China’s Easily Overlooked Monetary Transmission Mechanism: Monetary Reservoir

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Abstract
The traditional monetary transmission mechanism usually views the equity markets as the monetary reservoir that absorbs over-issued money, but due to China’s unique fiscal and financial system, the real estate sector has become an "invisible" non-traditional monetary reservoir in China for many years. First, using data from Chinese housing market and central bank for parameter estimation, we constructs a dynamic general equilibrium model that includes fiscal expansion and financial accelerator to reveal the mechanism of monetary reservoir. An asset can be called a loan product, which worked as financed asset for local fiscal expansion, as long as it satisfies the following three conditions: leveraged trading system, balance commitment payment, and the existence of the utility of local governments. This paper refers to this mechanism as the monetary reservoir that will push up the premium of loan product, form asset bubbles and has a significant impact on the effectiveness of monetary policy. Local governments leverage the sector of the loan product to obtain short-term growth by influencing the balance sheets of financial intermediaries through fiscal financing, expenditure and also investment, but this mechanism undermines the foundations of long-term growth by crowding out human capital and technological accumulation.

Keywords: Monetary Policy, DSGE Model, Chinese Economy

1. Introduction
Since the financial crisis in 2008, both the Chinese housing market and the American stock market have experienced a boom period that was significantly higher than consumer price index (CPI) and producer price index (PPI). Since the rapid expansion of the price and market value of these assets relative to other assets coincides with the loose monetary policy of China and the United States,
the notion that "Chinese housing and US stocks" are "monetary reservoirs" has
come widespread. Premium price lever is that the nth-year price of product X
divides the base-year price, and also divides CPI or PPI cumulative level which
is the multiplier of each CPI or PPI from base year to nth year. Figure 1 below
illustrates that cumulative premium increase trend of two markets relative to
the PPI and CPI, with Federal Reserve’s initiation of quantitative easing policy
since 2009 and China’s offsetting of additional US dollar issuance through RMB
over-issuance in order to maintain its export volume.

The trends in both the US and China have certain commonalities as well
as individual characteristics. The commonality between them is that both the
housing and stock markets have experienced significantly higher price increases
compared to the CPI and PPI, particularly in China, where the housing price
premium to CPI has accumulated to over 45 times within less than a decade,
and the price premium to PPI has also accumulated to around 5 times. This
phenomenon also happened in the US, but the level of premium accumulation
is much lower than the one in China. On the other hand, there are also remark-
able differences between these markets. Firstly, the increase in asset prices is
much higher in China than in the US, and secondly, in China the real estate
sector acts as a monetary reservoir, whereas in the US it is the stock market
that performs this function. Indeed, the US real estate sector also absorbed
much of the excess money and speculative capital before the bursting of the
mortgage-backed securities bubble in 2008, and the US equity market became
a monetary reservoir asset because of the US government’s heavy-handed regu-
latory measures on housing securitisation.

The main feature of the monetary reservoir asset phenomenon is a counter-
cyclical boom. The main basis of the view that loose monetary policy regards
as a monetary is that the central bank’s monetary easing cycle largely coincides
with the rise in the prices of monetary reservoir assets, however, this point just
confirms a correlation between the monetary reservoir phenomenon and the ex-
pansionary monetary policy of the central bank. But it does not explain the
following questions: (i) Why did the monetary reservoir assets only stand out
and show the significant premium trend under the same conditions of monetary
excess? (ii) Did all the newly increased market value of the monetary reservoir
in aggregate come from monetary easing policy? The significance of the first
question lies in the fact that if monetary reservoir assets have the characteristic
of naturally attracting excess money, on the one hand they can help alleviate
inflation and serve the real economy with their financing effect, but on the other
hand they can lead to serious asset price bubbles and eventually to serious sys-

temic financial crises.

To answer these problems, the traditional theory of the top-down monetary
transmission mechanism still needs to be supplemented. Relevant research nor-
mally ignores the possibility of local governments expanding credit and issuing
more money, therefore there is the biased understanding in local governments’
financing and investment behaviors. In fact, local governments have certain
pricing rights over production factors and tax guarantees, so they finance and
invest through financial intermediaries, forming a monetary transmission mech-
anism of monetary issuance - increasing credit - driving economic growth or over-issuing money to cultivate growth. This mechanism has been "invisible" to the academic community, i.e. only partial but not overall, only ranked secondly but not firstly in importance.

The marginal contributions of this paper are: (i) the construction of a dynamic general equilibrium model that includes the public goods sector and the financial accelerator to provide a detailed and rational explanation for the high debt problem of local governments and the counter-cyclical boom in the real estate sector in China; (ii) the analysis of the impact of the monetary reservoir on the effectiveness of monetary policy in addition to the monetisation of the fiscal deficit; and (iii) through the monetary reservoir, this paper provides a more microscopic explanation for China’s growth model since the beginning of the new century, which has been driven by a combination of fiscal investment and foreign investment, and proposes corresponding policy recommendations for the problems of high leverage and high asset bubbles.

The following parts of this paper are organized as follows: the section 2 is a literature review; the section 3 starts from the traditional theory of monetary transmission mechanism and theoretically analyzes the local government-led monetary reservoir mechanism in the context of China’s unique fiscal and financial system; the section 4 constructs a dynamic general equilibrium (DSGE) model based on Bernanke et al.’s (1998) financial accelerator model that includes local government, loan contracts, and The fourth part constructs a dynamic general equilibrium (DSGE) model based on Bernanke et al.’s (1998) financial accelerator model that includes local government, loan contracts, and the public goods sector; the section 5 calibrates the parameters of the above DSGE model and estimates Bayesian simulation moments based on China’s housing market and relevant macroeconomic data; the section 6 analyzes the market value of the sector with a loan transaction system (loan goods) and the premium factors of unit commodity prices relative to the non-loan goods sector; the section 7 investigates the monetary reservoir mechanism through the impulse response function and variance decomposition analysis to study the impact of the monetary reservoir mechanism on the efficiency of monetary policy; the section 8 analyzes the role of monetary reservoirs on the macroeconomic system in the short run in terms of growth rate, resource allocation, growth structure and the role of fiscal investment; the section 9 of this paper embeds the DSGE model with Romer (1987[1], 1990[2]) endogenous growth model in the DSGE model to study the economic effects of the crowding out of R&D labour by the monetary reservoir in the long run.

2. Literature Review

Public opinions has mostly attributed the boom in the real estate and stock markets to the over-issue of money by central bank, arguing that the real estate and stock markets acted absorb overflow money as monetary reservoirs. This is still essentially a central bank-centred and top-to-bottom perspective. Even though many scholars have studied issues such as land finance or local debt,
they still analyse local finance and the monetary transmission mechanism in China independently.

To understand the monetary over-issuance out of central bank, it is necessary to clarify the two core issues. The essence of currency additional issuance is credit expansion. There are some certain conditions for transforming the credit expansion into the additional monetary issuance. Specifically, it depends on whether the fiscal financing investment has turned into a government deficit. If fiscal financing and investment of the credit expansion brings higher return rather than debt, then it should not be called the monetary over-issuance. On the contrary, the accumulation of surplus government deficit is converted into money through financial inter-mediation, and this conversion is not limited to the payments of central bank. After the reform of the tax-sharing system in 1994, the central government gained more financial power while local governments took larger fiscal powers. The gap in financial funds forced local governments to seek financial financing. In addition, GDP was the main performance indicator in the evaluation of local government officials in China for a long period of time. The officials promoted local economic growth or maximizes fiscal revenue through the return of financial subsidies, the construction of supporting facilities, tax incentives, land discounts, etc. [Huang (2012) 3; Shao (2016) 1], empirical evidence such as Wang(2015) 5. Local governments promote real estate sector investment through credit expansion and financial leverage. However, this also leads to rapid issuance of currency by local governments, most of which flow into currency reservoirs. The core support assets for local government credit expansion are land finance, shadow banks and invisible guarantees [Mei(2021) 6; Fu(2017) 7; Liang(2019) 8; Wu(2013) 9; Wu et al. (2016) 10]. The essence of fiscal financing based on land finance is the capitalization of land resources by local governments under the condition of monopoly land market. Local governments indirectly form local debts through bank project loans, city investment bonds and capital market financing. Although the credit expansion of local governments is based on land capital as the underlying asset, its rapid growth relies on the endorsement of government tax revenue. restricts the supply of land in various ways to promote land prices for continuous financing, further increasing the financial sector’s loans to the real estate sector. In total, there are two main reasons for financial intermediaries to cooperate with local governments in their credit expansion: In total, there are two main reasons for financial intermediaries to cooperate with local governments in their credit expansion: First, the equity of financial intermediaries based on local financing platforms is mostly owned by local governments, or the policy willingness of financial intermediaries to cooperate with local government officials in the Chinese banking system may be possible. There is greater operational convenience in this situation. All in all, financial intermediaries and local governments have common interests; the second is that financial intermediaries and social capital “trust” the guarantees of the central and local governments.

