Is China's Economic Growth Promoted by the Monetary Supply

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Abstract. In order to test if China's economic growth is driven by the monetary supply, this paper does an empirical study of the relationship between GDP and M2 increment over the period of 1990-2016 based on the co-integration analysis approach, error modifying model and Granger causality tests model. It is found that LGDP and LM2 have equilibrium relationship in the long run. Moreover, if ZM2 increases by one percent, GDP will increases by 0.928085 percent in the short run. LM2 does not Granger causes LGDP while LGDP doing Granger causes LZM2 with 5 lags. As a result, ZM2 can drive GDP powerfully in the short run, but this effect will weaken rapidly in the long run and GDP can drive ZM2 inversely in a way.

Introduction

China's economy has made great achievements since the reform and opening-up, and its GDP, which rose by 38.4 fold over the past 26 years, increased from 18872.9 *RMB* in 1990 to 743585.5 *RMB* in 2016. However, the broad money supply M2 in the same period, which rose by 100.4 fold over the past 26 years and its growth rate is 2.6 fold compared with the GDP, increased from 15293.40 *RMB* in 1990 to 1550066.67 *RMB* in 2016. Thus, is China's economic growth driven by the monetary supply? It's one of the most debatable problems in the academic circle. China's economy has stepped into "new normal" since the global financial crisis in 2008 while many economies adopting monetary loose policies early or late. Under the background of global economic recovery uneven, it will be of theoretical significance and realistic meaning to test the problem above again.

Literatures Review

The scholars in China and overseas have made a series of theoretical analysis and empirical study about the relationship between the monetary supply and economic growth, but there's a lot of disagreement among the research conclusions. All in all, there are two views:

The monetary is neutral.

Patinkin(1956)[1] argues that monetary supply has no effect on the real output and then monetary is neutral. Friedman(1956, 1970) [2, 3] argues that monetary supply might have effect on the output in the short run, but monetary is neutral in the long run. The empirical study of Boschen & Mills(1995) [5] supports that monetary is neutral in the long run which was defined by Fisher & Seater (1993) [4] before. Some China's scholars make similar conclusions by the empirical studies of China: Weiping Zhang(2012) [6] argues that it can not be denied that monetary is neutral in the long run. Yuxia Wang(2014) [7] argues that monetary supply is not the cause of output growth by using co-integration approach. Chengsi Zhang(2012)[8] argues that monetary supply does not drive output but inflation.

The monetary is not neutral.

Hayek (1933) [9] argues that monetary is not neutral under the condition of affecting the relative price. Keynes (1936) [10] argues that monetary supply can improve output level. Yun Tong(2013) [11] argues that it exactly is the theory base of central banks' macro-control that monetary is not neutral. Some China's scholars also argue that monetary is not neutral by the empirical studies of China: Xiaoling Li(2012) [12] & Zhixiong He(2014) [13] argue that the monetary supply can improve economic growth by using co-integration approach. Xiaoqian Liu(2012) [14] finds that the monetary

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supply and fiscal expense can obviously affect economic growth by building simultaneous equations to do empirical study. Guoping Liu(2012) [15] finds that the monetary supply can raise the real output lagging 5 quarters by building SVAR model to do empirical study of the relationship between China's monetary supply and economic growth. Xianglan Meng(2011) [16] argues that the monetary supply can improve economic growth and the monetary is not neutral in the long run by empirical study. Zhihong Jian(2012) [17] finds that China's monetary polices can steady economic fluctuation by building DSGE model.

It can be found that the research remains open whether monetary supply can improve economic growth. Most of current literatures often directly adopt the M2 data as the monetary supply when analyze the relationship of both above, however, the data is stock while GDP is flow. As a result, it is necessary to improve the research approach properly and use the newest data to do farther analysis and study. This paper will do an empirical study of the problem above to test whether China's economic growth is driven by the monetary supply based on the increment data of China's GDP and M2 over the period of 1990-2016.

Empirical Study of China

Model Setting and Data Select.

