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10 March 2015

Online at https://mpra.ub.uni-muenchen.de/62781/
MPRA Paper No. 62781, posted 10 Apr 2015 20:29 UTC

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Taoxiong Liu Mengdan Huang[1]

Abstract

China has experienced several episodes of inflation in recent years. Popular arguments attribute these episodes to relatively high growth rates of money, which were then primarily explained by China's accumulation of foreign exchange reserves and the undervaluation of RMB. We attempt to explain China's high monetary growth rates through the supply of land. Under China's land system, the supply of land is controlled by the government and can be viewed as exogenous to the monetary system. An increase in the money supply stimulates bank loans and thereby monetary growth. Both an error correction model and a simultaneous equations model are developed to explore the effect of the land supply on monetary growth. The empirical results show that the effect of the land supply on the money supply is significantly positive and even exceeds that of foreign exchange reserves. The significance for monetary policy is that, under China's existing political economy, both the central bank and local governments should be responsible for monetary policy and price levels.

JEL classification: E50, R14

Key words: land supply, money supply, foreign exchange reserves

1. Introduction

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Since 2000, the average annual growth rates of M_1 and M_2 in China are 15.3% and 16.8%, respectively, both of which are much higher than the average GDP growth rate of 9.9%. The reasons for the rapid growth of the money supply in China have been discussed by many authors, and the most popular explanation focuses on China's accumulation of foreign exchange reserves. Starting in approximately 2002, China's international payment surplus climbed continuously, and foreign exchange purchases became one of the central bank's main channels for the supply of the monetary base. The rapid growth of China's foreign exchange reserves led to the expansion of the money supply and substantially changed its mechanisms. Many scholars believe that the substantial increase in the monetary base triggered by funds outstanding for foreign exchange is the major cause of the excess money supply in China, which is exacerbated by expanding bank credit (Chen (2010)). Yan and Wang (2011) argue that, before 2007, the large scale of foreign exchange greatly promoted the expansion of the money supply, while after 2007, fiscal and credit policies were the primary driving forces of credit expansion and monetary growth. Zhang (2013) examines the passive characteristic of the central bank issuing money and concludes that the continuous growth in the land supply has led to government investments and increased revenue, causing more commercial bank loans to be generated and therefore more money to be created. Deng and E (2010) also argue that bank loans, as the primary financing tool, still play an important role in the supply of money.

Nevertheless, in their research on the impact of land on the macroeconomy, Liu et al. (2007) claim that bank credit is closely related to the land supply. Bank credit is involved in each stage of land supply and real estate development, providing banking funds for land, real estate development funds, and funds for housing purchases for local governments, companies and consumers. Other researchers find that the land supply can increase the capital of institutions and individuals and can mobilize more bank credit, particularly land mortgage loans, while reductions in the supply of construction land exert a contractionary impact on bank credit.

These authors suggest that the land supply may have significant impacts on China's money growth. However, they only discuss the land supply as an idea, and no author has developed and tested hypotheses based on a formal theoretical framework or a serious econometric model to explore the role of the land supply in the growth of money. In addition, we do not know whether the land supply still plays a significant role in the growth of money when we control the channel of funds outstanding for foreign exchange. Therefore, this paper explores the following two questions on the basis of theoretical analyses: First, does the land supply in China influence the amount of money even when forex purchase amounts are controlled? Second, how does the land supply impact the amount of money in China? To answer these questions, we first use an error correction model framework to explore the long-run and short-run relationships between land supply and money supply. Furthermore, we develop a simple, formal model to explain the mechanism through which the land supply impacts China's money supply, and we stress the role of land as collateral in money creation under China's particular land system. A simultaneous equations model is then used to more carefully examine the effect of land supply on the money supply. We find that there is a long-run, positive relationship between land supply and the money supply in China. In addition, the land supply may even contribute more to the money supply than the accumulation of foreign reserves, which has been considered the heart of China's money creation mechanism.

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

2. Preliminary Analysis

Before 1978, land market transactions were banned in China. Companies, organizations and individuals could only acquire land use rights from the government through non-market-oriented land allocations (Du, Ma, An, 2011). Over the past thirty years, however, China's land system has experienced significant change. The current system can be described as a semi-market system. The Chinese government classifies land into two main categories: farm land and construction land. Farm land is used for agricultural activities, and only construction land can be used in the industrial and service sectors. The government ultimately owns the land and controls the supply of the amount of the land, primarily construction land, in the market. In China's land system, the Ministry of Land and Resources is in charge of approving the transformation of agricultural land to non-agricultural construction land for local governments and distributing quotas of construction land among the provinces (World Bank, 2005). Municipal governments then put land on the market through a tender/auction/listing system based on their plans for land supply (Peng, Thibodeau, 2011). Manufacturing firms, real estate companies or other organizations buy the land from the government and conduct business. Thus, China's land system implies that the land supply is actually an instrument of the government to control economic growth, similar to other fiscal policy tools. Therefore, it is reasonable to treat the land supply as an exogenous variable when we explain the money supply.

Based on the land use purpose, construction land can be divided into industrial land, real estate land and infrastructure land. In the first three quarters of 2014, industrial land accounted for approximately 28.35% of all construction land supply, which was less than real estate land at 28.87% and infrastructure land at 42.78%. An increase in the land supply will increase the total amount of bank credit, and real estate land provides the most prominent boosting effect.

