Land Supply and Money Growth in China

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Abstract

China has experienced several episodes of inflation in the recent years. The popular arguments attribute them into the relative high growth rates of money, which were then mainly explained by the accumulation of Chinese international reserve and the undervaluation of RMB. We try to explain Chinese high money growth with the land supply. Under Chinese particular land system, land supply is controlled by the government and could be viewed as exogenous to the money system. The increase of money supply stimulates bank loans and then money growth. Both the error correction model and a simultaneous equations model is setup to explore the effect of land supply on money growth. The empirical results show that the effect of land supply on money supply is significantly positive and even excels that of the foreign exchange reserve. The essential meaning for money policy is that, under existing Chinese political economy system, not only the central bank but also the local governments should be responsible for money policy and the price level.

JEL classification: E50, R14

Key word: land supply, money supply, foreign exchange reserve

1. Introduction

Since 2000, the average annual growth rates of M_1 and M_2 in China have achieved 15.3% and 16.8%, much higher than the average growth rate of 9.9% of GDP. Compared with GDP, money supply in China is growing at a faster pace in this period.

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The reasons for the rapid growth of money supply have been discussed by many authors and the most popular explanation focuses on the accumulation of Chinese foreign exchange reserves. From around 2002, the surplus of Chinese international payment climbed continuously and foreign exchange purchase became one of the central bank's main channels for the supply of monetary base. The rapid growth of Chinese foreign exchange reserves leads to the expansion of money supply in China, and changes the mechanism of Chinese money supply. Many scholars believes that the substantial increase in the monetary base triggered by funds outstanding for foreign exchange is the major cause of excess money supply in China, which is exacerbated by the expanding bank credit. (Chen (2010)). Yan and Wang (2011) show that, before 2007, the large scale of foreign exchanges greatly promoted the expansion of money supply; and after 2007, the fiscal and credit policies are the main driving forces of credit expansion and monetary growth. Zhang (2013) examined the passive characteristic of the central bank in issuing money, and concluded that, with the government investments and financial revenues brought by land growing continuously, more commercial bank loans have been generated and thus more money are created. Deng and E (2010) also argue that bank loan, as the primary financing tool, still plays an important role in the supply of money.

Nevertheless, Liu et al. (2007) in their research on the impact of land on macroeconomy claim that bank credit is closely related with land supply. Bank credit is involved in each stage of land supply and real estate development, providing land banking funds, real estate development funds, housing purchasing funds for local governments, companies and consumers. Other researchers find that land supply could increase the capital of institutions and individuals and mobilizes more bank credit, especially land mortgage loan; while the reduction in the supply of construction land exerts a contractionary impact on bank credit. Zhou (2011) also mention that the land supply plays a special role in the money creation process.

These authors suggest that the land supply may have significant impacts on Chinese money supply. But they only talk about it as an idea and no serious econometric model has ever been set up to test it. Even more, seriously we don't know whether the land still play a significant role in money growth when we control the channel of funds outstanding for foreign exchange. Therefore, this paper explores the following two questions on the basis of theoretical analysis: First, does land supply in China have influence on money supply even if the forex purchase amount is controlled? Second, how much does land supply impact money supply? In order to answer these questions, we first uses an error correction model framework to explore the long run and short run relationship between land supply and money supply. Furthermore, we setup a simultaneous equations model to examine more carefully the effect of land supply on money supply. We find that there really exists a long run positive relationship between land supply and money supply in china. More interesting is that, the land supply can even contribute more to the money supply than the accumulation of foreign reserve, which roots on Chinese money creation mechanism.

This paper is organized as follows. We first review the mechanism of land supply in China and analyze the relationship between land supply and money supply in Section 2. Then, we explore the effect of land supply on money supply by using error correction model and simultaneous equations model in Section 3 and Section 4. Section 5 concludes the study.

2. Preliminary Analysis

Before 1978, land market and transactions are banned in China. Companies, organizations and individuals could only acquire land use rights from the government through non-market-oriented land allocation (Du, Ma, An, 2011). Over the past thirty years, China's land system has experienced significant changes. The current system can be described as a semi-market system. Chinese government classifies the land into two main categories, farm land and construction land. The first type of land is used for agricultural activities and only the second type can be used for industrial and service sectors. The government owns ultimately the land property and controls the supply amount of the land, mainly the construction land, to the market. In Chinese land system, the Ministry of Land and Resources is in charge of approving the transformation of agricultural land to non-agricultural construction land reported by local governments and distributing the quotas of construction land among provinces (World Bank, 2005). Municipal governments put land on the market through the tender/auction/listing system, based on their plans for land supply (Peng, Thibodeau, 2011). The firms, either manufactories, real estate companies or others, buy the land from the government and do business. Chinese land system implies that the land supply is actually an instrument of the government to control the economic growth, similar to other fiscal policy tools.

