Empirical Study on Endogeneity of Money Supply in China

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Abstract: *This paper applies cointegration test and Granger causality test to make an empirical analysis on the endogeneity of China's money supply, and puts forward some suggestions on how to improve the effectiveness of China's monetary policy under the condition of the endogeneity of China's money supply.*

Keywords: Money Supply, Endogeneity, Cointegration, Granger Causality Test

1. Introduction

The money supply which closely relates to the operation of macro economy and economic development goals is an important macroeconomic variables, with the reform and opening up, the marketization of our country deepens, the money supply in China happens a series of qualitative change. Therefore, the research on the endogeneity of China's money supply is of great significance to the understanding of the mechanism of money supply and the formulation of effective monetary policy.

2. Literature Review

Qiangjie (2007) used cointegration, Granger causality test, variance decomposition and other empirical methods to study and show that China's basic money supply has a significant "reverse force" characteristic, and the change of basic money depends on the change of money supply[1]. Cai Gaoyuan (2012) research shows that foreign exchange reserves and credit scale are the influencing factors of money supply, and credit scale has a greater impact on money supply[2]. Research by Li Xiaohua, Hou Chuanbo and Chen Xuebin (2003) shows that prices and investment are Granger causes of money supply, fiscal expenditure is less affected by changes in money supply, and exports are more affected by changes in money supply[3]. Zhao Chen (2005) believes that output determines money demand, and money demand determines money supply. He makes it clear that money supply in China is an endogenous variable, thus providing a theoretical basis for the formulation of demand-driven monetary policy with interest rate as the intermediary target[4]. Zhao Guanglei (2015) found through data research from 1999 to 2013 that money supply is characterized by unstable and volatile money multiplier. There is no long-term stable relationship between the basic money and the money supply, and the change trend between the two is opposite, which means that the money supply is not independently determined by the central bank[5]. Xiang Ye and Liang Shanshan (2011) used our country's basic currency analysis to show that the net foreign assets held by the central bank are the dominant factors in the growth of the basic currency. The central bank's use of the three major

monetary policies can hedge the influence of foreign net assets to some extent, but the operation space is limited[6]. Sun Sen and Lu Zijun (2013) analyzed the central bank's control over money supply from two aspects of basic money and money multiplier, and found that under the background of the inherent nature of basic money, the central bank can control money multiplier by adjusting the statutory reserve ratio, thus controlling money supply[7]. Research by Wang Jing and Wei Xianhua (2012) shows that China's money supply is becoming more and more endogenous. The concrete manifestation is that the money multiplier is extremely unstable in the short term. It has the opposite change trend with the basic money. There is no stable relationship between the basic money and the money supply. The change of the basic money quantity is largely influenced by the foreign exchange reserves and the central bank's changes in deposit bank bonds[8]. Ji Woong Choung and jian li (2010) The endogeneity of China's money supply is attributed to the endogeneity of the basic money and the money multiplier. In addition, factors such as the access of foreign capital institutions, the opening of capital and financial accounts, capital flow and exchange rate system also affect the money supply[9].

3. Empirical Test on Endogeneity of Money Supply in China

3.1 Variable Selection, Data Source and Processing

Based on the view of money endogenesis, this paper selects M2 as the index of money supply. The following indexes are used as explanatory variables: (1) gross domestic product (GDP); (2) stock market turnover; (3) Total retail sales of social consumer goods; (4) foreign exchange reserves.

In this paper, the annual data from 2000 to 2014 are selected, of which M2data are from the website of the People's Bank of China and the rest are from the China Statistical Yearbook from 2000 to 2014. Take the natural logarithm for the annual data of the above variables. M2, gross domestic product (GDP), stock market turnover, total retail sales of consumer goods and foreign exchange

reserves are defined as y, x1, x2, x3 and x4 respectively. The variables after their respective corresponding natural logarithms are lny, lnx1, lnx2, lnx3 and lnx4 respectively.