Using real estate land as an example, the supply of real estate land has important impacts on the real estate market. First, real estate investment and real estate sales are closely related to the supply of real estate land. An increase in real estate land leads to higher expenditures on land acquisition and exploitation by real estate enterprises. In addition, as a result of the always significant demand in Chinese housing market, a greater supply of real estate always triggers more sales. Second, the main source of funding for real estate investment is bank loans, which is even more important. Among all of the funding sources for real estate investment, direct or indirect bank loans account for approximately 60% (CBRC, 2005). Direct bank loans consist of land reserve loans, real estate development loans and mortgage loans, while indirect bank loans include other funds such as equity funds and advanced project money for real estate developers. As shown in Figure 1, during the period from 2005 to 2014, the growth rates of the land supply and real estate loans demonstrate similar trends; thus, it can be extrapolated that an increase in the supply of real estate sites can promote an increase in real estate loans.

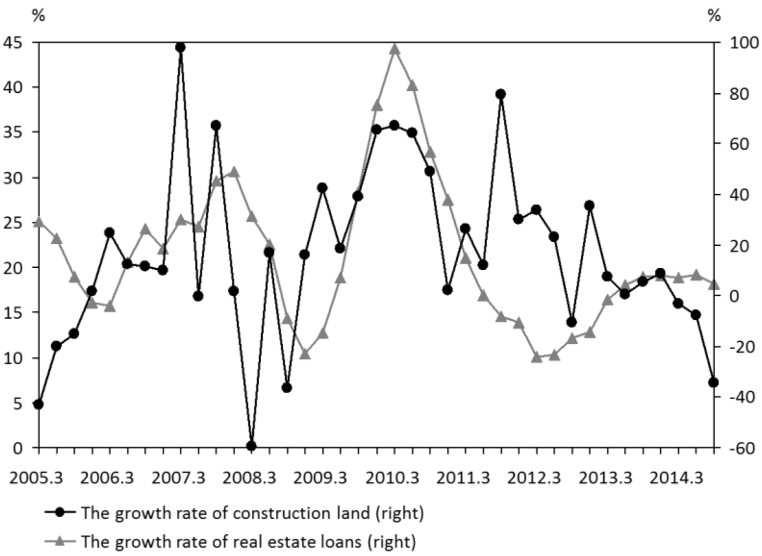

Fig. 1 The growth rates of construction lands and real estate loans in China from 2005-2014

The endogenous money theory tells us that the money supply is partly driven by credit. Rochon (2001) concludes 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 the decisions of commercial banks. When financial institutions and particularly commercial banks expand their loans, more deposits are created, and the money supply increases (Tang, 2006). Thus, after the government, which is 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 takes place, and real estate purchases begin, which promotes the expansion of bank loans and accordingly the creation of deposits, thus resulting in a greater money supply. As shown in Figure 2, from 2005 to 2014, it appears that increases in the land supply were usually accompanied by increases in the money supply.

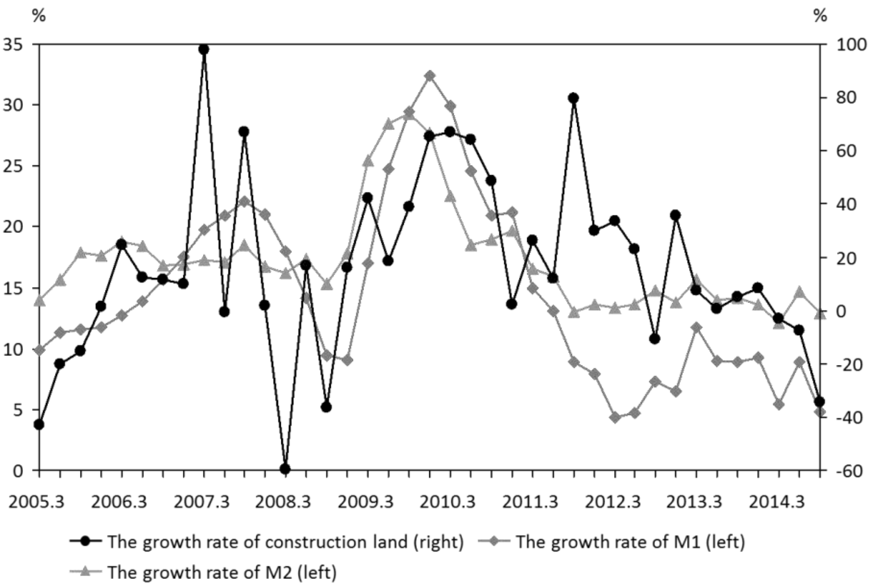

Fig. 2 The growth rates of construction lands, M_1 and M_2 in China from 2005-2014