So it is reasonable to treat the land supply as an exogenous variable when we explain the money supply.

According to the purpose of land use, construction land can be divided into industrial land, real estate land and infrastructure land. In the first three quarters of 2014, industrial land accounts for about 28.35% of all construction land supply, below the real estate land’s 28.87% share and infrastructure land’s 42.78% share. The increase in land supply will increase the total amount of bank credit, among which the boosting effect of the real estate land is the most prominent.

Taking real estate land as an example, the supply of real estate land has important impacts on real estate market. Firstly, real estate investment and real estate sales are closely related to the supply of real estate land. The increase in real estate land leads to more expenditure on land acquisition and exploitation by real estate enterprises. In addition, as the result of continuous huge demand in Chinese housing market, more supply of real estate always triggers more sales. Secondly, more important is that the main source of funding for real estate investment is bank loans. Among all funding sources of real estate investment, direct or indirect bank loans account for about 60% (CBRC, 2005). The direct bank loans consist of land reserve loans, real estate development loans and mortgage loans and many other funds such as equity funds and project advanced money of the real estate developers are indirectly from bank loans. As shown in Figure 1, in the period from 2005 to 2014, the growth rate of land supply and real estate loans demonstrate similar trends, so it can be extrapolated that an increase in the supply of real estate sites can promote increase in real estate loans.

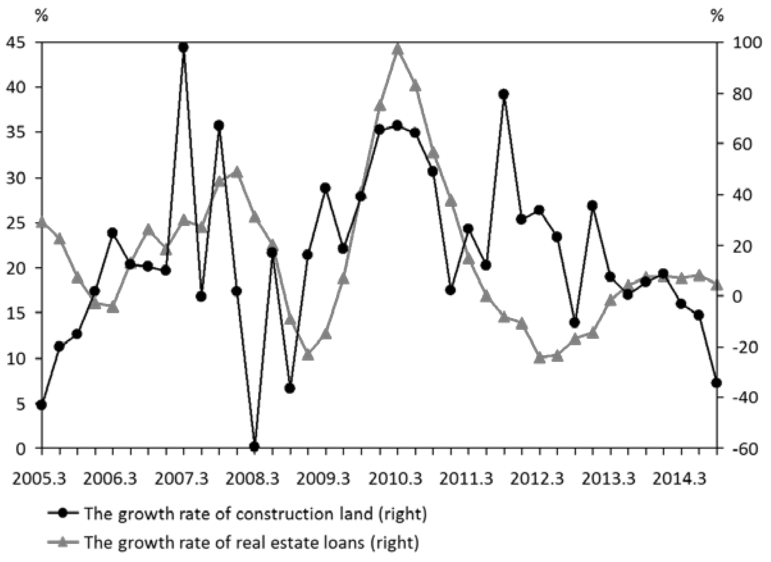

Fig.1. The growth rates of construction lands and real estate loans in China from 2005-2014

The endogenous money theory tells us that money supply is partly driven by credit. Rochon (2001) concluded that money is a result of the demand for credit which allows firms to implement their spending plans and the supply of credit is determined by decisions of commercial banks. As financial institutions, especially commercial banks expand their loans, more deposits are created and money supply increases (Tang, 2006). Thus, after the government, the monopolistic supplier in the land market, increases the supply of land to the market, a new round of development and investment by industrial and real estate firms as well as real estate purchases begins, which promote the expansion of bank loans, and deposits are created accordingly, resulting in more money supply. As shown in Figure 2, from 2005 to 2014, it seems that the increases in land supply are usually accompanied by the increases in money supply.