In order to distinguish in detail between the two different mechanisms, we first analyse the widely accepted monetary transmission mechanism. The empirical and theoretical models related to the monetary transmission mechanism...
have remained relatively controversial over the years and, in general, there are three views on the monetary transmission mechanism: Firstly, the Keynesian view, which argues that monetary policy affects long-term interest rates through the manipulation of short-term interest rates, thereby influencing real investment and long-term growth [Bernanke et al.(1992)]. The second is the monetarist view, which sees monetary policy as generating wealth effects through short-term interest rate adjustments in relative asset returns and driving investment through Tobin Q values. Thirdly, the credit view, which argues that monetary policy acts first on asset prices, affecting the asset and liability positions of firms and banks, and ultimately affecting output through the level of aggregate social credit. The transmission channels discussed in the three perspectives are mainly four mediating variables: interest rates, exchange rates, asset prices and credit. Without exception they all study the transmission path from the central bank to commercial banks and finally to enterprises.

According to the above analysis, there are two main additions to the traditional view: on the one hand, in contrast to the traditional view that the central bank is the only centre of the monetary transmission mechanism, the credit expansion of local governments also has a monetary issuance-circulation transmission mechanism under certain conditions. On the other hand, there is a need to consider the benefits of fiscal investment, such as the role of public goods investment on output efficiency, for example, the contradiction that increased monetary issuance under conditions of resource allocation imbalance instead aggravates the reduced efficiency of financial resource allocation, while public goods investment originating from fiscal financing enhances output efficiency [Chen(2016), Liu(2021)].

The previous literature on the relationship between the real estate sector and economic growth has been divided into two main splits of research, which are the asset price channel [Chaney(2012) and Atif(2014), Yang(2014), Li(2014), Xiao(2014), Song(2021), Bernstein(2021)] and the financial system channel. [Luo(2015)]. The conclusion that real estate investment crowds out consumption, investment and reduces financial efficiency is the more widely accepted conclusion in the two main splits mentioned above, which suggests at least two facts: first, that the monetary reservoir represented by the real estate sector takes up more financial funds, i.e. credit preference; and second, that the excessive boom in the real estate sector weakens the potential for long-term growth by crowding out consumption and innovative investment and also reducing financial efficiency.

The result of credit preference is an increased flow of financially intermediated funds to the real estate sector, increased leverage and a push up in the market value of the monetary reservoir, where financial funds include increased money issuance, providing an explanation for the countercyclical boom of the monetary reservoir, for which some scholars have also presented empirical evidence [Landvoig et al.(2011), cong et al., Wei(2017)]. Financial credit generally uses the volume of loans from financial intermediaries as a proxy variable, but an increase in the volume of loans does not necessarily increase asset leverage, but rather the transaction regime such as down payment or guar-
antee determines asset leverage, which explains the boom in the real estate sector. The essence of this phenomenon is to explain credit expansion and economic cycles in terms of leverage. Similar findings from other countries include Justiniano et al. (2015), Mian et al. (2016), Schularick (2012), and Iacoviello (2010). Thus, credit preference and monetary reservoir booms should be causally related, with leverage leading to initial credit appetite, which drives an increase in credit size, generating boom cycles, which in turn increase credit appetite.

![Figure 1: Comparative chart of price increases in the Chinese housing and US equity markets](image)

3. **Theoretical analysis**

There are two main aspects of leverage: the trading system and the refinancing mechanism. The leveraged trading system consists of a down payment ratio or margin system, while the refinancing mechanism is indirectly leveraged. Assuming that an asset has to be purchased in full, financial intermediary provides a partial "rebate" of the amount paid, and the purchaser of the asset can continue to repay the loan with a loan, the actual effect of refinancing is basically
the same as that of a leveraged trading system. The interest rate is the central factor in a leveraged trading regime. In addition, due to information asymmetry and financial friction, financial intermediaries form an interest rate premium, that is, the financial accelerator mechanism [Bernanke et al., (1999)] This paper introduces the mortgage of housing assets on the basis of the financial accelerator.

Figure 2: Two channels of monetary transmission

In figure 2 the left and right panels depict the traditional monetary transmission mechanism and the monetary reservoir-fiscal financing and investment monetary transmission mechanism respectively. The traditional view is that financial intermediaries provide financing services to the productive sector, the household sector and the government at all levels, and that the central bank influences the cost of capital and loanable funds through various policy variables. Therefore, the traditional transmission mechanism is a unidirectional and top-to-bottom money supply process. The biggest difference between these two mechanisms is that the second one takes into account that local governments can also monetize fiscal deficits. As the marginal returns of fiscal investment decrease, fiscal deficits increase, which will promote the monetization of government debt and form the currency transmission mechanism that is completely different from the traditional path.

The argument for over-issuance out of central bank might be argued as follows: If there is the over-issuance existing in the China’s real estate sector instead of the central bank, why is there a significant correlation between housing prices and money supply instead of independent changes or even counter-cyclical characteristics? It is undeniable that there is a strong correlation between the price fluctuations of currency reservoir assets and the central bank’s monetary easing policy, but the correlation between the two operating cycles is not strong. In order to measure the operating period, this paper performs Fourier transform on the growth rate sequence to convert the original signal into frequency and its corresponding amplitude, and arranges the phases in order according to the magnitude of the amplitude (due to symmetry, only the part whose absolute magnitude...
value is greater than 0 is considered), and finally By calculating the rank (amplitude order) correlation coefficient corresponding to the same frequency of the two variables, the results are shown in Table 1. The results in Table 1 show that both the housing and stock markets in China and the US are significantly correlated with money supply and price-based policy variables. Among them, the growth of China’s housing market premium has a strong cyclical correlation with M2 money supply, while housing prices have a strong cyclical correlation. The cyclical correlation with M2 money supply is not obvious (negative cyclical correlation also means weak cyclical correlation). In contrast, the U.S. stock market index and market interest rates have a stronger cyclical correlation with CPI/PPI. Since 2008, the U.S. Federal Reserve’s loose monetary policy and monetary over-issue of fiscal deficit monetization have driven the price level of consumer and industrial products to rise. Therefore, there is a strong correlation between the price series and the operating cycle at the same time [Iacoviello(2010)]27. As China’s main monetary policy control variable, money supply does not have a significant impact on the operating cycle of price levels in various sectors, which at least shows that it is not comprehensive to understand the additional issuance of money only from the perspective of the central bank.

|        | CPI | PPI | SSE index | \( P_h \) | \( \frac{\Delta_1 P_h}{\Delta_1 t} \) | \( \frac{P_h}{P_{PPI}} \) | \( \frac{P_h}{CPI} \) |
|--------|-----|-----|-----------|------------|---------------------------------|----------------|----------------|
| \( M_2 \) Corr. | -0.19 | -0.02 | 0.016 | -0.134 | -0.052 | -0.071 | -0.009 |
| \( M_2 \) Rank Corr. | -0.10 | -0.34 | -0.098 | -0.310 | 0.229 | 0.074 | 0.130 |

|        | CPI | PPI | SSE index | \( P_s \) | \( \frac{\Delta_1 P_s}{\Delta_1 t} \) | \( \frac{P_s}{P_{PPI}} \) | \( \frac{P_s}{CPI} \) |
|--------|-----|-----|-----------|------------|---------------------------------|----------------|----------------|
| Interest Rate Corr. | 0.03 | 0.137 | -0.091 | -0.440 | -0.097 | -0.108 | -0.086 |
| Interest Rate Rank corr. | 0.043 | 0.04 | 0.044 | 0.075 | -0.01 | -0.092 | -0.096 |

1 \( P_h \) denotes the house price index made by data in over 30 cities in China, \( P_{s,c} \) is the SSE index.

2 \( P_s \) denotes the Dow Jones industrial index. \( P_h \) is the house price index in U.S.

Table 1: Comparison of stock market indices and house price levels in China and U.S.

Figure 3: Diagram of the process of increasing money in the real estate money reservoir
Figure 3 depicts the relationship among financial intermediaries, the real estate sector, the household sector, local governments and the public goods sector. The straight line in the diagram indicates the obvious visible financial flow relationship, i.e. the buying and selling of property, while the dotted line indicates the hidden financial flow relationship, indicating the expansion of local government credit. Local governments are not involved in the sale of property, but they influence the real estate market in two ways: On the one hand, local governments guarantee realization and value-added of real estate functions by discounting land transfer fees and increasing the construction of supporting facilities (such as building shopping malls and building public transportation systems). On the other hand, local governments raise funds from financial intermediaries through financial financing to invest in the public goods sector. The biggest beneficiaries are still the household sector and the real estate sector (compared to the real estate sector, the market value of the non-real estate sector is not directly affected by the positive externalities of infrastructure). In addition, the leverage of the real estate sector also implies high value and is more conducive to improving the performance of officials in the short term. Local governments and financial intermediaries provide more loans to the real estate sector through fiscal financing in their mutual interest, and the increasing leverage of the real estate sector contributes to the boom cycle of real estate. In the long run, this leads to a marginal decrease in productivity. As a result of the imbalance between local government authority and financial authority and the performance appraisal system of officials that emphasises short-term achievements at the expense of long-term benefits, local governments form a path dependency and a cycle of debt expansion, with local governments forming a large amount of government debt through fiscal financing that affects the balance sheets of financial intermediaries and, under the effect of credit preference, credit mainly goes to the real estate sector, with the leverage of local governments and the real estate sector increasing simultaneously. Long-term fiscal deficits drive debt monetisation resulting in increased monetary issuance, constituting a so-called monetary reservoir mechanism.