When implementing its monetary policy, the China's central bank is not very effective at controlling the money supply. For example, the growth rate of M_2 always varies a certain amount from the projected target. The average deviation was 1.51% from 2000 to 2013. In addition to monetary policy, the central government also uses its land policy to regulate the economy by adjusting the construction land supply. Based on the above analysis, we hypothesize that an increase in the land supply will increase the money supply. In the following section, we explore the impact of the land supply using 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, money growth in China is affected by forex purchases and bank credit. Foreign money primarily flows into China through foreign direct investment and the trade surplus. The People's Bank of China buys foreign exchange passively and regularly; thus, China's foreign exchange reserves and the supply of the monetary base increases simultaneously. Therefore, in addition to the interest rate and GDP, which are two commonly accepted variables for explaining the supply of money, we can add foreign exchange reserves as another explanatory variable. As noted above, Chinese bank credit depends not only on total output and the interest rates but also on the land supply because a significant portion of bank loans, particularly real estate loans, are driven by the land supply. Therefore, we presume that the real money stock, M_t, could be related to the real output, Y_t, the foreign exchange reserve, FER_t, and the supplied land, L_t. We can use cointergration analysis and an error correction model to examine the specific relationships between these variables.

3.1 Data Processing

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

Nominal M1, M2, foreign exchange reserves and nominal GDP, which are obtained from statistics published by the People's Bank of China, are all deflated by a GDP deflator (using 2003 as the base). Next, we use the X–12 seasonal adjustment to eliminate effects due to seasons on real M1, M2， GDP and foreign exchange reserves. Finally, we transform these values into natural logarithms to reduce potential heteroscedasticity. Based on the analysis in section 4, we believe that *M1* is more closely related to the land supply than *M2*; therefore, we use M1 as the measure of the money supply if not specified otherwise.

3.2 Unit Root Test and Cointegration Test

First, we perform an ADF unit root test for all of the variables to test the stationarity. The lag length is decided according to the minimum SIC criterion. The unit root test results show that $M1_t$,L_t,Y_t, and FER_t are a first-order integrated time series.

Then, we perform Johansen's cointegration test for $M1_t$, L_t, Y_t, and FER_t, assuming that there is a linear deterministic trend in the levels of the data, and there are intercepts and no trends in the cointegration equations. The results show that there is one cointegration vector for $M1_t$, L_t, Y_t, and FER_t.

3.3 Error Correction Model

Based on the above cointegration analysis, there is one cointegration vector for M_{1_t}, L_t, Y_t, and FER_t. The cointegration equations are:

$$M_{1_t} = 0.19L_t + 0.06Y_t + 0.28FER_t - 5.75 \quad (1)$$

In the long run, given unchanged total output and foreign exchange reserves, a 1 unit increase in the logarithm of the land supply will cause a 0.19 unit increase in the logarithm of M_1. To analyze the short-run relationship amongM_{1_t}, L_t, Y_t, and FER_t, we estimate the vector error correction model (VECM):

$$V_t = A_0 + \sum_{i=1}^{3} A_i V_{t-i} + A_4 EC_{t-1} + \epsilon_t, \quad (2)$$

where $V_t$is the 4-dimensional vector $(M_{1_t}, Y_t, L_t, FER_t)'$, EC_{t-1} is the error correction term, A_0 is the constant vector and A_i is the coefficient matrices. The lag length is chosen based on the lag length criterion from the EVIEWS software, as in Johansen's cointegration test. The estimated results are presented in Table 1; the first estimated equation is

$$dM_t = 0.12 + 0.07dM_{t-1} + 0.29dM_{t-2} + 0.62dM_{t-3}$$

$$-2.20dY_{t-1} - 2.39dY_{t-2} - 0.43dY_{t-3}$$

$$+0.17dFER_{t-1} + 0.07dFER_{t-2} - 0.33dFER_{t-3}$$

$$+0.02dL_{t-1} + 0.08dL_{t-2} + 0.06dL_{t-3} - 0.33EC_t + \hat{\epsilon}_t$$

The results show that dL_{t-1}, dL_{t-2} and dL_{t-3} have a positive influence on the money supply, which means that an increase in the land supply increases the money supply in the short term. The coefficients of EC_t are both negative and significant, thus verifying the existence of a long-run equilibrium relationship. Any deviation in the money supply in the short term from its long-term equilibrium would be amended, and the speed of adjustment toward the long-run equilibrium is impressively high, at more than 33% in one quarter.

[Insert Table 1 here]

3.4 Granger Causality Test

We assume that the land supply is exogenous to the money supply. The Granger Causality test shows that the money supply does not (Granger) cause the land supply, while the inverse Granger Causality exists. Table 2 shows the results of the pairwise Granger Causality tests, which are implemented with VAR in levels, and the result support that the land supply is exogenous to the money supply in the long term (over the sample period). Table 3 lists the results of the tests of the VECM, which are consistent with the assumption of an exogenous land supply in the short run because the VECM are in the form of differenced variables.

[Insert Table 2 here]

[Insert Table 3 here]

3.5 Impulse Responses and Variance Decomposition

We are interested in a comparison of the effects on *M* from *L* and *FER* because the popular view focuses on the role of the funds outstanding for foreign exchange in money creation in China. Figure 3 shows the responses to the generalized one S.D. innovations. From the first diagram, we find that the response of *M* to the impulse of *L*, which attaches at the peak approximately four quarters later, is much bigger and more durable than that of *FER*. The variance decompositions are listed in figure 4. Similar conclusions can be drawn from the first dialog in Figure 4, which shows that *L* contributes the most, except the lags of *M* itself, to the variation of *M*.