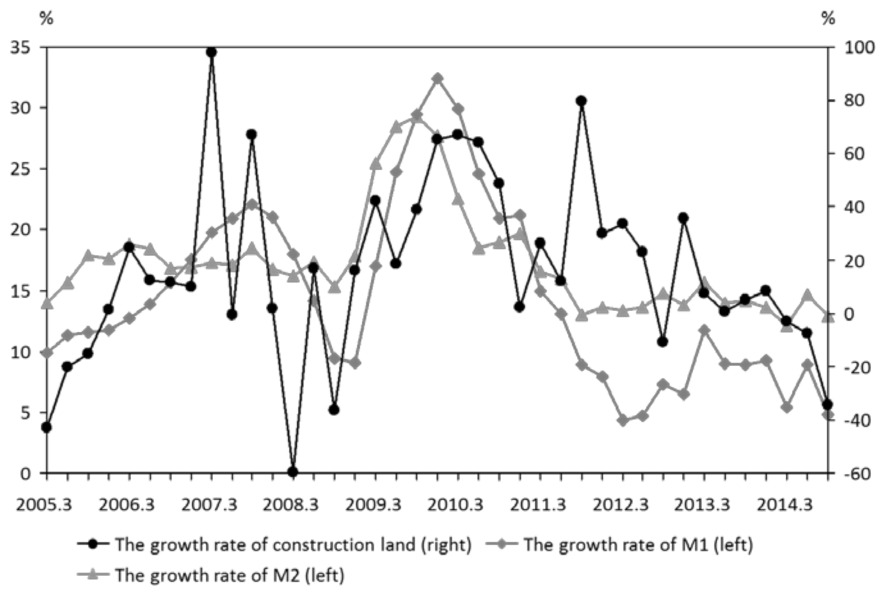

Fig.2. The growth rates of construction lands, M_1 and M_2 in China from 2005-2014

While implementing monetary policy, the central bank in China is not very effective in controlling the money supply. The growth rate of M_2, for example, always varies a certain amount from the projected target. The average deviation is 1.51% from 2000 to 2013. In addition to monetary policy, the central government also use land policy to regulate the economy through adjusting the plan of construction land supply. Based on the above analysis, we hypothesize that an increase in land supply will increase money supply. In the following part, the paper will explore the impact of land supply with an error correction model and a system of simultaneous equations based on the IS-LM model.

3. Error Correction Model

According to previous studies and the analysis in this paper, the money growth in China is affected by forex purchase and bank credit. Foreign money flows into China mainly through foreign direct investment and trade surplus. The People's Bank of China buys foreign exchanges passively and regularly, thus Chinese foreign exchange reserve and the supply of monetary base increases simultaneously. So, in addition to interest rate and GDP, two commonly accepted variable for explaining the money stock, we add foreign exchange reserves as another explanatory variable. As mentioned above Chinese bank credit depends not only on total output and the interest rates but also on the land supply, since part of the bank loans especially real estate loans are driven by land supply. Therefore, the real money stock, which is measured by M1 or M2, can be represented as:

$$M_{1_t} = a_0^1 + a_1^1 i_t + a_2^1 L_t + a_3^1 Y_t + a_4^1 FER_t + \varepsilon_t^1 \qquad (1)$$

$$M_{2_t} = a_0^2 + a_1^2 i_t + a_2^2 L_t + a_3^2 Y_t + a_4^2 FER_t + \varepsilon_t^2 \qquad (2)$$

Where i_t is the real interest rate at time *t*, L_t refers to land supply, Y_t is the real output, FER_t is the foreign exchange reserve, and ϵ_t is an error term.

3.1 Data Processing

This analysis is based on quarterly data from the first quarter of 2004 to the second quarter of 2014. We use the supply of state-owned construction land published by Chinese Ministry of Land and Resources as a measure of land supply. In the previous studies, land supply is usually represented by the granted land or the total area of land purchased by real estate developers. However, as the supply of state-owned construction land represents the total area of land transferred from government through the tender/auction/listing system, it is more accurate.

Nominal M1, M2, foreign exchange reserve and nominal GDP obtained from the statistics of People's Bank of China are all deflated by GDP deflator (with year 2003 as the base). In order to get real interest rate, we subtract the next quarter's inflation rate from the benchmark rate for short-term loans set by the People's Bank of China.

Next, we take the approach of X–12 seasonal adjustment to eliminate effects due to seasons in real M1, M2，GDP and foreign exchange reserve. Finally, we transform them, except interest rate, into natural logarithms to reduce potential heteroscedasticity.

3.2 Unit Root Test

First, we perform ADF unit root test for all the variables to test the stationarity. The lag length is decided according to the minimum SIC criterion. Unit root test results show that M_{1_t},M_{2_t},L_t,Y_t, and FER_t are first order integrated time series and i_t is stationary.

Table 1 Results of unit root test

Variable	Testing types	ADF testing values	Result	Variable	Testing types	ADF testing values	Result
M_{1_t}	（c, t, 1）	-1.8564	I（1）	dM_{1_t}	（c, t, 0）	-4.0315	I（0）
M_{2_t}	（c, t, 1）	-2.8441	I（1）	dM_{2_t}	（c, t, 0）	-4.6032	I（0）
L_t	（c, t, 1）	-2.9317	I（1）	dL_t	（c, t, 0）	-11.9807	I（0）
Y_t	（c, t, 1）	-0.8702	I（1）	dY_t	（c, t, 0）	-4.7785	I（0）
FER_t	（c, t, 0）	-2.2973	I（1）	$dFER_t$	（c, t, 0）	-5.8813	I（0）
i_{L_t}	（c, t, 2）	-4.1359	I（0）				

Notes: (1) d represents first difference of the variables; (2) c, t, n represents intercept, trend and lag length of the test equation; (3) statistical significance are at 5% level; (4) Critical values are from MacKinnon (1996).