4. Model Setup

The model assumes that the labor factor accounts for the same proportion of total output in the loan good and non-loan good sectors, i.e., \( \phi_h + \psi_h = \phi_f + \psi_f \). The proof in Appendix A illustrates that this assumption is made only to facilitate the presentation of the results and does not affect the core conclusions. Loan goods in the model refer to transactions where the system allows partial payments and purchasers can buy commodities with a small cost. In this paper, a typical example of a loan good is the real estate sector.

4.1. Mortgage contracts

The individual borrower actively chooses the best loan term for each period based on the prime rate to maximize his or her leverage and thus ensure the least
amount of debt service per period. The loan contract is designed as follows: the down payment ratio is \( \theta_t \), the financial intermediary charges the debtor’s family an equal amount of the mortgage in each installment. The total loan contract is

\[
(1 - \theta_t) P_t y_t (1 + i_t)^T = T * D
\]

where \( D \) denotes the amount of mortgage repaid in equal installments per period, the leverage ratio is defined as the ratio of the total loan amount per period to the amount repaid in equal installments per period, and the leverage ratio is defined as \( \omega_t \) and \( i_t \) denotes the loan interest rate.

\[
\omega_t = \frac{T}{(1 - \theta_t) * (1 + i_t)^T} = \frac{P_t y_t}{D}
\]

The debtor first selects the optimal term \( T \) with the first-order condition that \( T^* \approx \frac{1}{i_t} \). Assuming that the debtor chooses the minimum term \( T \) and the maximum leverage ratio under the condition of the given total loan amount \( P_{h,y_t} \), and substitutes it into the original equation. We can find \( \omega_t \) is approximately equal to the following equation.

\[
\omega_t = \frac{1}{(1 - \theta_t) * (1 + i_t)^T} \approx \frac{1}{1 - \theta_t * e * i_t}
\]

4.2. Financial intermediaries

Financial intermediaries earn interest on loans by lending. The interest rate on loans is represented by the following equation.

\[
i_t = f_h (\omega_{h,t}) R_t, f_h (x < 1) = 1, f'_h > 0, f''_h (<) < 0
\]

where \( R_t \) is the base interest rate and \( \omega_t \) denotes leverage rate. \( f_h (\omega_t) = \omega^{\xi_t} \), where \( \xi_t > 0 \) denotes that the financial intermediary’s mortgage interest rate premium increases monotonically with the mortgage leverage. Financial intermediaries determine the proportion of leveraged commodities refinancing \( \mu_t \) and the coefficient of the mortgage interest rate premium \( \xi_t(t) \). \( \mu_t \) is correlated with the central bank’s money supply, economic prosperity and regulatory policy, and is regarded as a proxy variable for exogenous shocks to quantitative monetary policy and risk preference of financial intermediaries in this paper.

Combining Equation 3, Equation 4 can be re-expressed as:

\[
i_t = R_t^{\frac{1+i_t}{\xi_t}} \left[ \frac{1}{(1 - \theta_t) * e} \right]^{\frac{\xi_t}{1+i_t}}
\]

Combining Equation 3 and Equation 5, the leverage ratio for a down payment ratio of \( \theta_t \) is expressed as

\[
\omega_t = (1 - \theta_t)^{\frac{\xi_t}{1+i_t}} - 1 \ e^{-\frac{\xi_t}{1+i_t} R_t^{\frac{1+i_t}{\xi_t}}}
\]
4.3. Representative households

In this paper, we consider households surviving indefinitely, choosing in each period to purchase consumption of consumption goods \( C_t \), loan and non-loan goods \( Y_{h,t} \) and \( Y_{f,t} \), providing labor \( N_t \) and holding money \( M_t \) and borrowing \( B_t \).

\[
\text{Max } E \sum_{t=0}^{\infty} \frac{C_t^{1-\sigma}}{1-\sigma} + \chi \cdot (M_t - B_t) + j_h \cdot \log[Y_{h,t}] + j_f \cdot \log[Y_{f,t}] - \kappa \cdot N_t
\]  

(7)

where \( E \) denotes expectations, \( M_t \) is the money balance held by residents, \( \sigma \) is the household’s risk aversion coefficient, \( \beta \) is the discount factor, \( j_h \) and \( j_f \) is the preference of leveraged and non-leveraged commodities respectively. \( \kappa \) denotes the household’s aversion to labor. The representative household supplies labor \( n_{f,t} \) and \( n_{h,t} \) to two sectors, non-loan good \( f \) and loan good \( h \), respectively, and the total labor supply constraint for the representative household is set to \( n_t \). The utility to the representative household is equivalent between the two types of labor.

\[
N_t = n_{f,t} + n_{h,t}
\]  

(8)

The budget constraints for the household sector are:

\[
M_t + C_t + \frac{E(\sum_{k=t+1}^{\infty} \frac{P_{h,k}Y_{h,k}}{(1+R_k)^k})}{\omega_{h,t}} + P_{f,t}Y_{f,t} + \theta_t P_{h,t}Y_{h,t} + i_{t-1}B_{t-1} = (1 + R_{t-1})M_{t-1} + B_t + W_{f,t}n_{f,t} + W_{h,t}n_{h,t}
\]  

(9)

where \( \frac{E(\sum_{k=t+1}^{\infty} \frac{P_{h,k}Y_{h,k}}{(1+R_k)^k})}{\omega_{h,t}} \) denotes the discounted value of the expenditure on debt service according to the loan contract, and \( P_{f,t} \) and \( P_{h,t} \) denote the prices of the non-loan and loan products, respectively. The representative household also needs to repay the interest on the previous period’s borrowing \( i_{t-1}B_{t-1} \) and the down payment on the expenditure loan good \( \theta_t P_{h,t}Y_{h,t} \). Meanwhile the representative household receives labor income \( W_{f,t}n_{f,t} + W_{h,t}n_{h,t} \). In this paper, we consider the borrowing constraint of using \( \mu_t \) proportion of cumulative loan items as the loan amount, where \( \mu_t \) denotes the refinancing proportion of loan items.

\[
B_{h,t} \leq M_t + \mu_t \sum_{k=0}^{t} P_{h,k}(Y_{h,k})
\]  

(10)

Households determine consumption, labor in both sectors, money and borrowing, and first-order conditions for the products of both sectors.

\[
C_t^{-\sigma} = \lambda_t
\]  

(11)

\[
-\kappa \cdot \frac{1}{n_{h,t}} + \lambda_t W_{h,t} + \mu_t = 0, -\kappa \cdot \frac{1}{n_{f,t}} + \lambda_t W_{f,t} + \mu_t = 0
\]  

(12)

\[
\chi - \lambda_t + \beta \cdot E(\lambda_{t+1})[1 + R_t] = 0
\]  

(13)
\[ \frac{\dot{j}_h}{Y_{h,t}} - E\left(\sum_{k=t}^{\infty} \frac{\beta^k \lambda_k}{(1+R_k)^k}\right) \frac{P_{h,t}}{\omega_{h,t}} - \theta_t P_{h,t} + \gamma_t \mu_t P_{h,t} = 0 \]

where \(\lambda_t, \gamma_t\)and\(\mu_t\) are Lagrange multipliers for the budget constraint, the credit constraint and the labor supply constraint, respectively. Collapsing the loan goods sector and the non-loan goods sector yields the demand curves with respect to the two major sectors.

\[ P_{f,t} Y_{f,t} = j_f \]

\[ P_{h,t} Y_{h,t} = \frac{j_h}{E\left(\sum_{k=t}^{\infty} \frac{\beta^k \lambda_k}{(1+R_k)^k}\right)} \]

Under all first-order conditions satisfying the household sector, since \(P_{h,t} Y_{h,t}\) is proportional to \(\omega_{h,t}\) this paper assumes that \(\theta_t = \gamma_t \mu_t\) to simplify the formula for the reader’s understanding.

\[ P_{h,t}(Y_{h,t}) = \frac{j_h}{E\left(\sum_{k=t}^{\infty} \frac{\beta^k \lambda_k}{(1+R_k)^k}\right)} \]

4.4. Leveraged commodities production sector

In addition to the capital required to produce the loan good firm, it also employs labor \(n_{h,t}\) and purchases land \(L_{h,t}\) in each period, while the production functions of both the loan good and non-loan good sectors benefit from the positive externality \(\Phi_t\) of the public good sector. \(\Phi_t\) denotes the output that can be increased without increasing the firm’s additional factor inputs. The corresponding production functions are as follows.

\[ Y_{h,t} = \Phi_t K_{h,t}^{\rho_h} L_{h,t}^{\psi_h} n_{h,t}^{1-\rho_h-\psi_h} \]

\(\psi_h\) is the share of rewards of land in total factors, and a larger \(\psi_h\) indicates a larger role for land in the production function, while \(\phi_h\) is the share of returns to capital in total factor rewards. The real estate sector satisfies the following conditions in its profit maximisation. Define the profit function as follows.

\[ \prod_{h,t} = P_{h,t} Y_{h,t} - W_{h,t} n_{h,t} - PL L_{h,t} - i_{h,t}^P K_{h,t} \]

\(W_{h,t}\) is the wage per unit of labor, \(PL_{h,t}\) is the price of land, exogenously given by the local government, and \(i_{h,t}^P\) is the interest rate on capital borrowed from producers of loan goods, choosing three factors of production such that the profit function is maximized.