[Insert figure 3 here]

[Insert figure 4 here]

4. Simultaneous Equations Model

To understand the inherent mechanism by which the land supply influences the money supply and also to avoid the measurement bias generated by the existence of endogeneity variables in the VECM because, for example, the output and money supply might impact each other simultaneously, we formulate a simultaneous equations model in the spirit of the IS-LM Model to examine the effect of the land supply on the money supply.

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

4.1 Model Setup

The IS-LM model is a basic framework used for analyzing macroeconomic equilibria. Due to the important role of the land system in Chinese economic growth, some researchers recently began to investigate the effect of land input on economic growth by introducing it as an input factor in IS-LM models (Wu, 2009; Tong, Huang, 2009; Diao, Yan, 2012). In contrast to these studies, we focus on examining the effect of the land supply on the money supply.

In China's land system, the Ministry of Land and Resources is 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 the land supply. Therefore, the land supply in China can be considered exogenous. According to the above analysis, the supply of land could stimulate investment and real estate purchases, which in turn drive increases in bank credit and the money supply. We modify the IS-LM model by introducing land supply as one of the determinants of the money supply, and we estimate its effect on the 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 that investment is influenced by autonomous investment, the interest rate and the land supply, the output equation can be represented as:

$$Y_t = C_t + I_t + G_t + NX_t = \bar{C} + a(1-\tau)Y_t + \bar{I} + bi_t + hL_t + G_t + NX_t \tag{3}$$

where Y_t, C_t, I_t, G_t, L_t and NX_t are the equilibrium output, consumption, investment, government spending, net export and land supply at time t, respectively, $\bar{C}$ 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 the interest rate and land supply on investment, and i_t is the interest rate.

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

$$M_t^d = M^d(Y_t, i_t) = \bar{M}^d + kY_t + si_t \quad (4)$$

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

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

$$M_t^s = C_t + D_t \quad (5)$$

where M_t^s is the money supply at time t, C_t is the cash in circulation and D_t is the deposit amount. Consider the balance sheet of a 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,

$$D_t = R_t + Q_t. \quad (6)$$

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

$$R_t = R(FER_t) \tag{7}$$

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 their 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 of firms and individuals is affected by the land supply L_t, their income and the loan interest rate, as shown by $Q_t^d = Q^d(L_t, Y_t, i_{lt})$. When $Q_t^s = Q_t^d$, Q_t and i_{lt} are determined, given the values of the other variables. Using Equation (7), the loan amount can be written as a function:

$$Q_t = Q(Y_t, L_t, FER_t, r_t) \ . \tag{8}$$

Let $c = C_t/D_t$, the currency ratio. From (5), (6), (7) and (8),

$$M_t^s = (1+c)[R(FER_t) + Q(Y_t, L_t, FER_t, r_t)]$$

Then, we have

$$M_t^s = \overline{M}^s + \alpha L_t + \beta Y_t + \gamma r_t + \theta\, FER_t, \tag{9}$$

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

According to Equations (3), (4) and (9), the IS-LM model can be given by:

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

The first equation is the condition for the commodity market equilibrium, and the others show the condition 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

$$\begin{cases} Y_t = a_0 + a_1 i_t + a_2 GNX_t + \sum_k a_{3k} L_{t-k} + \varepsilon_1 \\ M_t^d = b_0 + b_1 Y_t + b_2 i_t + \varepsilon_2 \\ M_t^s = c_0 + c_1 Y_t + \sum_k c_{2k} L_{t-k} + c_3 FER_t + c_4 r_t + \varepsilon_3 \end{cases} \tag{10}$$

where k is used to introduce the lagged L_t into the model to evaluate the dynamic effects of the land supply on the money supply.

4.2 Data Processing

This analysis is based on quarterly data from the first quarter of 2004 to the final quarter of 2014. The nominal M1, M2, government expenditures, net exports and nominal GDP obtained from the People's Bank of China and the National Bureau of Statistics are deflated by the GDP deflator (using 2003 as the base). Real government expenditures and net exports are merged into one variable, represented as GNX_t. The real interest rate is obtained by subtracting the next quarter's inflation rate from the three-month interbank lending rate. The legal deposit reserve ratio of large financial institutions set by the People's Bank of China is considered the measure of the deposit reserve ratio.

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

4.3 Empirical Results

The equation system of (10) is estimated using GMM. For the GMM estimation, the basic procedure is to use the exogenous variables, here, L_{t-k}, GNX_t and FER_t, as instrumental variables. To eliminate endogeneity, it is better to use lagged values as instrumental variables. We estimate several different forms of system (10), as shown in Table 6.

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

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

(3) $k = 0$, that is, no lag of L_t is included. r_t is added into the controlled variables. M_t is measured using M2.

(4) $k = 0,1,2,3$, that is, 4 lags of L_t are included. r_t is added into the controlled variables. M_t is measured using M2.