3.2 Establishment of model

3.2.1 Cointegration Analysis of Endogenous Money Supply

(1) Unit Root Inspection
The premise of cointegration relationship between variables is whether each variable is subject to unit root process. The unit root test method used in this paper is ADF unit root test. In this paper, McKinnon critical value is adopted, and the unit root test results of the above sequences are shown in Table 1:

Table 1: Unit Root Test Results of Time Series

Variable to be tested	ADF t-statistics	Critical value of 1% significance level	Critical value of 5% significance level	Critical value of 10% significance level	Test result
Lny	16.25	-2.74	-1.97	-1.60	Not smooth
Δlny	-0.74	-2.75	-1.97	-1.60	Not smooth
$\Delta^2 lny$	-4.85	-2.77	-1.97	-1.60	Smooth
Lnx_1	11.74	-2.74	-1.97	-1.60	Not smooth
Δlnx_1	-0.95	-2.82	-1.98	-1.60	Not smooth
$\Delta^2 lnx_1$	-4.54	-2.79	-1.98	-1.60	Smooth
Lnx_2	0.10	-2.74	-1.97	-1.60	Not smooth
Δlnx_2	-3.52	-4.06	-3.12	-2.70	Not smooth
$\Delta^2 lnx_2$	-4.39	-2.79	-1.98	-1.60	Smooth
Lnx_3	13.689	-2.74	-1.97	-1.60	Not smooth
Δlnx_3	-0.36	-2.75	-1.97	-1.60	Not smooth
$\Delta^2 lnx_3$	-5.45	-2.77	-1.97	-1.60	Smooth
Lnx_4	13.68	-2.74	-1.97	-1.60	Not smooth
Δlnx_4	-0.35	-2.75	-1.97	-1.60	Not smooth
$\Delta^2 lnx_4$	-5.45	-2.77	-1.97	-1.60	Smooth

From the results of ADF unit root test in Table 1, it can be seen that lny, lnx1, lnx2, lnx3 and lnx4 are all second-order uniformities, i.e. I(2), thus deducing that there may be cointegration relationship between them.

(2) Cointegration test
Cointegration refers to a certain linear combination of several time series with the same order of single integration as stationary series, which is the basis for understanding the long-term equilibrium relationship between economic variables. From the previous stationarity tests of lny, lnx1, lnx2, lnx3 and lnx4, it can be seen that lny, lnx1, lnx2, lnx3 and lnx4 are all subject to second-order single integration, which satisfies the premise of cointegration test. First, a regression equation is established to estimate the linear relationship between lny, lnx1, lnx2, lnx3 and lnx4.

The results are shown in Table 2:

Table 2: Linear Regression Equations between lny and ln_1, ln_2, ln_3, lnx_4

Explanatory variable	Coefficient value	Standard deviation	T-statistics	Ending probability	Adjusted R^2	F-statistics	F value concomitant probability
lnx_1	-0.27	0.36	-0.73	0.48			
lnx_2	-0.02	0.02	-0.92	0.39			
lnx_3	0.71	0.27	2.62	0.03	0.998	1595.37	0.00
$lnx4$	0.15	0.07	2.16	0.06			
@trend	0.07	0.03	1.99	0.08			
c	6.46	2.58	2.50	0.03			

The unit root test was carried out on the residual term of the above regression equation, and the results are shown in Table 3:

Table 3: Stationarity Test of Residual Term E

Variable to be tested	ADF t-statistics	1% threshold	5% threshold	10% threshold	Test result
e	- 3.81	- 2.74	- 1.97	- 1.60	Stationary sequence

The residual sequence e in Table 3 is a stationary sequence, and there is a cointegration relationship between variables in the long term.