If there is no generally accepted economic theory support, it might be "spurious regression", which can lead to deviation between the research results and economic reality, to do regression analysis directly of two economic variables' equilibrium relation in the long run using non-stationary time series data. The continual development of econometrics has solved the difficult problem and the appearance of co-integration model can test if there is equilibrium relation in the long run between two economic variables. The idea of co-integration analysis is mainly as below: if the time series data of two economic variables is non-stationary while some kind of their linear combination might be stationary, we can use OLS regression analysis approach to test its equilibrium relation further as long as the difference time series data of the two economic variables is same order integration after ADF unit root test. On the premise that the statistical tests of the equation are through under 10% significanc level, the equilibrium relation in the long run between the two economic variables can be made certain ultimately. Co-integration analysis is now applied to study economic problems more and more just due to its non-transcendental test advantage. This paper will use the approach to do an empirical study of the equilibrium relation between China's economic growth and the increment of broad money supply M2.

The definition of variables is as below:

GDP ── China's gross domestic products, unit: one hundred million *RMB*;

ZM2──the increment of broad money supply M2 in China, unit: one hundred million *RMB*

The data of China's GDP and the increment of broad money supply M2 over the period of 1990-2016 can be seen in table I, and the variation tendency of GDP and ZM2 can be seen in figure 1.

Table I The relative data of China's GDP and M2 over the period of 1990-2016

Year	GDP/ one hundred million RMB	M2/ one hundred million RMB	ZM2/ one hundred million RMB
1990	18872.9	15293.40	—
1991	22005.6	19349.90	4056.5
1992	27194.5	25402.20	6052.3
1993	35673.2	34879.80	9477.6
1994	48637.5	46923.50	12043.7
1995	61339.9	60750.50	13827
1996	71813.6	76094.90	15344.4
1997	79715.0	90995.30	14900.4
1998	85195.5	104498.50	13503.2
1999	90564.4	119897.90	15399.4
2000	100280.1	134610.30	14712.4
2001	110863.1	158301.90	23691.6
2002	121717.4	185006.97	26705.07
2003	137422.0	221222.80	36215.83
2004	161840.2	254107.00	32884.2
2005	187318.9	298755.70	44648.7
2006	219438.5	345603.59	46847.89
2007	270232.3	403442.21	57838.62
2008	319515.5	475166.60	71724.39
2009	349081.4	606225.01	131058.41
2010	413030.3	725774.10	119549.09
2011	489300.6	851590.90	125816.8
2012	540367.4	974148.80	122557.9
2013	595244.4	1106524.98	132376.18
2014	643974.0	1228374.81	121849.83
2015	689052.1	1392278.11	163903.3
2016	743585.5	1550066.67	157788.56

Source: National Bureau of Statistics，http://www.stats.gov.cn/tjsj/

The People's Bank of China，http://www.pbc.gov.cn/diaochatongjisi/116219/index.html

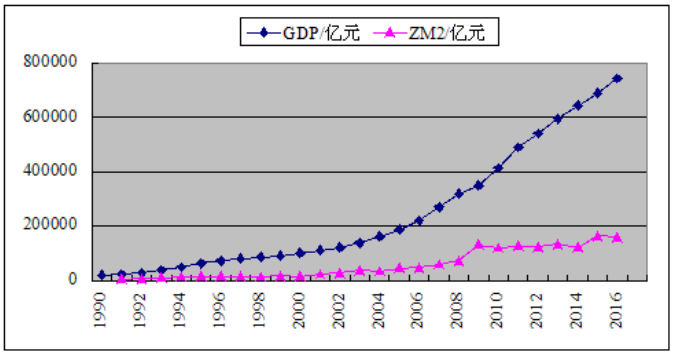

Fig. 1 The variation tendency of GDP and ZM2 in China over the period of 1990-2016

Co-integration Analysis and the Results.

First, it is necessary to judge if the data of GDP and ZM2 follow normal distributions. The Q-Q splashed figure is obtained using statistic software, see figure 2. It can be found that both the time series data of the two variables follow normal distributions, then the supposed premise of co-integration is correct.