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

$$\begin{cases} \hat{Y}_t = 3.36 - 0.01 i_t + 0.63 GNX_t + 0.14 L_t \\ \widehat{M1}_t^d = -0.57 + 1.13\, Y_t - 0.03 i_t \\ \widehat{M1}_t^s = 3.89 - 0.11\, Y_t + 0.34 L_t + 0.46 FER_t \end{cases}$$

In the supply equation of M1, the coefficient of L_t is 0.34, which means that one percent growth in the land supply causes 0.34 percent growth in the money supply. This impact is relatively large. Because FER_t represents the accumulated stock of foreign exchange reserves, while L_t is the flow of the land supply in each quarter, L_t usually fluctuates much more than FER_t. For example, in the four quarters of 2007, the growth rates of the land supply relative to the previous quarters are 68%, -80%, 59% and 46%, while the counterparts for FER_t are only 9%, 7%, 4% and 3%. Therefore, although the estimated coefficient of FER_t in the money supply equation is 0.57, which is larger than that of L_t, the money supply changes due to land supply changes could be much larger than those due to changes in foreign exchange reserves. If we differentiate the supply equation by assuming r_t remains unchanged over time, then the M1 changes can be decomposed into three terms:

$$d\widehat{M1}_t = -0.21d\,Y_t + 0.34dL_t + 0.46dFER_t$$

We calculate the contributions to M1 growth from land supply and foreign exchange, as shown in Figure 3.[2] The result demonstrates that in approximately half of the quarters, the land supply contributed more to money growth than increases in the foreign exchange reserves.

[2] The calculation is performed using seasonally adjusted data.

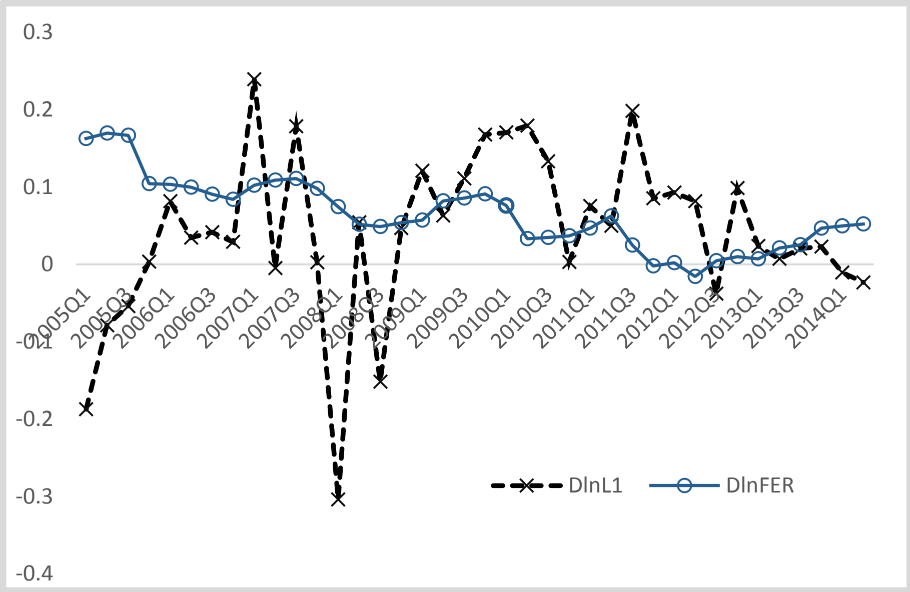

Fig. 5 Impacts of the Land Supply and Foreign Exchange Reserves on Money Growth

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

In Model (3), the impact of the land supply on M2 is still positive, but the coefficient is insignificant, and a similar situation is found for FER_t. However, we can obtain 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 is 0.07, which shows that a one percent increase in the land supply would cause the supply of M2 to grow by approximately one-tenth of a percent. Therefore, the effect of the land supply on M2 is much weaker than that on M1. Nevertheless, it still exceeds that of FER_t because the coefficient of FER_t is negative and insignificant. The fact that the land supply has a weaker impact on M2 than on M1 is not difficult to understand.

The main factor that is included in M2 but not in M1 is time deposits, while most of the deposits created in the process of loan issuance caused by the land supply are current deposits.

4.4 Robustness Tests

To further test the reliability of the above conclusion, we perform several more regressions and find that the main conclusions remain unchanged.

One might argue that the value of the supplied land instead of its area should be used because using the value makes more sense considering the creation of loans and deposits and the land's role as collateral. Therefore, we substitute LV_t, which is the value of the quarterly land sales contracts, for L_t, and we obtain the estimated Model (5), which is also shown in Table 4. The contribution of the land supply to the money supply is still significant, and its coefficient is even greater than that of *FER*. We also estimated several other regressions, although they are not listed here. We replaced the construction land supply with the acquisition area of real estate developers as the measure of land supply in the models, and we obtained similar results to those described above. Considering that land supply may affect the demand for money, we also introduced land supply and its lags into the money demand equation. In this case, land supply again shows a positive and significant effect on the money supply. Finally, we included more instrumental variables, such as the lags of output and the lags of the money amount, into the GMM estimation, and the results remain robust.

5. Conclusions

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

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

We then incorporate the land supply into the money supply equation and the IS-LM model. A model of simultaneous equations is developed to more closely examine the effect of the land supply on the money supply. The econometric results show that the effect is significantly positive, even when outstanding foreign exchange reserves are controlled in the models. Furthermore, this impact is relatively large with respect to that of the foreign exchange reserves. A simple simulation demonstrates that in slightly more than half of the quarters from 2005 to 2014, the land supply contributed more to money growth than the increase in foreign exchange reserves. Even when using the M2 supply, the land supply still has a positive impact and plays a more important role than foreign exchange reserves.