\[ W_{h,t} = \frac{P_{h,t} \ast (1 - \phi_h - \psi_h)}{n_{h,t} \ast Y_{h,t}}, PL_{h,t} = \frac{P_{h,t} \ast \psi_h Y_{h,t}}{L_{h,t}}, PK_{h,t} = \frac{P_{h,t} \ast \phi_h \ast Y_{h,t}}{n_{h,t}} \]
According to the financial intermediation setting, the price of capital is equal to the borrowing rate and the leverage ratio is defined as the ratio of total assets $P_{h,t}Y_{h,t}$ to borrowed capital $K_{h,t}$. Because $i_{h,t} = R_t(\omega_{h,t})^{\zeta_t} = R_t(\frac{P_{h,t}Y_{h,t}}{K_{h,t}})^{\zeta_t}$

\[ i_{h,t} = \frac{R_t}{\zeta_t} \left[ \frac{1}{\zeta_t} \right] = R_t \left[ \frac{1}{\zeta_t} \right] \tag{23} \]

4.5. Non-Leveraged Commodities sector

First-order conditions in the non-real estate sector differ from those in the real estate sector only in the extent to which each factor of production - land, labour and capital - contributes to production.

\[ W_{f,t} = P_{f,t}^* (1 - \psi_f) n_{f,t}^* Y_{f,t}, PL_{f,t} = P_{f,t}^* \psi_f Y_{f,t}, PK_{f,t} = P_{f,t}^* \phi_f Y_{f,t}, i_{f,t} = R_t \left[ \frac{1}{\phi_f} \right] \tag{24} \]

4.6. Public goods sector

In this paper, we define $G_t$ to denote direct government investment for public goods construction. Public goods include factors such as infrastructure, science and technology, and human capital accumulation, and $TF_t$ denotes fiscal transfers to the household sector, for which the public goods sector and fiscal transfers satisfy the following conditions.

\[ \Phi_t = exp(\lambda P_t [G_t - \delta_k T - 1 \sum_{0}^{T-1} G_i]) \tag{25} \]

where $\Phi_t$ denotes the positive externality that the public good brings to the production sector, causing the production efficiency of the production sector to rise, and $\Phi_t$ is determined by $G_t$, the capital depreciation rate $\delta_k$. When the parameter $\lambda P_t$ in the formula is less than 0, the coefficient of action of the public goods sector on the production efficiency of the production sector is less than 1. The public goods sector instead leads to a decrease in the level of output with the same factor inputs. As the aggregate demand curve remains unchanged, the fall in the level of output causes an increase in prices.

4.7. Local government

In this paper, the objective decision function of the local government is divided into two parts. The objective of the local government is to maximize the total local economy and tax revenue. The weights of the two policy objectives are $W_G$ and $1 - W_G$. Local governments are able to decide public goods investment $G_t$ and land supply $L_t$ to influence economic growth. In this paper, the local government objective function is set as.

\[ Max : E_t \sum_{t}^{+\infty} \beta_G^t W_G (P_{h,t}^* \Phi_t K_{h,t}^{\rho_h} L_{h,t}^{\psi_h} n_{h,t}^{1-\rho_h-\psi_h} + P_{f,t}^* \Phi_t K_{f,t}^{\rho_f} L_{f,t}^{\psi_f} n_{f,t}^{1-\rho_f-\psi_f}) + (1 - W_G)(PL_{h,t} L_{h,t} + PL_{f,t} L_{f,t}) \tag{26} \]
Assume that the local government also faces a zero down payment loan contract for fiscal financing with fiscal leverage of $\omega_{G,t}$. The local government borrows funds from the financial intermediary using the land concession revenue as a pledge and expects to repay the debt in each period for $\omega_{G,t}$ times at the equal cost of $PL_{h,i,L_{h,i}} + PL_{f,i,L_{f,i}}$.

$$G_t + [PL_{h,t} L_{h,t} + PL_{f,t} L_{f,t}] \sum_{p=t}^{\infty} \frac{1}{(1 + \delta_k)^p} \leq [PL_{h,t} L_{h,t} + PL_{f,t} L_{f,t}] \times \omega_{G,t}$$

(27)

where

$$\omega_{G,t} = e^{-\frac{\xi_{G,t}}{1 + \frac{\xi_{G,t}}{\delta_k}}}$$

(28)

4.8. Capital accumulation equation

Each period the firm depreciates the remaining capital goods $(1 - \delta_k)$ at a depreciation rate $\delta_k$ to realise them, and the capital goods producer can likewise produce the final capital goods in conjunction with the newly increased investment $I_t$, with the final capital goods being produced in the next period. The capital accumulation equation is as follows.

$$K_{t+1} = (1 - \delta_k)K_t + I_{t+1}$$

(29)

4.9. Central bank

In most DSGE models, the central bank sets monetary policy according to the Taylor monetary rule.

$$\frac{R_t}{R} = [R_{t-1} \frac{\rho_{R}}{\rho_{GDP}} G_{DP}]^{\rho_Y}$$

(30)

4.10. Market clearing conditions

The model assumes that markets are in equilibrium when each market is cleared, consistent with the Keynesian output constancy equation. Labor and land supply are exogenously given.

$$Y_{f,t} + Y_{h,t} = C_t + I_t + G_t$$

(31)

$$n_{f,t} + n_{h,t} = n_{f.t}$$

(32)

$$L_{h,t} + L_{f,t} = L_t$$

(33)

5. Calibration and Estimation of Parameters in Models

The parameters $\beta$ and $\beta_G$ denote the subjective discount rates of residents and local governments respectively, and are set to 0.98 according to the classical DSGE model. The depreciation rate $\delta_k$ for capital goods is taken to be about 0.01. The labour supply elasticity $\kappa$ is taken to be 1.2 in this paper. Referring to the classical financial accelerator model, the household sector risk aversion
coefficient $\sigma$ is set to 0.9. $j_h$ and $j_f$ are taken as 0.2 both and labour preference $\kappa = 0.1$. Personal income tax rate $T_p$ and corporate income tax rate $T_q$ are both taken as 0.05. Based on housing market data from April 2020 to February 2021, the down payment ratio is set to 0.2833 and calculated from the first home loan interest rate in steady state by simulating moment estimation of financial. The level of the interest rate premium of intermediaries on home purchase loans is $E(\xi_{h,t}) \approx 0.0357$. The preference of government investment $\gamma_d$ is 0.5. Using the one-year interest rate on refinancing loans from the central bank to financial institutions and GDP data from 1991 to 2015, we estimate $\rho_R \approx 0.9929, \rho_Y \approx 0.0071$.

The non-real estate sector production function has a capital goods share $\phi_f$ of 0.5 and a land share $\psi_f$ of 0.2, a land share $\psi_h$ of 0.3 and a capital goods share $\phi_h$ of 0.4 for the real estate sector. The home mortgage ratio and the mortgage rate premium coefficient are constructed given first-order optimal conditions and the moment conditions are estimated using the Bayes formula and the prior distributions of the benchmark loan rate. The posterior parameters of the target parameters are estimated using the Bayes formula and the prior distributions of the benchmark loan rate, the down payment ratio and the premium level, and the results are presented in Table 2.

As the above set of equations are non-linear, they are typically solved using either the projection method or the perturbation method. Mikkel & Christian (2021)[28] demonstrate that the impulse response functions projected by the projection method and using the VAR are asymptotically consistent. This paper therefore generates stochastic shocks for the variables $R_t, \theta_t, \mu_t$ and $\xi_t$, then solves for each endogenous model variable according to the general equilibrium conditions described above, generates N periods of data through stochastic simulation, and then performs a VAR regression on the generated data to select the optimal lag order according to the BIC criterion. Finally, the VAR model is used to derive the impulse response function and to perform the forecast error decomposition.
6. Premium source of monetary reservoir

Using \(\%(x)\) to denote the growth rate of variable \(x\) and comparing the market value of the real estate (Leveraged commodities) sector with that of the non-real estate sector, the increase premium of the market value of the real estate sector relative to the non-real estate sector is mainly determined by the following equation.

\[
\%\left(\frac{P_{h,t}Y_{h,t}}{P_{f,t}Y_{f,t}}\right) = \%\left(C_t^\omega \omega_{h,t} \left(1 + R_t \right) * j_h \right)
\] (34)

In short, the market value premium of the real estate sector relative to the non-real estate sector is caused mainly by the leverage used by the household sector to purchase products in the real estate sector, and the larger the increase in leverage, the larger the relative increase in the market value of the real estate sector. By \(\omega_{h,t} \approx [R_t * (1 - \theta_{h,t})]^{t+1} \), mortgage leverage is mainly determined by the down payment ratio \(\theta_{h,t}\), the interest rate \(R_t\), and the mortgage interest rate coefficient \(\xi_{h,t}\). The down payment ratio can be considered to be relatively stable in the short run, but the interest rate and the mortgage interest rate premium coefficient however, can be determined by the central bank and financial intermediaries on a case-by-case basis, so that the growth rate of \(\omega_{h,t}\) in the short run can be decomposed into two sources: the mortgage rate premium coefficient and the prime rate.

\[
\%\left(\omega_{h,t}\right) = \%\left[ (1 - \theta_t) \frac{R_t^{t+1}}{1 - \xi_{t+1}} e^{-1 - \frac{t}{1 - \xi_t}} R_t^{-\frac{t}{1 - \xi_t}} \right]
\] (35)