3.3 Cointegration Test

Then we perform Johansen's cointegration test for M_{1_t}, L_t, Y_t, FER_t as well as for M_{2_t}, L_t, Y_t, FER_t, assuming that there is linear deterministic trend in the levels of the data and there are intercept and no trend in cointegration equations. The results in Table 2 and Table 3 show that there exists one conintegration vector for M_{1_t}, L_t, Y_t, FER_t and for M_{2_t}, L_t, Y_t, FER_t at the 1% level of significance.

Table 2 Trace statistics for Johansen's cointegration test for M_{1_t}, L_t, Y_t, FER_t

Hypothesized No. of Cointegration Equation(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None***	**0.5828**	**65.7527**	**47.8561**	**0.0005**
At almost 1**	**0.3523**	**30.7819**	**29.7971**	**0.0384**
At almost 2	**0.1832**	**13.4103**	**15.4947**	**0.1006**
At almost 3**	**0.1245**	**5.3176**	**3.8415**	**0.0211**

Notes: (1) ***, ** and * implies statistical significance at 1%, 5% and 10% level, respectively; (2) Critical values are from MacKinnon-Haug-Michelis (1999)

Table 3 Trace statistics for Johansen's cointegration test for M_{2_t}, L_t, Y_t, FER_t

Hypothesized No. of Cointegration Equation(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None***	**0.5034**	**59.7473**	**47.8561**	**0.0026**
At almost 1**	**0.3027**	**31.7478**	**29.7971**	**0.0294**
At almost 2**	**0.2702**	**17.3258**	**15.4947**	**0.0262**
At almost 3**	**0.1115**	**4.7286**	**3.8415**	**0.0297**

Notes: (1) ***, ** and * implies statistical significance at 1%, 5% and 10% level, respectively; (2) Critical values are from MacKinnon-Haug-Michelis (1999)

3.4 Preliminary Estimation

Table 4 is the results of OLS estimation for M_{1_t}, L_t, Y_t, FER_t and for M_{2_t}, L_t, Y_t, FER_t. The estimated coefficients of L_t in model (1) and model (2) are both positive and statistically significant at the 1% level.

Table 4 The results of OLS estimation

	Model (1)	Model (2)
Intercept	1.3567 (0.6730*)	-0.9805 (0.6256)
i_{L_t}	-0.0037 (-0.0041)	0.0100 (0.0038**)
L_t	0.1220	0.0748

	Model (1)	Model (2)
	(0.0378***)	(0.035**)
Y_t	0.6712 (0.1885***)	1.3300 (0.1752***)
FER_t	0.1473 (0.0997)	-0.1428 (0.093)
R^2	0.9798	0.9877
DW 值	0.6509	0.7606

Notes: ***, ** and * implies statistical significance at 1%, 5% and 10% level, respectively.

3.5 Error Correction Model

Based on the above cointegration analysis, there exists one cointegration vector for M_{1_t}, L_t, Y_t, FER_t and for M_{2_t}, L_t, Y_t, FER_t at the 1% level of significance. The cointegration equations are:

$$M_{1_t} = 0.4163L_t - 1.8784Y_t + 2.1575FER_t \quad (3)$$
$$(0.1975)\ (0.9525)\ (0.4883)$$

$$M_{2_t} = 0.2987L_t - 0.6093Y_t + 1.9064FER_t \quad (4)$$
$$(0.3633)\ (1.7056)\ (0.8515)$$

In the long run, given total output and foreign exchange reserves unchanged, 1 unit of increase in the logarithm of the land supply will cause 0.4163 unit of increase in the logarithm of M_1 and 0.2987 unit of increase in the logarithm of M_2.

In order to analyze the short run relationship among M_{1_t}, L_t, Y_t, FER_t and among M_{2_t}, L_t, Y_t, FER_t, we set up two error correction models:

$$\begin{aligned} dM_{1_t} = a_0^1 + a_1^1 i_t + a_2^1 r_t + a_3^1 dM_{1_{t-1}} + a_4^1 dL_t + a_5^1\, dL_{t-1} \\ + a_6^1 dY_t + a_7^1 dY_{t-1} + a_8^1 dFER_t + a_9^1 dFER_{t-1} \\ + a_{10}^1 ECM_{t-1}^1 + \varepsilon_t^1 \end{aligned} \quad (5)$$

$$dM_{2_t} = a_0^2 + a_1^2 i_t + a_2^2 r_t + a_3^2 dM_{1_{t-1}} + a_4^2 dL_t + a_5^2 dL_{t-1} + a_6^2 dY_t + a_7^2 dY_{t-1} + a_8^2 dFER_t + a_9^2 dFER_{t-1} + a_{10}^2 ECM_{t-1}^1 + \varepsilon_t^2 \quad (6)$$