[Insert table 4 here]

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Table 1 The Estimated Results of the VECM

	D(M1)	*D(Y)*	*D(FER)*	*D(L)*
	-0.33	-0.02	-0.30	-0.04
EC	(0.05)	(0.02)	(0.10)	(0.81)
	[-6.13228]	[-1.15469]	[-3.16156]	[-0.05416]
	0.07	0.13	0.24	0.85
D(M(-1))	(0.16)	(0.05)	(0.28)	(2.40)
	[0.43283]	[2.60263]	[0.85904]	[0.35628]
	0.29	-0.03	-0.02	0.36
D(M(-2))	(0.18)	(0.05)	(0.31)	(2.67)
	[1.61541]	[-0.62676]	[-0.05541]	[0.13625]
	0.62	0.07	0.57	1.10
D(M(-3))	(0.19)	(0.06)	(0.33)	(2.78)
	[3.34718]	[1.15107]	[1.75614]	[0.39475]
	-2.20	0.55	0.19	1.42
D(Y(-1))	(0.58)	(0.18)	(1.01)	(8.64)
	[-3.79264]	[3.12536]	[0.18862]	[0.16421]
	-2.39	-0.31	-2.16	6.11
D(Y(-2))	(0.70)	(0.21)	(1.22)	(10.41)
	[-3.42081]	[-1.46596]	[-1.76865]	[0.58692]
	-0.43	0.03	-0.18	-7.52
D(Y(-3))	(0.50)	(0.15)	(0.87)	(7.42)
	[-0.86925]	[0.20018]	[-0.21094]	[-1.01450]
	0.18	-0.04	0.16	-1.27
D(FER(-1))	(0.11)	(0.03)	(0.19)	(1.65)
	[1.60732]	[-1.05451]	[0.81575]	[-0.77368]
	0.07	0.00	0.11	0.16
D(LNFER(-2))	-0.11	-0.03	-0.19	-1.59
	[0.67612]	[0.02204]	[0.60863]	[0.10177]
	-0.33	0.06	-0.24	0.01
D(LNFER(-3))	(0.10)	(0.03)	(0.17)	(1.47)
	[-3.35145]	[2.06247]	[-1.38572]	[0.00720]
	0.02	-0.01	-0.02	-0.68
D(LNL1(-1))	(0.01)	(0.00)	(0.03)	(0.21)
	[1.44616]	[-1.20574]	[-0.83232]	[-3.14783]
	0.08	-0.01	0.02	-0.11
D(LNL1(-2))	(0.02)	(0.01)	(0.03)	(0.27)
	[4.58580]	[-1.41779]	[0.68456]	[-0.41709]
	0.06	0.00	0.02	0.05
D(LNL1(-3))	(0.02)	(0.01)	(0.03)	(0.25)
	[3.48541]	[0.82265]	[0.65878]	[0.19607]
	0.12	0.01	0.06	0.03
C	(0.02)	(0.01)	(0.04)	(0.31)
	[5.63767]	[1.99921]	[1.61836]	[0.09941]
R-squared	0.80	0.71	0.57	0.44
Adj. R-squared	0.70	0.56	0.36	0.16

Notes: Standard errors in ( ) & t-statistics in [ ].

Table 2 Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
L does not Granger Cause M1	40	3.28662	0.0234
M1 does not Granger Cause L		1.90402	0.1347

Table 3 Granger Causality Tests using the VECM

Dependent variable	*Excluded*	*Chi-sq*	*df*	*Prob.*
DMt	D(Y)	32.52	3.00	0.00
	D(FER)	12.71	3.00	0.01
	D(L)	21.97	3.00	0.00
	All	53.68	9.00	0.00
DYt	D(M)	12.25	3.00	0.01
	D(FER)	4.97	3.00	0.17
	D(L)	6.79	3.00	0.08
	All	32.87	9.00	0.00
DFERt	D(M)	6.58	3.00	0.09
	D(Y)	3.41	3.00	0.33
	D(L)	2.24	3.00	0.52
	All	12.30	9.00	0.20
DLt	D(M)	0.66	3.00	0.88
	D(Y)	1.37	3.00	0.71
	D(FER)	0.61	3.00	0.89
	All	3.00	9.00	0.96

