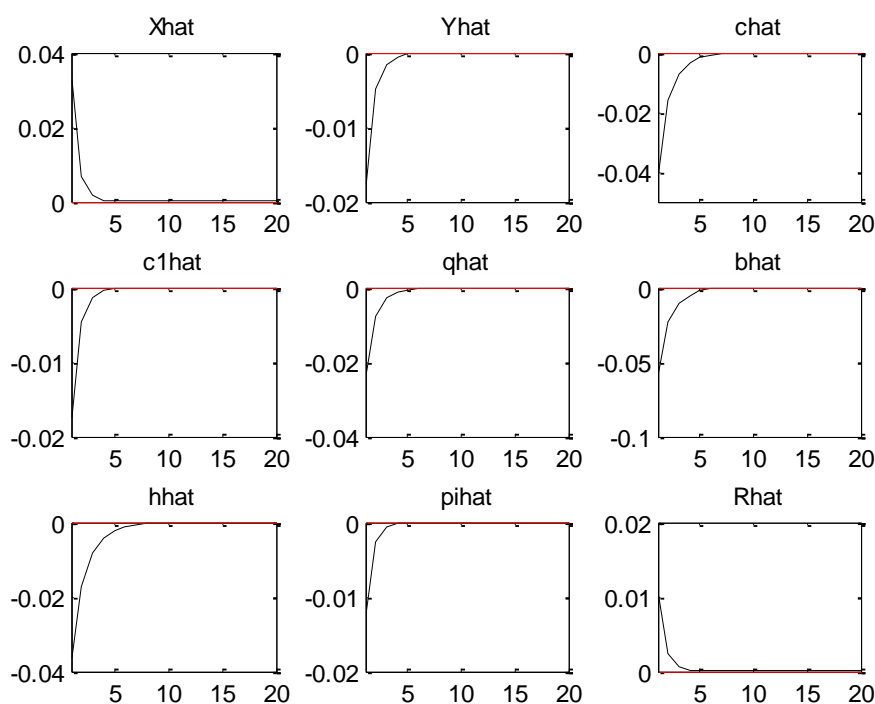


Figure 1. In response to a monetary shock.

Figure 1 provides a stylized answer for 9 variables subject to the same shock of a one-standard deviation of the interest rate in China. Nine variables are as follows: X (markup), Y (output), C (entrepreneurial consumption), C' (household'

consumption), q (housing price), b (entrepreneurial debt), h (house), π (inflation), R (interest rate). With the shock of a one-standard positive deviation of the interest rate, markup rises by about 3 percent. Output falls by about 2 percent,

entrepreneurial consumption about 4 percent, households' consumption about 2 percent, housing price about 2 percent, entrepreneurial debt about 5 percent. Entrepreneurial debt, markup and housing price are mostly influenced by the monetary policy.

With reference to the research of U.S.A. conducted by Iacoviello [9], the decline in output is larger, and the total decline is 4.42 percent. Housing price falls by about 4 percent (for full model-based reference). Compared with the research of this paper, the economic variables in China are less volatile than those of U.S.A. One important reason is that the entrepreneurs in China are more constrained than those of U.S.A. which results in less risk in the economy. Based on our research, a conclusion is arrived at that high LTV Ratio renders American housing market and financial system more vulnerable to monetary shocks. With high LTV Ratio, even a comparatively closed economy is more volatile, which is reflected by what is happening in China's current housing market.

4. Conclusion

With the collateral constraint, the economy is more fragile, that is, if the loan to value ratio is lower, the economy is more stable. We conduct a research based on China's economy and find that China's economy is more stable than economy of U.S.A.. One important reason is that the entrepreneurs in China are more constrained than those of USA which results in less risk in the economy. Entrepreneurial debt, markup and housing price in China are mostly influenced by the monetary policy. Affected by tight monetary policy in China, output falls by about 2 percent. Housing price falls by about 2 percent. Entrepreneurial debt falls about 5 percent. Affected by tight monetary policy in U.S.A. with higher LTV ratio, output falls by about 4.4 percent. Housing price falls by about 4 percent. Collateral constraint is one important factor that the monetary policy shall note. With high LTV Ratio, even a comparatively closed economy such as China, is more volatile. In fact, it is the Chinese institution that really affects the difference in the results. China's real estate market is a field where the government is deeply involved. Our DSGE model does not reflect these differences, and this is what we will strive to do in the future.

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Conflicts of Interest

The authors declare no conflicts of interest.

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