Here r_t, the required deposit ratio, is also added into the model because Chinese central bank adjusted it frequently as a powerful tool of monetary policy. The estimated results of model (5) and model (6) are presented in Table 5. The results show that dL_t, dL_{t-1} have positive influence on money supply. The coefficients of ECM are both negative and significant, verifying the existence of long run equilibrium relationship. Any deviation of money supply in short term from its long term equilibrium would be amended. But the speed of adjustment toward long run equilibrium is some slow, less than 10% in one year.

[Insert Table 5 here]

4. Simultaneous Equations Model

In order to avoid the measurement bias generated by the existence of endogeneity of total output and interest rate in single money supply equation, we formulate a simultaneous equations model on the spirits of IS-LM Model to examine the effect of land supply on money supply.

Our model consists of an aggregate output function, a money demand function and a money supply function. The endogenous variables are aggregate output, interest rate and money supply. This model incorporates the hypothesis that land supply can affect money supply and the land supply can be considered exogenous in the model for China.

4.1 Model Setup

IS-LM model is a basic framework for analyzing macroeconomic equilibrium. Due to the important role of the land system in Chinese economics growth, recently, some researchers begin to investigate the effect of land input on economic growth by introducing it as an input factor into IS-LM model (Wu, 2009; Tong, Huang, 2009; Diao, Yan, 2012). Different from the studies, we focus on examining the effect of land supply on money supply.

In Chinese land system, the Ministry of Land and Resources are in charge of approving the transformation of agricultural land to construction land and the supply of new construction land. Municipal governments are responsible for putting land on the market through the tender/auction/listing system (Peng, Thibodeau, 2011), based on their plans for land supply. Therefore, land supply in China can be featured as exogenous. According to the above analysis, the supply of land could stimulate investment and real estate purchases which drive more bank credit and money supply consequently. We modify the IS-LM model by introducing land supply as one of the determinants of money supply and estimates its effect on money supply. The model consists of three equations: an output function, a money demand function and a money supply function.

Assuming that consumption is determined by autonomous consumption and income level, and investment is influenced by autonomous investment, interest rate and land supply, the output equation can be represented as:

$$Y_t = C_t + I_t + G_t + NX_t = \bar{C} + a(1-\tau)Y_t + \bar{I} + bi_t + hL_t + G_t + NX_t \qquad (7)$$

where Y_t, C_t, I_t, G_t, L_t and NX_t is the equilibrium output, consumption, investment, government spending, net export and land supply at time t, $\bar{C}$ is the autonomous consumption, a is the marginal propensity to consume, τ is the tax rate, $\bar{I}$ is the autonomous investment, b and h measure the marginal effect of interest rate and land supply on investment, i_t is the interest rate.

With regard to the money market, we assume that real money demand is driven by income level and interest rate and use the classical simple form of money demand function:

$$M_t^d = M^d(Y_t, i_t) = \overline{\mathrm{M}}^d + kY_t + si_t \qquad (8)$$

Where M_t^d is real money demand at time t, k represents the marginal effect of real income on money demand and s measures the marginal effect of real interest rate on money demand.

The key change is introduced for the money supply model. We starts with

$$M_t^s = C_t + D_t \qquad (9)$$

Where M_t^s is the money supply at time t, C_t is the cash in circulation and D_t is the deposit. Consider the balance sheet of the commercial bank. Assuming that the banks hold only loans, denoted by Q_t and the reserve, denoted by R_t as assets and deposits D_t as liabilities,

$$D_t = R_t + Q_t. \quad (10)$$

Under the pressure of huge international payment surplus, The central bank spends huge money to purchase foreign exchange, which usually means to increase the commercial bank's reverse R_t. So we assume that R_t is a function of the foreign exchange reserve FER_t :

$$R_t = R(FER_t) \quad (11)$$

We can understand the loan Q_t from the supply and demand perspectives. The loan supply by commercial banks is related to the aggregate reserve, which determines the capability of the banks to expand the loans, the required deposit reserve ratio r_t, and the loan interest rate i_{lt}, as $Q_t^s = Q^s(R_t, r_t, i_{lt})$. The loan demand by the firms and individuals is affected by land supply L_t, income and loan interest rate as $Q_t^d = Q^d(L_t, Y_t, i_{lt})$. So with the equation (11) the loan amount can be written as a function of

$$Q_t = Q(Y_t, L_t, FER_t, i_{lt}) \quad (12)$$

Let $c = C_t/D_t$, the currency ratio. From (9), (10), (11) and (12)

$$M_t^s = (1+c)[R(FER_t) + Q(Y_t, L_t, FER_t, i_{lt})]$$

Then we have

$$M_t^s = \overline{\mathrm{M}}^s + \alpha L_t + \beta Y_t + \gamma r_t + \theta\, FER_t\,, \quad (13)$$

while we assume the linear form the functions, where α, β, γ and θ represent the marginal effects of land supply, output, deposit reserve ratio and foreign exchange reserve on money supply.