The economic implication of the above equation is that mortgage leverage will rise and drive up the market value of the real estate sector, which explains the phenomenon of market value premium in the price of a monetary reservoir asset. In short, a necessary condition for an asset to function as a monetary reservoir is the presence of leverage in the trading system. Both housing and equities have this characteristic, with housing assets being naturally leveraged due to their high value, which inevitably requires a down payment plus regular repayments, and equity markets, where trading activity is fully settled in most countries, but institutional and professional personal investors are able to use their capital advantage to fully leverage a wide range of financial instruments, such as the US stock market, which is dominated by institutional and professional investors. For example, the US stock market is dominated by institutional and professional personal investors, thus making its stock market another money reservoir after the real estate market, whereas the Chinese stock market is still dominated by retail investors and therefore there is merely the minority of investors can be accessible to leverage their equities. In addition, the real estate market still has a lower cost leveraged trading system (mortgage contracts) compared to stock market, thus making the Chinese housing market, rather than the Chinese stock market, a monetary reservoir.

\[
\frac{P_{h,t}}{P_{f,t}} \propto R_t^{\phi_h - \phi_f} \times L_t^{\psi_f - \psi_h} \times \left(C_t^\omega \omega_{h,t} \left(1 + R_t \right) \right)^{1 - \phi_h - \psi_h + \psi_f - \psi_h}
\] (36)
Decomposing the dynamics of the ratio of prices between the two sectors according to the formula, the premium increase of money pool assets relative to the non-real estate sector is determined by four factors: money pool asset leverage, benchmark interest rate, labor supply, and land supply. Based on the nature of the power index, the effect of the rate of change of each factor on the percentage of premium increase is organized in Table 3, in this paper. \( \mu_t \) is mainly determined by the loanable funds of financial intermediaries. \( \xi_t \) can be used as a proxy variable for quantitative monetary policy, which provides an explanation for the formation of a monetary reservoir in the Chinese housing market. When the central bank over-issues money (e.g., imported inflation or monetisation of the fiscal deficit), financial intermediaries will moderately increase the proportion of housing mortgages to obtain higher profits, and the current mortgage leverage will rise and stimulate more premium of monetary reservoir assets, which provides an explanation for the continued boom in the real estate sector.

The data in Table 4 show similar trends that are generally consistent with the option in this paper: the ratio of disposable income per urban household to medium- and long-term loans has been declining year on year since 2010, and the proportion of medium- and long-term loans by financial institutions to the residential sector has been growing at a much higher rate than to the non-financial sector. Considering the rapidly growing leverage of the residential sector and the increasing amount of investment in property development as a share of GDP, it can be derived that the household sector is expanding its financing of housing assets, and that the source of financing is none other than financial intermediation. The leveraged trading system for housing asset purchases provides the underlying conditions for the real estate market to become a monetary reservoir. Local governments provide a source of credit funding for the household sector and financial intermediaries through fiscal financing. Financial intermediaries’ loan premiums become less dependent on loanable funds, providing the impetus for a countercyclical boom in the prices and market value of money reservoir assets, such as the December 2015 to June 2019 US Federal Reserve raised its benchmark interest rate from 0.25% to 2.5%, but both the US stock market and the Chinese housing market, maintained higher price levels over the same period.

Many Chinese scholars have studied the role of land finance in financing local economic development [Fu et al. (2017)][7], Huang (2012)[3], so land finance is essentially a policy tool for local government credit expansion, where more land at higher prices results in more fiscal income and fewer debt. The direct collateral

### Table 3: Decomposition of the weighting of the currency reservoir sector premium factor

| Signals | Factors | Coefficients |
|---------|---------|--------------|
| \( \% (\omega_{h,t}) \) | Percentage change in leverage of leveraged commodities | \( 1 - \phi_h - \psi_h + \psi_f - \psi_h \) |
| \( \% R_t \) | Percentage change in baseline interest rate | \( \frac{\phi_h}{1 - \phi_h} \) |
| \( \% L_t \) | Percentage change in land supply | \( \psi_f - \psi_h \) |
| \( \% E (\sum_{k=0}^{\infty} \frac{\beta^k C^k_t}{(1 + \delta_f)^k}) \) | Percentage change in land price | \( \phi_h + \psi_h - \psi_f + \psi_h - 1 \) |
| Year | \( I_h / GDP \) | \( A_h / A \) | \( \omega \) |
|------|----------------|----------------|---------|
| 2010 | 11.71%         | 55.56%         | 27.3    |
| 2011 | 12.65%         | 53.82%         | 27.9    |
| 2012 | 13.33%         | 55.94%         | 30      |
| 2013 | 14.51%         | 53.99%         | 33.5    |
| 2014 | 14.77%         | 53.60%         | 36      |
| 2015 | 13.93%         | 54.70%         | 39.2    |
| 2016 | 13.74%         | 52.78%         | 44.7    |

**Annual Growth Rate** 2.83% -0.81% 8.63%

| Year | \( LL_h / LL \) | \( NFL / LL \) | \( IH / LL_h \) |
|------|----------------|----------------|----------------|
| 2014 | 11.38%         | 23.27%         | 19.08%         |
| 2015 | 11.76%         | 22.33%         | 17.54%         |
| 2016 | 13.53%         | 21.91%         | 14.12%         |
| 2017 | 15.07%         | 23.29%         | 12.50%         |
| 2018 | 16.16%         | 23.97%         | 11.52%         |
| 2019 | 17.21%         | 24.40%         | 10.62%         |
| 2020 | 18.52%         | 25.38%         | 9.19%          |

**Annual Growth Rate** 8.52% -1.52% -11.35%

| Year | \( IH / LL_h \) |
|------|----------------|
| 2010 | Disposable income per urban household/medium and long-term loans to the residential sector |
| 2011 | Residential sector leverage |

Table 4: Contribution of the real estate sector to economic growth and the level of credit to the household sector

1 Data source: National Bureau of Statistics, National Balance Sheet Research Centre, Guotaian database, China Financial Yearbook (2020)

2 \( I_h / GDP \) denotes Investment in property development /GDP.\( A_h / A \) is the residential sector housing assets /Total Assets.\( LL_h / LL \) represents the Medium and long-term loans to the residential sector/total loans to financial institutions, while \( NFL / LL \) is the Medium and long-term loans to non-financial institutions/total loans to financial institutions.\( IH / LL_h \) denotes Disposable income per urban household/medium and long-term loans to the residential sector.\( \omega \) denotes residential sector leverage.
asset for land finance is land but the essential asset is still tax revenue. According to the local government budget constraint equations (16) and (18), the total value of GDP will be much higher than average through local government credit expansion $\omega_{h,t}$, which provides an explanation for China’s high growth rate, with mortgage contracts amounting to household sector commitments to the real estate sector through land and future tax guarantees. Therefore it provides the local government with the function of ’cashing in’ on economic growth in advance, thus also explaining the phenomenon of land prices driving up house prices [Wu(2016)] [10], where the local government uses fiscal financing to drive high growth, which inevitably drives up land prices in order to service debt and continue financing. The rise in land costs eventually pushed up house prices further Mei(2021) [29], and the result of this development approach was a rapid increase in the leverage of the residential sector and the share of real estate development investment in GDP at the same time (see Table 4).

7. Impact by monetary reservoir on the efficiency of monetary policy

This paper uses both impulse response and variance decomposition to analyse how the price-based monetary policy, the quantity-based monetary policy proxy and the main housing market variables affect the macroeconomy under a monetary transmission mechanism of monetary reservoir-fiscal financing-investment mechanism. The impulse response analyses all take one standard deviation of the upward shock. Figure 4-7 depict the results of the impulse response analysis for four exogenous shocks: interest rate, housing refinancing ratio, down payment ratio and mortgage interest rate premium coefficient. Consumption is affected by all four shocks - interest rate, housing refinancing ratio, down payment ratio and mortgage interest rate premium - in a way that deviates from theoretical expectations, with the shock effects of interest rate and mortgage interest rate premium being the most significant. Those of refinancing ratio and down payment ratio are more subtle mainly because the cost of funding mortgage payments squeezes the budget constraint of the household sector, while the other two shocks are indirectly affected through mortgage leverage, and monetary policy adjustment by central bank indirectly affect consumption. The effect of shocks on interest rates, which are the traditional monetary policy mediating variable, is divided into two transmission mechanisms: consumption in the household sector and mortgage leverage. The consumption transmission mechanism follows the interest rate-consumption-wage-labour supply-production sector transmission chain, while the mortgage leverage channel generates a shock effect on the economic system through the mortgage leverage - fiscal financing - fiscal transfer channel. The difference from the traditional monetary policy transmission mechanism is that important policy variables in the real estate market such as the down payment ratio, mortgage interest rate premium and refinancing ratio have effect on the macroeconomic system outside the real estate sector through the leverage of the monetary reservoir assets $\omega_{h,t}$, which is consistent with the empirical experience. Table 5 depicts
Figure 4: Impact Response Analysis by $R_t$
Figure 5: Impact Response Analysis by $\mu_t$
Figure 6: Impact Response Analysis by $\theta_t$
Figure 7: Impact Response Analysis by $\xi_{h,t}$
the result of the variance decomposition. The result of the variance decomposition shows that non-traditional monetary policy variables such as housing refinancing ratio, down payment ratio and mortgage interest rate premium have a moderating effect that is no weaker than the base interest rate in both the conditional and unconditional decomposition scenarios, with household sector home purchase behaviour, mortgage leverage and land finance acting as a transmission bridge. There is no significant difference in the ranking of the strength of economic variables such as consumption, investment, prices across sectors and production output affected by the four factors in both the short and long run. Financial financing and household leverage are mainly affected by interest rates in the short run, but in the long run, the highest degree of influence is seen in the down payment ratio, which accounts for over 50% of the total, and the long run impact of the loan interest rate premium is second only to the down payment ratio, suggesting that the asset leverage of the money storage pool channel plays an important role in the long run.