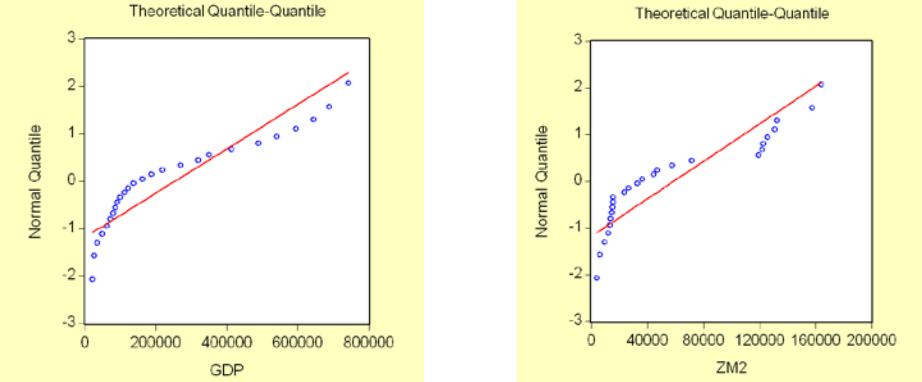

Fig. 2 The Q-Q splashed figure of GDP and ZM2

The stationary of GDP and ZM2 is test after being taken the logarithm in order to eliminate the possible heteroscedasticity of the time series data, see table II-III.

Table II The Unit Root Test Results Of Lgdp Data

Null Hypothesis: LGDP has a unit root				
Lag Length: 3 (Automatic-based on SIC, max lag =5)				
			t-Statistic	**Prob. ***
Augmented Dickey-Fuller test statistic			-3.774736	0.0381
Test critical values:	1%		-4.440739	
	5%		-3.632896	
	10%		-3.254671	

Table III The Unit Root Test Results Of Lzm2 Data

Null Hypothesis: LZM2 has a unit root				
Lag Length: 2 (Automatic-based on SIC, max lag =5)				
			t-Statistic	**Prob. ***
Augmented Dickey-Fuller test statistic			-3.365727	0.0809
Test critical values:	1%		-4.416345	
	5%		-3.622033	
	10%		-3.248592	

It can be seen in table 2 that LGDP refuses the original hypothesis of unit root under 5% level of significance, which indicates the series stationary, marked I(0). It can be seen in table 3 that LGDP refuses the original hypothesis of unit root under 10% level of significance, which indicates the series stationary, marked I(0). As a result, there is possibly equilibrium relationship between LGDP and LZM2 due to their zero order integration. Next the OLS approach can be used to do regression analysis of LGDP and LZM2 and test their co-integration relation further, the results of regression analysis can be seen in table IV

Table Ⅳ The Results Of Regression Analysis Of Lgdp And Lzm2

Dependent Variable: LGDP				
Method: Least Squares				
Sample: 1991 2016				
Included observations: 26				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	2.267543	0.336242	6.743784	0.0000
LZM2	0.928085	0.031935	29.06133	0.0000
R-squared	0.972368	Mea dependent var		1.043807
Adjusted R-squared	0.971217	S.D. dependent var		11.98692
S.E. of regression	0.177088	Akaike info criterion		-0.550533
Sum squared resid	0.752647	Schwarz criterion		-0.453756
Log liklihood	9.156925	F-statistic		844.5608
Durbin-Watson stat	1.026145	Prob (F-statistic)		0.000000

It can be seen in table 4 that R^2 is 0.972368, which indicates that the equation fits better. The regression equation (1) can be obtained since the probability of t-Statistic and F-statistic is approximately zero under 1% level of significance:

$$\begin{gathered} LGDP=2.267543+0.928085LZM2 \\ (6.743784)\ \ (29.06133) \end{gathered} \qquad (1)$$

Next to test the residual error of the regression equation above about its flat noise, the results can be seen in table V

Table V The Results Of The Flat Noise Test Of The Regression Equation Lgdp And Lzm2

Null Hypothesis: RE has a unit root				
Lag Length: 0 (Automatic-based on SIC, max lag =5)				
			t-Statistic	**Prob.**
Augmented Dickey-Fuller test statistic			-2.829725	0.0066
Test critical values:	1%		-2.660720	
	5%		-1.955020	
	10%		-1.609070	

It can be seen in table 5 that the residual error of t-Statistic of the regression equation passes under 1% level of significance, which indicates that it is flat noise. Thus there is long-run equilibrium relationship between LGDP and LZM2, and LGDP will increase by 0.928085 percent if LZM2 increases 1 percent. It's worth noting that the equilibrium relationship between LGDP and LZM2 is not always indicating that there is equilibrium relationship between GDP and ZM2 since it is just for meeting the demand of statistic analysis to take the logarithm of GDP and ZM2, it is necessary to do analysis further. Next the error correction model and Granger causality test will be used to test the relationship between the two variables.