According to equation (7), (8) and (13), the IS-LM model can be given by:

$$\begin{cases} IS:\ Y_t = \bar{C} + a(1-T)Y_t + \bar{I} + bi_t + hL_t + (G_t + NX_t) \\ LM: M_t^d = \bar{\mathrm{M}}^d + kY_t + si_t \\ \quad M_t^s = \bar{\mathrm{M}}^s + \beta Y_t + \alpha L_t + \theta\, FER_t + \gamma r_t \\ \quad M_t^s = M_t^d = M_t \end{cases}$$

The first equation is the condition for the commodity market equilibrium and the others for the money market equilibrium. Here the endogenous variables are Y_t, i_t and M_t. Placing (Y_t, M_t) on the left side of the equations and letting $GNX_t = G_t + NX_t$, we can write the econometric model as

$$\begin{cases} Y_t = a_0 + a_1 i_t + a_2 GNX_t + \sum_k a_{3k} L_{t-k} + \varepsilon_1 \\ M_t^j = b_0 + b_1 Y_t + b_2 i_t + \varepsilon_2 \\ M_t^j = c_0 + c_1 Y_t + \sum_k c_{2k} L_{t-k} + c_3 FER_t + c_4 r_t + \varepsilon_3 \end{cases} \quad (14)$$

where $j = 1,2$ indicate M1 or M2 respectively and k is used to introduce the lagged L_t into the model to evaluate the dynamic effects of the land supply on the money amount.

4.2 Data Processing

This analysis is based on quarterly data from the first quarter of 2004 to the second quarter of 2014. The nominal M_1, M_2, government expenditure, net export and nominal GDP obtained from the People's Bank of China and the National Bureau of Statistics are deflated by the GDP deflator (with year 2003 as the base). The real government expenditure and net export are merged into one variable represented as GNX_t. The real interest rate is obtained by subtracting the next quarter's inflation rate from three-month interbank lending rate. The legal deposit reserve ratio of large financial institution set by the People's Bank of China is considered as a measure of deposit reserve ratio.

In order to eliminate seasonal effect, we seasonally adjust all the variables except interest rate and deposit reserve ratio with X-12 method. Finally, we replace the variables except interest rate and deposit reserve ratio with their natural logarithms to reduce potential heteroscedasticity.

4.3 Empirical Results

The equation system of (14) is estimated with GMM. For the GMM estimation, the basic way is to use the exogenous variables, here L_{t-k}, GNX_t and FER_t, as instrumental variables. To eliminate the endogeneity, it is better to use lagged value as instrumental variables. We estimate several different forms of system (14), as shown in Table 6.

(1) $k = 0$, that is no lag of L_t is included. M1 is used for M_t.

(2) $k = 0,1,2,3$, that is 4 lags of L_t is included. M1 is used for M_t.

(3) $k = 0$, that is no lag of L_t is included. M2 is used for M_t.

(4) $k = 0,1,2,3$, that is 4 lags of L_t is included. M2 is used for M_t.

[Insert Table 6 here]

These models show that the land supply definitely has a positive effect on the money supply. The estimated equations for model (1) are

$$\begin{cases} \hat{Y}_t &= 2.34 + 0.04 i_t + 0.67 GNX_t + 0.21 L_t \\ \widehat{M1}_t &= 2.83 + 0.80\, Y_t - 0.03 i_t \\ \widehat{M1}_t &= 3.80 - 0.21\, Y_t + 0.35 L_t + 0.57 FER_t - 0.01 r_t \end{cases}$$