Table 4 Estimation of Simultaneous Equations

	(1)			（2）			（3）			（4）			（5）		
Dependent variable	Y_t	$M1_t$	$M1_t$	Yt	$M1_t$	$M1_t$	Y_t	$M2_t$	$M2_t$	Y_t	$M2_t$	$M2_t$	Y_t	$M1_t$	$M1_t$
Constant	3.36 (0.25***)	-0.57 (0.60)	3.89 (1.62**)	2.79 (0.34***)	-0.50 (0.48)	3.48 (0.82***)	3.36 (0.14***)	-1.06 (0.40***)	-1.74 (0.70)	2.75 (0.25***)	-1.38 (0.39***)	-1.67 (0.55***)	4.63 (0.59***)	-0.57 (0.56)	6.46 (2.34***)
Y_t		1.13 (0.05***)	-0.11 (0.51)		1.21 (0.04***)	-0.24 (0.31)		1.26 (0.04***)	1.36 (0.21***)		1.29 (0.04***)	1.36 (0.27***)		1.12 (0.05***)	-0.12 (0.44)
i_t	-0.01 (0.01)	-0.03 (0.01***)		-0.02 (0.01**)	-0.03 (0.01***)		-0.00 (0.00)	0.01 (0.01)		-0.01 (0.00***)	0.00 (0.01)		-0.00 (0.01***)	-0.03 (0.01***)	
GNX_t	0.63 (0.07***)			0.78 (0.05***)			0.62 (0.05***)			0.82 (0.05***)			0.50 (0.10***)		
FER_t			0.46 (0.20**)			0.73 （0.18***）			-0.12 (0.10)			-0.09 (0.18)			0.31 (0.13**)
L_t	0.14 (0.01**)		0.34 (0.16**)	0.03 (0.02)		0.05 (0.02**)	0.15 (0.04***)		0.11 (0.09)	0.05 (0.02**)		0.03 (0.01**)			
L_{t-1}				-0.05 (0.04)		0.07 (0.03**)				-0.04 (0.04)		0.04 (0.01***)			
L_{t-2}				-0.02 (0.02)		0.07 (0.03***)				-0.03 (0.02)		0.01 (0.03)			
L_{t-3}				0.09 (0.03***)		0.09 (0.03***)				0.06 (0.03**)		-0.02 (0.04)			
LV													0.18 (0.06***)		0.38 (0.15**)
r_t									-0.01 (0.04)			-0.00 (0.00)			
J-statistic		0.02			0.4			0.07			0.08			0.00	

Notes: ***, ** and * imply statistical significance at the 1%, 5% and 10% levels, respectively.