In sum, the previous view that real estate absorbed the central bank’s excess money and blocked its transmission to the general consumer goods and production sectors is not valid for two reasons: first, the core cause of the phenomenon of market value inflation and premium increases in money pool assets is asset leverage, and the inflationary phenomenon caused by credit expansion amplifies the market value and price volatility of some assets through a leveraged trading system, showing Second, the leveraged trading system of monetary pool assets provides payment commitments to the household sector, i.e., pledged financing of labor income, which is essentially an atypical security if it has third-party utility (e.g., local governments can obtain performance and growth effects by promoting real estate development), then the asset has third-party utility (e.g., local governments can obtain performance and growth effects by promoting real estate development), then the asset has ample incentive to expand self-credit without the constraints of lendable funds from financial intermediaries, while the cost of risk is borne by the third party or the next counterparty to the third party. In the case of land finance, for example, local government officials are incentivized by GDP tournaments to overdraw future taxes to finance investment in public goods to generate positive externalities to drive economic growth, which can be interpreted as a third-party utility, and land finance and the resulting local debt problems are essentially the consequences of local gov-
ernment credit expansion. Similarly, in the U.S. real estate market before 2008, as third-party financial institutions were able to make huge profits by reselling real estate mortgage-backed securities, the real estate sector began to rapidly expand its own credit until the asset bubble became too large and caused a financial crisis.

8. The short term effect of monetary reservoir

8.1. Leverage of loan good: power of economic growth in short term

Decompose the output of the two sectors into growth rates

\[
\% (P_{h,t} Y_{h,t} + P_{f,t} Y_{f,t}) = \% (C_t^\sigma \omega_{h,t} \frac{(1 + R_t) + j_h}{R_t} + j_f)
\]

(37)

\(C_t\) can be solved by solving the difference equation on the interest rate \(R_t\). Thus when the base rate is constant, \(C_t^\sigma\) remains essentially constant. The growth rate of \(P_{h,t} Y_{h,t} + P_{f,t} Y_{f,t}\) is largely determined by the growth rate of \(\omega_{h,t}\). Thus, the main driver of short-term economic growth comes from the leverage of loan goods. Financial intermediaries are unlikely to provide continuous financing for the loan goods sector due to the constraints on loanable funds, so for the purpose of stimulating short-term growth, local governments provide additional financing for the loan goods sector. As shown in Figure 3, an increase in local government debt equates to an expansion in bank debt assets, which increases the risk appetite of financial intermediaries and reduces their interest rate premium coefficient \(\epsilon_t\). Other intermediation variables include the refinancing ratio of loan goods assets \(\mu_t\) and the down payment ratio of loan goods assets \(\theta_t\). Since the refinancing ratio of loan goods assets \(\mu_t\) and the down payment ratio of loan goods assets \(\theta_t\) have very significant local governments provide banks with more adequate loan funds mainly through fiscal financing to expand banks’ balance sheets. Money pool assets have a higher level of premium as loan goods, and therefore financial intermediaries have a higher preference for lending to the loan goods sector, and therefore more loans flow to the loan goods sector, creating more economic growth. However, the fiscal leverage of local governments also necessarily grows in line with the leverage of the loan product sector due to the adjustment of the proportion of borrowed funds by financial intermediaries. The findings from the financial intermediation section show that the leverage of local governments and the loan product sector is linked. The main difference between the two is that there is a down-payment ratio and a refinancing mechanism for the loan product transaction mechanism, so that the ratio between the two is only related to \(\theta_t\) and \(\mu_t\). Even if financial intermediaries’ risk preferences for lending to local governments and the loan product sector are not perfectly aligned, i.e. the premium coefficient \(\epsilon_{h,t}\) for the loan product sector is higher than the interest rate premium coefficient \(\epsilon_{G,t}\) for local governments, this does not affect the linkage between the two.

\[
\omega_{h,t} = (1 - \theta_t)^{-\frac{1}{1+\epsilon_t}} e^{-\frac{1}{1+\epsilon_t} R_t^{-\frac{1}{1+\epsilon_t}} (1 - \mu_t)^{-\frac{1}{1+\epsilon_G}}} (38)
\]
\[
\omega_{G,t} = e^{-\frac{1}{1+\xi_t} R_t^{-\frac{1}{1+\xi_t}}}
\]  
(39)

Local governments are therefore in fact an important driver of increased leverage in the lending sector, although on the balance sheet they are not actual creditors of the lending sector, and this implied debt relationship is masked by third-party lending and financing relationships with financial intermediaries. Local governments set up financing platforms to absorb social capital, form government debt and facilitate financing for the lending sector by expanding fiscal expenditure and injecting fiscal funds, while local governments act with the motive of stimulating economic growth to obtain political performance or maintain employment. Because of the principal-agent problem, each local official is not responsible for the next official and the future local financial situation, so almost every local official will choose the short and quick way to increase fiscal leverage to promote economic growth, rather than the slow way to facilitate long-term growth.

8.2. Discriminatory allocation of resources

The monetary reservoir mechanism will greatly reduce the effectiveness of macro policy by distorting resource allocation. Decomposing the growth factors of \( K_{h,t}, L_{h,t}, n_{h,t}, n_{f,t} \) and \( G_t \).

\[
\frac{\% K_{h,t}}{K_{f,t}} = \% \left[ C_t \omega_{h,t} (1 + R_t) \frac{j_h \phi_h}{R_t^{1+\xi_t}} \frac{(1 - \theta_t)(1 - \mu_t) \ast e^{\frac{1}{1+\xi_t}}}{e^{\frac{1}{1+\xi_t}}} \right]
\]

\[
\propto \% \left[ \frac{\omega_{h,t} (1 + R_t)}{[(1 - \theta_t)(1 - \mu_t)]^{\frac{1}{1+\xi_t}} R_t} \right]
\]

Assuming that the base rate is unchanged and therefore \( -\frac{1}{1+\xi_t} \% R_t = 0 \).

\[
\frac{\% K_{h,t}}{K_{f,t}} \propto \% (\omega_{h,t} - \frac{\xi_t}{1 + \xi_t} \% (1 - \theta_t)) - \frac{\xi_t}{1 + \xi_t} \% (1 - \mu_t)
\]

(41)

The change in the ratio of the allocation of borrowed capital to the two sectors, lending and non-lending, is determined by three factors, \( \mu_t, \theta_t \) and \( \epsilon_t \) (\( \omega_{h,t} \) is also a function of these three factors). The easing of the borrowing constraint by financial intermediaries increases borrowing capital in both sectors, but also widens the degree of divergence in the allocation of credit resources between the two sectors. Similarly a growth rate decomposition of the ratio of land and labour allocation in the two sectors yields the following equation.

\[
\% \left( \frac{L_{h,t}}{L_{f,t}} \right) \propto \% (\omega_{h,t} = \% \left[ (1 - \theta_t) \frac{1}{1+\xi_t} e^{\frac{1}{1+\xi_t}} R_t^{-\frac{1}{1+\xi_t}} (1 - \mu_t)^{\frac{1}{1+\xi_t}} \right])
\]

(42)

\[
\% \left( \frac{n_{h,t}}{n_{f,t}} \right) \propto \% (\omega_{h,t} = \% \left[ (1 - \theta_t) \frac{1}{1+\xi_t} e^{\frac{1}{1+\xi_t}} R_t^{-\frac{1}{1+\xi_t}} (1 - \mu_t)^{\frac{1}{1+\xi_t}} \right])
\]

(43)

The easing of credit preferences by financial intermediaries for the loan goods sector also increases the degree of divergence in the allocation of other factors of
production between the two sectors. Since land and labour are not financially available to supply new loanable capital, the credit preference of financial intermediaries for the lending sector crowds out other factors of production in other sectors for a given quantity of supply, and the process of indirect lending by local governments to the lending sector through financially-financed investment and financial intermediaries is also a process by which the lending sector crowds out the non-lending sector in the factor market. With the invisible financial support of local governments and the credit preference of financial intermediaries, the lending goods sector is able to pay higher land premiums and wages and benefits, and is naturally able to purchase more land use rights and labour. As a result, leverage in the local government and loan goods sectors has risen while an increasing number of factors of production have been discriminatorily over-allocated to the loan goods sector, which drives short-term aggregate economic growth without contributing to long-term endogenous growth.