In the supply equation of M1, the coefficient of L_t is 0.35 which means that one percent growth in the land supply could cause 0.35 percent growth in money supply. This impact is relatively huge. Since FER_t represents the accumulated stock of foreign exchange reserve, while L_t is the flow of land supply in each quarter, L_t usually fluctuates much bigger than FER_t. For example, in the four quarters of 2007, the growth rates of land supply relative to the previous quarters are 68%, -80%, 59% and 46% while the counterparts of $\mathrm{FER_t}$ are only 9%, 7%, 4% and 3%. So, although the estimated coefficient of FER_t in the money supply equation is 0.57, bigger than that of L_t, the money supply changes due to land supply changes could be much larger than those due to the changes of foreign exchange reserve. If we differentiate the supply equation, assuming r_t unchanged over time, then the M1 changes can be decomposed into three terms:

$$d\widehat{M1}_t = -0.21 d\, Y_t + 0.35 dL_t + 0.57 dFER_t$$

We calculate the contributions to M1 growth from land supply and foreign exchange, as shown in figure 3.[2] It does demonstrate that in a little more than half of the quarters the land supply contributes more to money growth than the increase of foreign exchange reserve.

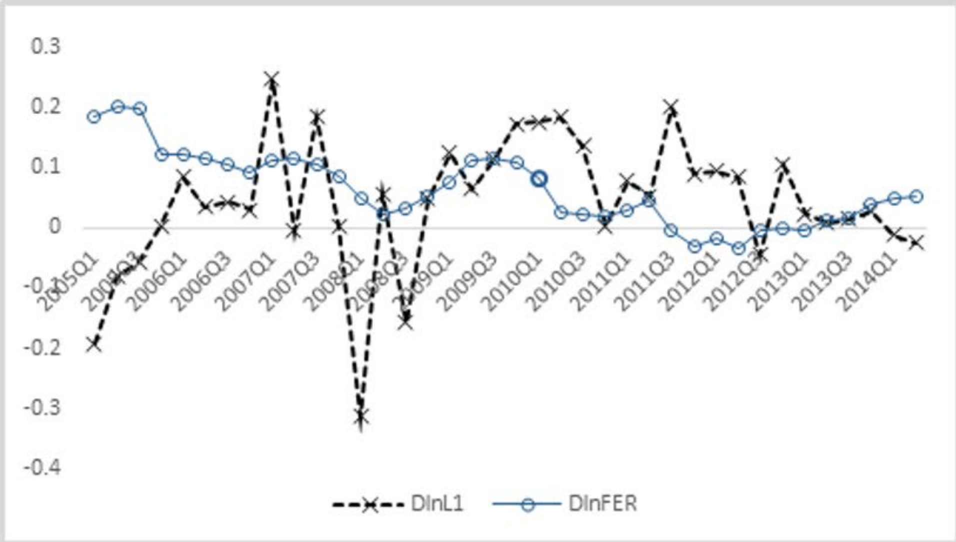

Fig.3. the impacts of land supply and foreign exchange reserve on money growth

Similar conclusions can be drawn from model (2). More than that, all the coefficients of the lagged L_t's are significantly positive, which shows that the effect on M1 from money supply continues more than four quarters. The accumulative marginal effect in one year of land supply can be measured the sum of the coefficients of L_t and its lags, which is around 0.30 consistent with that just discussed for model (1).

In model (3), the impact of land supply on M2 is still positive but not sure, since the coefficient is insignificant and the similar situation for FER_t. But we can get more information from model (4). L_t and L_{t-1} have significant positive coefficients while those of L_{t-2} and L_{t-3} are insignificant. The sum of the significant coefficients are 0.09, which shows that one percent increase in land supply would cause the M2 to grow by around one tenth percent. So effect on M2 of land supply is much weaker than that on M1. But nevertheless, it still excels that of FER_t seeing that the coefficient of FER_t is negative and insignificant. That land supply has the weaker impact on M2 than M1 is not difficult to understand. The main part in M2 but not in M1 is time deposit while most of the deposits created in the process of the loan issuing promoted by land supply are current deposits.

[2] The differentiation is done with respect to the fourth earlier quarters.

4.5 Robustness Tests

To further test the reliability of the above conclusion, we perform robustness tests in following three aspects.

Firstly, we replace construction land supply with the acquisition area of real estate developers as the measure of land supply in the models. The estimation results show that, the current acquisition area of real estate developers affects M_1 positively, and the coefficient is 0.13. But the influence of the current acquisition area of real estate developers on M_2 is not significant. Secondly, considering that land supply may affect money demand, we also introduce land supply and its lags into the money demand equation. In this case, land supply also shows positive and significant effect on money supply. The coefficient of current land supply on M_1 and M_2 is 0.04 and 0.02.Thirdly, we include more instrumental variables, such as the lags of output and the lags of the money amount, into the GMM estimation. The estimation results remain robust.

5. Conclusions

Since 2000, China has experienced relatively high growth of money supply, much higher than the growth of GDP. The most popular explanation for the high money supply growth in China focuses on the accumulation of Chinese foreign exchange reserves. But that is not convincing enough since Chinese central bank has eliminated most of its impact on monetary base through neutralizing transaction in the money market. We argue that land supply is an important factor to explain money growth based on the endogenous money creation.