According to the regression equation in Table 2, R2= 0.998274, the regression straight line of the sample fits the sample data very well. the accompanying probability of F value is 0.00000 < 0.05, which shows that the equation is significant in general. meanwhile, the t statistics of the coefficient of retail sales of social consumer goods are 2.616828 and the t statistics of the coefficient of foreign exchange reserves are 2.157964, both of which are greater than the t $0.025 = 1.8331$ under the significance level of 5%, thus the conclusion can be drawn that the change of money supply in China caused by the change of retail sales of social consumer goods and foreign exchange reserves.

3.2.2 Granger causality test
Granger (1988) pointed out that assuming the cointegration relationship between the two time series, they have Granger causality, but this relationship will not exist simultaneously in multiple directions. Considering the lag factor and setting p = 2, this paper conducts Granger causality tests on lny,

lnx1, lnx2, lnx3 and lnx4 respectively, and the test results are shown in Table 4:

Table 4: Granger Causality Test

Original hypothesis	F-statistics	Probability of significance	Test conclusion
Lnx_1 is not the Granger cause of lny	5.42	0.03	Refuse
Lny is not the Granger cause of Lnx_1	3.70	0.07	Refuse
Lnx_2 is not the Granger cause of lny	4.82	0.06	Refuse
Lny is not the Granger cause of Lnx_2	0.69	0.60	Don't refuse
Lnx_3 is not the Granger cause of lny	71.87	0.00	Refuse
Lny is not the Granger cause of Lnx_3	2.15	0.18	Don't refuse
Lnx_4 is not the Granger cause of lny	3.39	0.09	Refuse
Lny is not the Granger cause of Lnx_4	1.09	0.38	Don't refuse

According to the results of Granger causality test in Table 4, lnx1, lnx2, lnx3 and lnx4 are all Granger causes of lny at a significance level of 10%. That is, changes in gross domestic product, stock market turnover, total retail sales of social consumer goods and foreign exchange reserves are the reasons for changes in money supply M2.

4. Conclusions and Policy Recommendations

4.1 Main conclusions

This paper selects GDP, stock market turnover, retail sales of social consumer goods and foreign exchange reserves as explanatory variables, and broad money supply M2 as explanatory variables. Firstly, ADF unit root test is used to obtain that the above five economic quantities all obey I(2), and it is judged that there may be a cointegration relationship between them. Secondly, the above analysis shows that there is a long-term stable relationship between GDP, stock market turnover, retail sales of consumer goods, foreign exchange reserves and M2; Finally, through Granger causality test, the Granger cause with 4 explanatory variables of M2 is obtained. Therefore, it is concluded that China's money supply is endogenous.

4.2 Policy recommendations

(1) Paying attention to the endogenous economic variables that have influence on the money supply
The intermediate target of monetary policy in China is M_1 at this stage. From the conclusion that money supply is endogenous, we can see that the policy effect of this quantitative intermediate target of monetary policy is not significant. The central bank should pay more attention to economic variables and pay special attention to the influence of changes in social retail industry and foreign exchange reserves on the money supply in order to improve the policy effectiveness of the monetary authority.

(2) Applying interest rate to the intermediate target of monetary policy
The endogeneity of money supply has sharply reduced the monetary authority's binding force on it. In this way, it is suggested that the authority learn from foreign variables with interest rate as the intermediate target. At the same time, we are racing against time to perfect the process of interest rate marketization, striving to overcome possible resistance in the current economic system and mechanism, and striving to realize interest rate as the intermediary target of monetary policy.

(3) Reforming the main body of the market and strengthening market regulation
Economic unit activities make money supply endogenous, so we must improve the effectiveness of government policies and regulate economic units. That is to say, indirect adjustment will be implemented in the direction and focus of credit changes by means of increasing window guidance and moral advice, so as to transform the future behavior of various economic units to adapt to the central bank's policies and reduce the role of economic unit behaviors in controlling the money supply. Regulated economic units can improve the completeness of the financial system mechanism, so we must urge the improvement of the grass-roots system so as to change the transmission path of monetary policy and enhance the effectiveness of the implementation of government policies.

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