8.3. Structural imbalances in economic growth

Without changing aggregate land supply, labour supply and monetary policy, government regulation of the economy achieves its policy objectives mainly by influencing the three intermediary variables of capital \( K_{h,t} \), \( K_{f,t} \) and \( G_t \). However, the borrowed capital in the non-loan goods sector is only related to the change in the interest rate premium coefficient of the financial intermediary. If the financial intermediary and the local government do not change the down payment ratio and refinancing ratio of loan goods, the growth rate of new borrowing is only determined by the interest rate premium coefficient of the financial intermediary, and the factor decomposition of the source of the monetary reservoir premium can be combined to obtain the following equation.

\[
\%K_{h,t} = \%\omega_{h,t} - \frac{\xi_t}{1 + \xi_t} \left[ \%\left(1 - \theta_t\right) + \%\left(1 - \mu_t\right) - \Delta \frac{\xi_t}{1 + \xi_t} \right]
\]

\[
\propto \%\omega_{h,t} - \Delta \frac{\xi_t}{1 + \Delta_t} = -\Delta \left(\frac{1}{1 - \xi_t}\right) - \Delta \frac{\xi_t}{1 + \xi_t} \tag{44}
\]

\[
%I_t = %K_t - %K_{t-1} = \Delta \left[\frac{1 + \xi_t^2}{1 - \xi_t^2}\right] - \Delta \left[\frac{1 + \xi_{t-1}^2}{1 - \xi_{t-1}^2}\right] \tag{45}
\]

The above equation is a third-order difference equation and the simulation analysis shows that as the number of simulation periods increases, the curve of \( \epsilon_t \) gradually tends to zero in order to maintain a certain rate of investment growth \( %I_t = \bar{d} \), which predicts higher local government fiscal leverage and lending goods sector leverage, and therefore a gradually increasing probability of financial crisis. Both local governments and financial intermediaries therefore perceive that maintaining an appropriate interest rate premium is conducive to economic stability and thus maintain growth mainly by expanding fiscal spending and increasing local government leverage. This growth structure continues
to contribute to the debt crisis of local governments. A further decomposition of the growth rate of financial investment yields the following equation.

\[
\%G_t = \% \left\{ C^t \omega_{h,t} (1 + R_t) \omega_{h,t} + j_f \phi_f \left( \omega_{G,t} - \frac{1 + \epsilon_t}{\epsilon_t} \frac{1 - (1 + \epsilon_t)^{-\omega_{G,t}}}{\log(1 + \epsilon_t)} \right) \right\} 
\approx \% [\omega_{h,t}] + \% [\omega_{G,t}] 
\]

(46)

In the monetary reservoir mechanism, the interest rate premium coefficient \( \epsilon_t \) of financial intermediation will play a major regulatory role when the benchmark interest rate is unchanged. The second important regulatory path is the downpayment ratio \( \theta_t \) and the loan refinancing ratio \( \mu_t \). These three non-traditional policy variables form the core structure of the monetary pool mechanism, with local governments maintaining high fiscal leverage, providing more loanable funds to financial intermediaries through fiscal investment, lowering the interest rate premium coefficient \( \epsilon_t \) to attract investment or directly expanding fiscal spending. There is also a substitution relationship between the down payment ratio \( \theta_t \) and the refinancing ratio \( \mu_t \) of loan products. When the down payment ratio is high, the financial intermediary can also achieve the effect of de facto lowering the down payment ratio and increasing the leverage of loan products by increasing the refinancing ratio, as follows: the loan product purchaser seeks bridging funds to buy the asset at the down payment ratio \( \theta_t \), acquires ownership of the asset and then pledges the loan product to the financial intermediary to obtain \( mu_t \) ratio to repay the bridging funds. This is the main modus operandi of the "foreclosure" financial product commonly found in the Chinese real estate market. Such products provide purchasers with a more convenient way to leverage and enhance the macroeconomic impact of the monetary reservoir mechanism.

8.4. Strong reliance on financial investment

In this paper, the process by which fiscal investment leads to a reduction in total factor productivity is referred to as the growth effect and vice versa as the dampening effect. An important way to generate fiscal surpluses from credit expansion is through large government investments in the public goods sector. Fiscal investment generates positive externalities that boost overall social productivity, generating more income tax revenue for local governments and potential benefits such as population growth and technological innovation. The productive sector earns higher revenues without having to pay for public goods investments. The positive externalities of public goods in the current period significantly increase economic output to form tax rebates, and fiscal deficits are mitigated or even reach surpluses. This also explains another important reason for the rapid growth across China in the early 21st century. The main lesson is that local governments were given some financing autonomy to finance the public goods sector based on their own credit expansion of monetary reservoir
assets, and to feed the non-monetary reservoir assets sector with the support of positive externalities of public goods to achieve joint high growth.

According to Equation 23, $\lambda_P^t$ is greater than zero when government investment generates a net gain (growth effect) and a net loss (disincentive effect) otherwise. When the efficiency of investment in the public goods sector decreases, excessive credit expansion causes an increase in money issuance, new government investment does not increase output and does not increase fiscal revenue, which inevitably leads to a fiscal deficit in the long run, which is also solved by the central bank purchasing local debt or the central government transferring money to local governments. The fiscal deficit is also solved by the central bank’s purchase of local debt or the central government’s transfer payments to local governments, both of which inevitably lead to an increasingly accommodative monetary policy.

According to equation 29 of the macro equilibrium, in order to maintain product market clearing, the externality parameter $\lambda_P^t$ in the public goods sector needs to satisfy equation 30 (see Appendix A). Equation (30) clearly captures the main determinants of public goods efficiency and the trend of long-term changes. First, to maintain positive externalities in the public goods sector, i.e., the growth effect rather than the dampening effect of fiscal investment, government investment needs to ensure that it is always greater than the depreciation of the total amount of historical invested public goods, i.e., fiscal investment should be a net investment

$$\lambda_P^t = \frac{\log(C_t + I_t + G_t) - \log[K_{h,t}^0 L_{h,t}^{r_{h,t}} L_{h,t}^{(1-r_{h,t})-\psi_{h,t}} + K_{f,t}^0 L_{f,t}^{r_{f,t}} L_{f,t}^{(1-r_{f,t})-\psi_{f,t}}]}{G_t - \delta_k \sum_{i}^{t-1} G_i}$$ (47)

However, when $\delta_k > 0$, long-run $\sum_{i}^{t-1} G_i$ is a fast-growing function with time, so $G_t - \delta_k \sum_{i}^{t-1} G_i$ must have a clear peak, after which $\lambda_P^t$ starts to fall and must gradually become less than 0. $\lambda_P^t < 0$ means that the elasticity of fiscal investment with respect to output is negative: $\Phi_t \times \lambda_P^t < 0$ and output decreases for the same factor inputs, which drives up the long-run real price level. On the other hand, reducing the leverage of the loan sector and stimulating consumption and investment will help to make the marginal benefit of fiscal investment turn positive. The economically realistic interpretation of this conclusion is that when previous fiscal investment (mainly in infrastructure) has been overinvested, shifting from an economic growth approach dominated by (fiscal) investment and increased micro-sector leverage $\omega_{h,t}$ and $G_t = f(\omega_t G, t)$ to one that relies on consumption and investment is beneficial in reducing the negative economic effects of reduced output. This finding is consistent with the current economic phenomenon of high local government leverage and government investment pull in China and the dilemma of rising leverage in the local government, real estate sector and household sector.

Many Chinese scholars have conducted a number of studies on high investment and government-driven investment in public goods in China (Liu Yongzheng et al, 2021; Chen Binkai et al, 2016; Fan Ziying et al, 2018), the positive externalities of Chinese government investment are mainly derived from
the accumulation of technology, management, and human capital absorbed by
the provision of financial subsidies, i.e., growth beyond traditional factors of
production, however, non-traditional factors of production such as technology
are marginal decreasing in the absence of occur under the condition of revolu-
tionary innovation is marginal decreasing, human capital accumulation in the
long run also depends on population growth, in addition credit preference for
one sector will also harm the productivity of other sectors (Luo Zhi, 2015; Zhang
Jie, 2016; Peng Yu Chao, 2018), therefore $\lambda^P_t$ will gradually decrease in the long
run, the above development model in the long run will inevitably lead to in-
creased monetary issuance, which is in the technology, human capital and other
factors of production are not absorbed enough in the region is more obvious.
Therefore, the above corollary does not hold when the government is happy to
invest in public goods with almost no depreciation and depletion, such as edu-
cation and technology. Because when $\delta_k$ tends to zero, the long-run growth of
$\sum_{i=1}^{t-1} G_i$ does not require additional fiscal investment to cover the non-existent
fiscal "depreciation". In reality, however, most Chinese local governments invest
much more in public infrastructure than in education and science and technol-
ogy, which has a significant negative effect on long-run growth, although in the
short run it has a particular utility in driving economic growth and economic
performance for officials. This is the reason why local governments invest more
in infrastructure, so $\delta_k > 0$.