The Error Correction Model.

The error correction model of LGDP and LZM2 can be seen in table VI.

It can be seen in table Ⅵ that the t-Statistic of DLZM2 passes under 1% level of significance and the t-Statistic of RE(-1) passes under 1% level of significance nearly, thereby equation(2) can be obtained:

$$\begin{gathered} DLGDP=0.452755DLZM2-0.387604\ RE(-1) \\ ECMt=LGDP-0.928085LZM2-2.267543 \\ \Delta GDP=0.452755\Delta ZM2-0.387604\ ECM(-1) \end{gathered} \qquad (2)$$

Table VI The Error Correction Model Of Lgdp And Lzm2

Dependent Variable: DLGDP				
Method: Least Squares				
Adjusted Sample: 1991 2016 1992 2016				
Adjusted Included observations: 25				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
DLM2	0.452755	0.087934	5.148793	0.0000
RE(-1)	-0.387604	0.125272	-3.094096	0.0051
R-squared	-1.411749	Mea dependent var		0.066383
Adjusted R-squared	-1.516608	S.D. dependent var		0.140807
S.E. of regression	0.105308	Akaike info criterion		-1.587228
Sum squared resid	0.255067	Schwarz criterion		-1.489718
Log liklihood	21.84035	Durbin-Watson stat		0.963955

It can be seen in equation(2) that the difference item reflects the influence of the variables' short-run fluctuation. The fluctuation of the dependent variable can be divided into two parts: one is short-run fluctuation, and another one is long-run equilibrium. The short-run change of ZM2 causes GDP changes in the same direction according to the estimation of the model parameters: GDP will increase by 0.452755 percent if ZM2 increase by 1 percent. The coefficient of ECM reflects the adjustment level of the long-run equilibrium deviation and its adjustment dynamic is feeblish since the coefficient is －2.267543.

Granger Causality Test.

It can be done Granger causality test to analyze the causal relation non-transcendentally between GDP and ZM2 further. Here the lags are 5 and the results can be seen in table VII

Table VII The results of Granger causality test of LGDP and LM2

Granger Causality Tests			
Sample: 1991 2016			
Lags: 5			
Null Hypothesis:	**Obs.**	**F-Statistic**	**Prob.**
LZM2 does not Granger cause LGDP	21	1.74852	0.21133
LGDP does not Granger cause LM2		11.0577	0.00081

It can be seen in table 7 that LZM2 does not Granger causes LGDP when the lags are 5 while LGDP Granger causing LM2.

The empirical results above indicate that China's economic growth is not driven by the monetary supply in the long run. However, it is generally recognized that high M2 level would promote the inflation no matter what most of scholars in the world obtain the empirical study results. Although the former is not the sufficient condition of the latter, the former often becomes the necessary condition. Friedman(1963), who is the representative figure of monetarism, argues that "All inflation are the phenomena of monetary without exception no matter when and where". Consequently China should control the increasing degree of M2 in the economic new normal, which is not exceeding the increment speed of GDP, in order to prevent the economy from "stagflation" in the long-run.

Conclusions

This paper does an empirical study of the relationship between China's GDP and M2 increment over the period of 1990-2016 based on the co-integration approach, error correction model and Granger causality test model, it is found that there is long-run equilibrium relationship between LGDP and LZM2. In the short-run, LGDP will increase by 0.928085 percent if LZM2 increases 1 percent. LZM2 does not Granger causes LGDP when the lags are 5 while LGDP Granger causing LM2. As a result, M2 increment can promote GDP strongly in the short-run, but it will weaken greatly in the

long-run, on the contrary, GDP can promote M2 increment somewhat. Thus China's economic growth is not promoted by the monetary supply in the long-run but other factors.

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