In Chinese land system, the government controls the transformation of agricultural land into non-agricultural construction land and so construction land supply to the market. The increase of land supply promotes the expansion of bank loans, and deposits are created accordingly, resulting in more money supply. Based on the macroeconomic data from the first quarter of 2004 to the second quarter of 2014, we set up an error correction model and find that the land supply does have positive and significant influence on the current and continuing money amount. The coefficients of ECM are both negative and significant, verifying the existence of long run equilibrium relationship.

We then incorporate land supply into the money supply equation and the IS-LM model. A model of simultaneous equations is setup to examine in detail the effect of land supply on money supply. The econometric results show that the effect is significantly positive even when the outstanding foreign exchange reserve is controlled in the models. Furthermore, this impact is relatively huge with respect to that of the foreign exchange reserve. A simple simulation does demonstrate that in a little more than half of the quarters, from 2005 to 2014, the land supply contributes more to money growth than the increase of foreign exchange reserve. Even in the explanation of M2 supply, land supply still has positive impact and plays more important role than foreign exchange reserve.

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Table 5

The estimated results of Error Correction Models

	Model (5)	Model (6)
Intercept	0.4274 (0.1050***)	-0.1924 (0.1225)
i_{L_t}	0.0035 (0.0019*)	0.0041 (0.0023*)
$dM_{1_{t-1}}$	0.2887 (0.1605)	0.1758 (0.1727)
dL_t	0.0105 (0.0143)	0.0001 (0.0149)
dL_{t-1}	0.0019 (0.0179)	0.0002 (0.0172)
dY_t	-1.0771 (-0.5944*)	-1.259 (0.6080**)
dY_{t-1}	-0.8709 (0.5585)	-1.0112 (0.5615*)
$dFER_t$	0.5197 (0.1091***)	0.4143 (0.1037***)
$dFER_{t-1}$	-0.1296 (0.1038)	-0.1734 (-0.1020*)
ECM_{t-1}^1	-0.0999 (-1.7767***)	-0.0602 (0.0244**)
r	-0.0049 (0.0012***)	-0.0052 (0.0017***)
R^2	0.6655	0.6137
DW 值	2.5142	2.1839

Notes: ***, ** and * implies statistical significance at 1%, 5% and 10% level, respective

Table 6 The estimated results of simultaneous equations models

	(1)			(2)			(3)			(4)		
Dependent variable	Y_t	$M1_t$	$M1_t$	Y_t	$M1_t$	$M1_t$	Y_t	$M2_t$	$M2_t$	Y_t	$M2_t$	$M2_t$
Constant	2.34 (0.20***)	2.83 (0.45***)	3.80 (1.95*)	1.35 (0.36***)	3.15 (0.35***)	3.56 (1.33***)	2.40 (0.19***)	2.34 (0.44***)	0.81 (0.97)	1.12 (0.35***)	2.21 (0.42***)	0.91 (0.70)
Y_t		0.80 (0.04***)	-0.21 (-0.45)		0.77 (0.03***)	-0.37 (0.32)		0.94 (0.04***)	1.00 (0.34)		0.96 (0.04***)	1.06 (0.36***)
i_t	-0.004 (0.003)	-0.03 (0.01***)		-0.01 (0.0041**)	-0.02 (0.01***)		0.00 (0.00)	0.00 (0.01)		-0.01 (0.01**)	0.00 (0.01)	
GNX_t	0.67 (0.07***)			0.86 (0.06***)			0.61 (0.07)			0.91 (0.06***)		
L_t	0.21 (0.05***)		0.35 (0.14***)	0.06 (0.03*)		0.06 (0.02***)	0.25 (0.04***)		0.09 (0.12)	0.06 (0.03*)		0.05 (0.019)***
L_{t-1}				-0.01 (0.04)		0.08 (0.02)***				0.00 (0.04)		0.04 (0.02)**
L_{t-2}				0.01 (0.02)		0.07 (0.03**)				-0.01 (0.02)		-0.01 (0.04)
L_{t-3}				0.07 (0.04**)		0.07 (0.03**)				0.06 (0.04*)		-0.03 (0.04)

r_t			-0.01 (0.01*)			-0.01 (0.01)			-0.01 (0.002***)			-0.01 (0.002***)
FER			0.57 (0.15***)			0.81 (0.20***)			0.00 (0.14)			-0.03 (0.22)
J-statistic		0.06			0.08			0.06			0.10	

Notes: ***, ** and * implies statistical significance at 1%, 5% and 10% level, respectively.