Second, new investment, current consumption, and government investment
should be greater than the total output of the two major sectors. Without
changing the aggregate land supply and labor supply, government regulation of
the economy mainly achieves policy objectives by influencing three mediating
variables, capital $K_{h,t}, K_{f,t}, and G_t$. Where $I_t$ is also a function of $K_{h,t}$ and
$K_{f,t}$. Decomposing the growth elements of $K_{h,t}, K_{f,t}, and G_t$.

\[
\%K_{h,t} \propto \%\omega_{h,t} + \frac{1}{1 - \xi_t} \%R_t - \%\left(\sum_{k=t}^{\infty} \beta^k C_k^{-\sigma} \right) (1 + R_k)^k \tag{48}
\]

\[
\%K_{f,t} \propto \frac{1}{1 - \xi_t} \%R_t \tag{49}
\]

\[
\%G_t \propto \frac{1}{1 - \xi_t} \%\omega_{h,t} - \%\left(\sum_{k=t}^{\infty} \beta^k C_k^{-\sigma} \right) (1 + R_k)^k + \%\left(\omega_{h,t} - \frac{1 - (1 + i_t)^{\omega_{G,t}}}{\log(1 + i_t)}\right) \tag{50}
\]

The decomposition of the three variables shows that their common growth
factors are $R_t, \omega(h, t), \omega(G, t)$, and $E(\sum_{k=t}^{\infty} \beta^k C_k^{-\sigma} (1 + R_k)^k)$. In the monetary reservoir
mechanism, the interest rate premium coefficient $\xi_t$ and the down payment ra-
tio $\theta_t$ of the financial intermediary will play the main regulatory role when the benchmark interest rate is unchanged. The second important regulatory path
is the refinancing ratio $\mu_t$ of loans included in $E(\sum_{k=t}^{\infty} \beta^k C_k^{-\sigma} (1 + R_k)^k)$. Thus, these
three non-traditional policy variables form the core structure of the monetary reservoir, with local governments maintaining high fiscal leverage, squeezing out credit funds from other sectors, and pushing up the interest rate premium coefficient $\xi_t$. The down payment ratio and the refinancing ratio are substitutes. There is a substitution relationship between the two. When the down payment ratio is high, the financial intermediary can also achieve the de facto effect of lowering the down payment ratio and increasing the leverage of the loan product by increasing the refinancing ratio as follows: the loan product purchaser seeks bridging funds to buy the asset at the down payment ratio $\theta_t$, obtains ownership of the asset and then pledges the loan product to the financial intermediary to obtain $\mu_t$ proportion of funds to repay the bridging funds. This is the primary mode of operation of the "foreclosure" financial product common in the Chinese real estate market. This product provides a more convenient leveraging service for buyers and enhances the macroeconomic impact of the monetary reservoir mechanism.

To summarize the above process, the monetary transmission mechanism of monetary reservoir-fiscal financing investment is a spontaneous credit expansion that is part of a non-traditional monetary transmission mechanism. This process inevitably translates into monetary over-issuance by the central bank in the long run for two main reasons: First, the economic growth model under this mechanism relies on high leverage of local governments, the lending sector and the household sector, and high leverage in the long run inevitably means fiscal deficits or a general debt crisis, which will lead to monetary policy having to issue more money to dilute debt through inflation, so the operation of this mechanism is The process of saving "future excess money", hence the name "monetary reservoir"; second, the complementary relationship between the monetary reservoir mechanism and financial intermediation leads to credit imbalances between the lending and non-lending sectors. Even if the monetary policy remains unchanged, financial intermediaries provide new financing for the lending sector through various financial instruments, while the non-lending sector has no access to it.

9. The long term effect of monetary reservoir

In this subsection the paper extends the endogenous technological growth model constructed by Romer(1987[1], 1990[2]) by assuming that labourers have the choice of supplying labour to the current goods sector or investing it in the research sector $Z_t$ to obtain the discounted value of future income, and that labour is allocated in the production and research sectors in proportions $\alpha_t$ and $1 - \alpha_t$ respectively. The production sector is perfectly competitive, implying that each input factor The price of each input factor is equal to its marginal output, and labour is allocated in the loan and non-loan sectors in proportions $w_{h,t}$ and $1 - w_{h,t}$ respectively. The sum of the wages of the two sectors, loan
and non-loan goods, is:

\[ W_{h,t}n_{h,t} + W_{f,t}n_{f,t} \approx C_t^{\sigma} \omega_{h,t} (1 + R_t) j_h \left( 1 - \psi_h - \phi_h \right) + j_f (1 - \psi_f - \phi_f) \]  

(51)

\[ n_{h,t} + n_{f,t} = \alpha_t n_t \]  

(52)

The growth rate of the study sector is defined by the equation 53, where \( \eta \) is an unknown positive real number.

\[ \frac{A_{t+1}}{A_t} = 1 + \eta(1 - \alpha_t)n_t \]  

(53)

Assuming that workers expect to keep the proportion allocated to the R&D sector constant for an infinite future period, the growth rate of total labour supply is equal to the population growth rate, and the logarithm of the population growth rate, \( \log(n_t) \), follows a normal distribution with mean \( n_g,t \) and variance \( \sigma^2_{n,t} \). The R&D sector has a monopoly market for its technology products, so all profits are earned by workers. The expected discounted value of \( (1 - \alpha_t)n_t \) invested by labour in the R&D sector in the current period is

\[ E\left[ \sum_{k=t+1}^{+\infty} W_{h,k}n_{h,k} + W_{f,k}n_{f,k} \frac{A_k}{(1 + R_k)^{k-t}} \right] \approx \eta(1 - \alpha_t)n_t E\left[ \sum_{k=t+1}^{+\infty} \exp\left\{ \sum_{i=t}^{k} \epsilon_i \left( W_{h,k}n_{h,k} + W_{f,k}n_{f,k} \right) \right\} \left( 1 + R_k \right)^{-k-t} \right] \]  

(54)

When the equilibrium growth path is reached, there is no difference in the choice of workers between the research and production sectors, and the expected discounted stream of profits from R&D technology is equivalent to the labour remuneration received from the production sector.

\[ \eta(1 - \alpha_t)n_t E\left[ \sum_{k=t+1}^{+\infty} \exp\left\{ \sum_{i=t}^{k} \epsilon_i \left( W_{h,k}n_{h,k} + W_{f,k}n_{f,k} \right) \right\} \left( 1 + R_k \right)^{-k-t} \right] = 1 \]

\[ \alpha_t = 1 - \frac{1}{\eta E\left[ \sum_{k=t+1}^{+\infty} \exp\left\{ \sum_{i=t}^{k} \epsilon_i \left( W_{h,k}n_{h,k} + W_{f,k}n_{f,k} \right) \right\} \left( 1 + R_k \right)^{-k-t} \right]} \]  

(55)

From equation 55, it can be surmised that when the population growth rate is fast i.e. \( n_g,t > 0 \), the proportion of labour that workers choose to put into the R&D sector \( \alpha_t \to 1 \), i.e. almost all labour is used in current production. In reality the population growth rate is unlikely to remain positive for long. The economic implication illustrated by the above findings is therefore that in periods of rapid population growth, fewer resources are invested in the R&D sector, as the additional labour supply substitutes for progress in the technology sector, i.e. productivity substitution. It is worth noting that when the expected future leverage of loan goods \( \omega_{h,k} \) increases, the expected wage received by labour from
the non-R&D sector will increase and hence $\alpha_t$ will increase, and the process of increasing leverage of loan goods is also the process of excluding labour from investing in the R&D sector, which is referred to in this paper as leverage exclusion.

To maintain a fixed labour force R&D ratio of $1 - (\alpha_t)$, the central bank can offset the effects of productivity substitution and leverage exclusion through current interest rate regulation. The central bank needs to lower the benchmark interest rate when the population growth rate or the leverage ratio of loan products falls, and vice versa. Adjustments to the real interest rate can also affect inflation by adjusting the money supply or central bank communication to lower or raise the real interest rate. However, it is clear that maintaining this policy rule affects the independence of monetary policy.

Since $A_t$ is a monotonically increasing function with respect to time $t$, less labour input will result in relatively lower total factor productivity and ultimately long-run growth is affected by the dampening effect of the monetary reservoir mechanism. In the long run, therefore, central policymakers face a trade-off between short-term and long-term growth and the independence of monetary policy. When central policymakers place more emphasis on short-run growth, the lending goods sector becomes more leveraged and, in order to maintain a fixed ratio of R&D inputs, central policymakers raise the real interest rate for the year in various ways, also raising the debt of the sectors for the year by increasing principal and interest payable, and vice versa. If central policymakers need to preserve the independence of monetary policy and maintain long-term growth, high population growth and high leverage cannot be combined.

10. Conclusion

In this paper we constructs a dynamic general equilibrium model including fiscal financing investment and financial accelerator based on the monetary reservoir phenomenon of "Chinese housing and US stocks" and China’s unique fiscal and financial system to provide an explanation for the monetary transmission mechanism of monetary reservoir-fiscal financing and investment. Based on the theoretical model and numerical simulation results, the theory of monetary reservoir assets is proposed: an asset can become a monetary pool asset and be financed by a third party like local government if it satisfies three conditions: a leveraged trading system, a balance commitment payment and the existence of third-party utility. When it will lead to an increase in monetary over-issuance (bubble effect), forming a monetary transmission mechanism outside the central bank. Conversely, economic growth conceals the credit expansion of local governments, resulting in the monetary transmission mechanism being "invisible" to scholars. We also proposes a design for a de-bubble mechanism for monetary reservoir assets to address this problem.

Key findings, as well as policy implications, include: (i) Governments should pay attention to the accumulation of human capital, the introduction of innovative industries and the investment of public goods with strong positive externalities, so as to form a virtuous cycle of fiscal financing - tax return gain
- refinancing of fiscal surplus; (ii) The process of financial financing by local governments using monetary reservoir assets should be brought under the supervision of the central government to avoid the phenomenon that local government officials merely focus on short-term local gains and neglect long-term overall gains and maintain the stability of the economic system and to maintain the consistency of monetary policy; (iii) Financial markets for assets that satisfy the nature of monetary reservoir, such as derivatives in equity markets, futures markets, securitised consumer loans, etc., should be constrained to limit the refinancing of collateral (pledges), leverage and market access in order to control the overall size of credit. (iv) Trading system in monetary reservoir market can be a novel and effective instrument for non-traditional monetary policy.

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