Figure 3

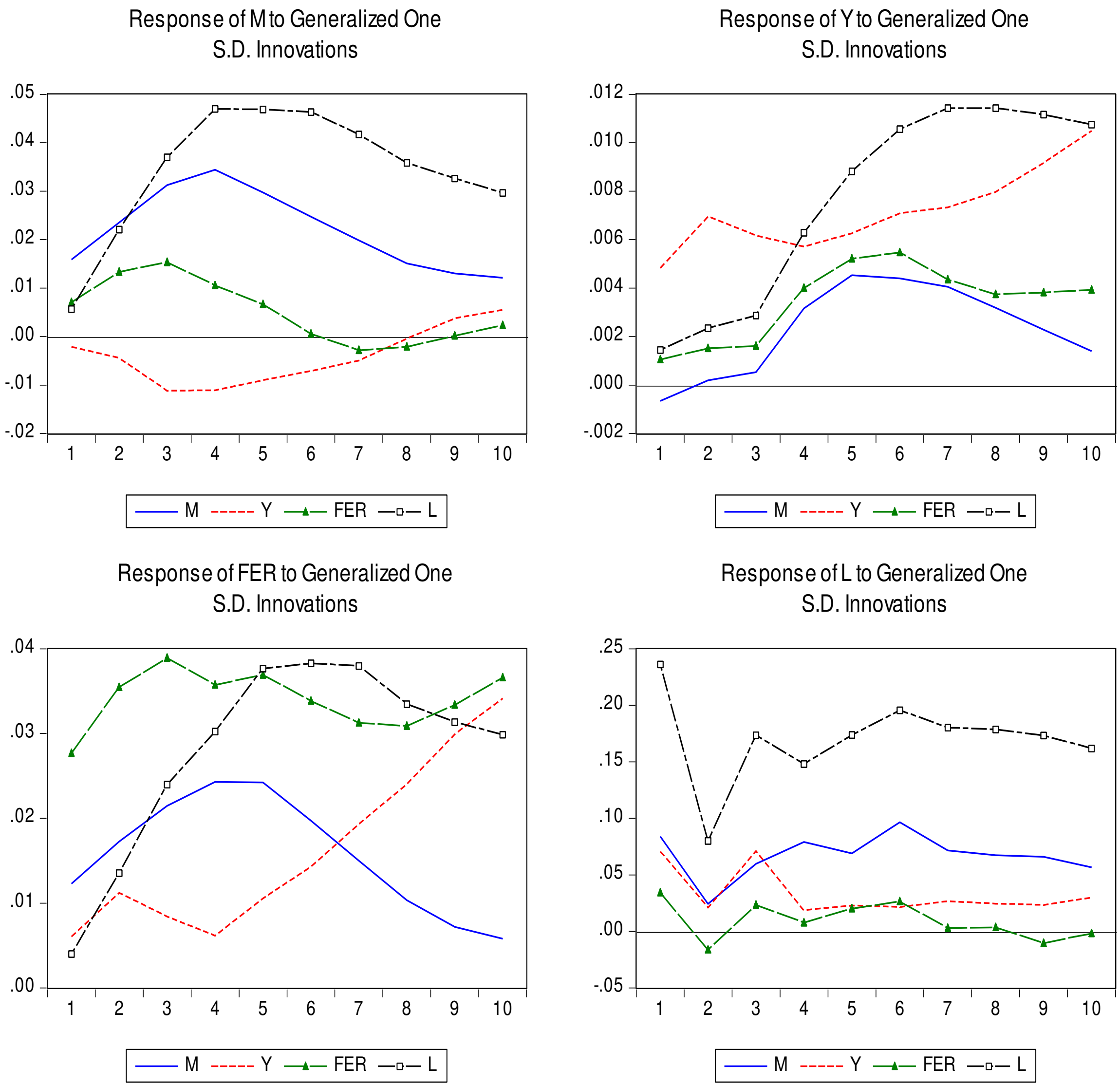
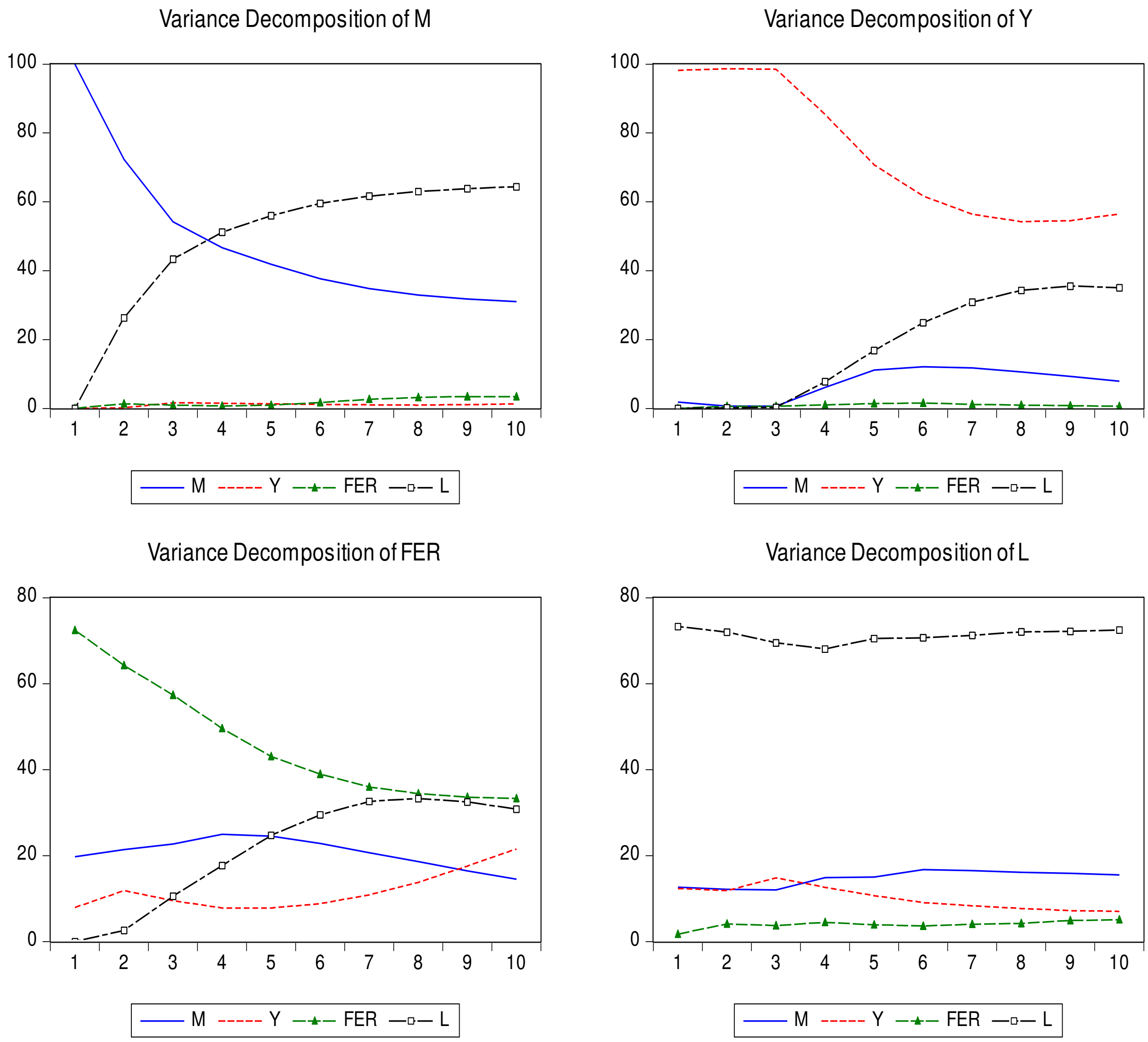

Response of M to Generalized One S.D. Innovations
.05
.04
.03
.02
.01
.00
-.01
-.02
1 2 3 4 5 6 7 8 9 10
M Y FER L
Response of Y to Generalized One S.D. Innovations
.012
.010
.008
.006
.004
.002
.000
-.002
1 2 3 4 5 6 7 8 9 10
M Y FER L
Response of FER to Generalized One S.D. Innovations
.04
.03
.02
.01
.00
1 2 3 4 5 6 7 8 9 10
M Y FER L
Response of L to Generalized One S.D. Innovations
.25
.20
.15
.10
.05
.00
-.05
1 2 3 4 5 6 7 8 9 10
M Y FER L

Figure 4



Variance Decomposition of M
Variance Decomposition of Y
Variance Decomposition of FER
Variance Decomposition of L
M
Y
FER
L