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A Study on the Relationship between Monetary Policy Variables and Stock Market

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Abstract

Through the analysis of monetary policy variables and stock market from January 2010 to December 2015, including money supply M1, M2,one-year Benchmark lending rate for financial institutions，interbank offered rate, and the stock market price index data, through correlation analysis, unit root test, co-integration test, Granger causality test and VAR model test, empirical test results show that there is a two-way causal relationship between money supply M1 and stock market , M2 and stock market have a one-way causal relationship from M2 to stock market. One-year benchmark lending rate for financial institutions and stock market have a one-way causal relationship from stock market to one-year benchmark lending rate for financial institutions. The interbank offered rate and the stock market have a one-way causal relationship from the stock market to the interbank offered rate. China's transmission channels between monetary policy and stock market exist, but is not sound and there is a delay. When using the monetary policy variable to adjust the stock market, the money supply policy is more useful than adjusting the interest rate.

Keywords: Co-integration Test, Granger Causality Test, Monetary Policy variables, Model of VAR, Stock Market

1. Introduction

1.1 Research Background

Since July 2014, China's new bull market has begun to emerge.。In December 2014, the financial stocks which are represented by brokerage, banking, insurance stocks suddenly burst, led the Chinese stock market in experiencing a new round of bull market. Shanghai Composite Index soared and once reached the peak point of 5178.19. Then turned down into the long-term adjustment interval. Some people believe that the root cause of the round of bull market are policy guidance, the decline of risk-free income, the stock market has been down for a long time and technical aspects.

We can’t ignore that China's monetary policy variables adjusted repeatedly and consequently had different effects on the market during the round of bull market. For example, the benchmark interest rate of RMB deposit and loan for financial institutions has been come down 5 times from November 22th, 2014 to October 24th, 2015.

So what’s the specific effects of the adjustments of China's monetary policy variables on the stock market? Whether China's stock market monetary policy transmission mechanism is mature? Here we use empirical methods to analyse the two-way correlation between the stock market and China's monetary policy variables.

1.2 Related Theories

1.2.1 The Mechanism of Monetary PolicyVariables on the Stock Market:

(1) The effect of money supply on stock prices: This effect can be achieved through three effects: expected effect, portfolio effect and intrinsic value growth of stock effect. The central bank will make stock prices rise when implementing more loose monetary policies.

(2) The effect of interest rates on stock prices: When interest rate falls, the impact is achieved mainly through three roles: firstly, the opportunity cost to invest in the stock market is reduced, leading more capital investing in the market and consequently rising stock prices. Secondly, financing cost of corporate declines, leading to

increasing investment and expanding production, thus increasing profits and causing stock prices rise. Thirdly, the investor's required return is reduced, and then the discount rate in the stock pricing model declines and the stock price rises. To sum up, more loose monetary policy will lead to rising stock prices, bringing the stock market boom.

1.2.2 The Mechanism of the Stock Market on Monetary Policy Variables:

(1) The effect of stock prices on money supply: M. Friedman's classic study points out that stock prices affect the money supply by four ways: wealth effect, portfolio effect, trading effect and substitution effect. In the first three effects, a positive stock market will result in an increase in the demand for money. The latter effect reduces the demand for money through stock substitution of the currency.

(2) The effect of stock prices on interest rates: From Tobin's q theory, it is concluded that the rise of the stock price will lead to the increase of the company's investment and the rise of the interest rate. However, interest rates are determined by the supply and the demand of funds. Therefore, the stock market's effect on interest rates can't be considered solely on the basis of changes in stock prices. At the same time, China's marketization of interest rate has not yet been fully realized, and the impact of stock prices on the interest rate is also determined by monetary authorities' judgment on macro-economic conditions.

2. Literature Review

Over the years, scholars in China have done a great deal of research on the relationship between the monetary policy and the stock market. Qian Xiaoan (1998) used the static regression and variance decomposition methods to test the correlation between the money supply and the stock price from March 1994 to February 1997. The results show that the stock price changes in the same direction with M0, has nothing to do with M1, and reverses with M2. Their correlation are weak and unstable. Yang Xinsong and Long Gesheng (2006) used co-integration test, Granger causality test and vector autoregressive model to analyze the correlation between the money supply and the stock market. They concluded that there is a two-way causal relationship between M1, M2 and market capitalization. Nominal interest rate, the real interest rate is the Granger reason of stock market capitalization. The central bank can adjust the stock market through the money supply and interest rate, and the interest rate is more effective. According to HP filter, Granger causality test, prediction variance decomposition and time-varying parametric state-space model, Xue Yonggang and Chao Yanming (2008) studied the relationship between the loan rates of commercial banks, M1, M2, interbank offered rate and the stock price from January 1998 to February 2007. The results show that there is an incomplete two-way causal relationship between China's monetary policy variables and stock prices. The stock market transmission channels exist but is not very efficient. The counter-effect of stock price on monetary policy variables is stronger than the positive effect. Cui Xiuhong and Xie Xuecheng (2012) studied the price-type variables, quantitative variables and credit conditions in China from January 1999 to October 2009 through VAR model. The results show that the return of stock market is insensitive to the official interest rate adjustment of deposit and lending rates, while it is sensitive to the quantitative response of bank loans and M2. At the same time, the response of the stock market of our country to the adjustment of monetary policy has obvious state-dependent characteristics. Zhang Xiuli (2012) analyzed the data of money supply and stock market prices from January 2001 to December 2011 by using empirical research methods such as unit root test, co-integration test and Granger causality test. The results show that the impact of different levels of money supply on the stock market is not the same. There is a long-term equilibrium relationship between M1 and the stock market price, and M0 and M2 have no significant effect on the stock market.

Due to the different degrees of maturity of China's stock market in different periods, their research results are different. Under the background of the marketization reform of interest rate in China and the bull stock market in 2015, this paper draws on the previous research methods and adopts correlation test, unit root test, co-integration test, Granger causality test and VAR model to analyze the two-way dynamic linkages between the Shanghai Composite Index and the money supply (M1, M2) and interest rates (interbank offered rate R2, the benchmark interest rate of financial institution's one-year loan R1) from January 2010 to December 2015. Based on this, we can prove the effectiveness of monetary policy to intervene in the stock market and the maturity of China's transmission channel between the money market and the stock market, and then put forward policy recommendations.

3. Empirical Analysis

3.1 The Selection of Sample Data

In the empirical analysis, this paper uses a total of 72 sets of data from January 2010 to December 2015. Using

the monthly highest point of the Shanghai Composite Index (SP) to represent the status of China's stock market. Using M1, M2, the two money supply level as Money supply (100 million yuan). The interest rate is based on the interbank offered rate R2 (7 days) and the financial institution's one-year loan benchmark interest rate R1 (%).The above data are from the People's Bank of China Survey and Statistics Division.

Before the specific analysis, we do data pre-processing firstly, that is, to make seasonal adjustment and take the natural logarithm to the above variables (except for interest rate variables).

3.2 Correlation Test

Before establishing autoregressive model, this paper do correlation test firstly to see whether there is a certain correlation. Test results in Table 1.

Table 1. the Results of correlation test

Correlation coefficient	M1	M2	R1	R2	SP
M1	1.000 000	0.988 114	-0.253 16	0.263 673	-0.017 86
M2	0.988 114	1.000 000	-0.234 09	0.254 538	-0.045 56
R1	-0.253 16	-0.234 09	1.000 000	0.594 050	-0.607 67
R2	0.263 673	0.254 538	0.594 050	1.000 000	-0.408 05
SP	-0.017 86	-0.045 56	-0.607 67	-0.408 05	1.000 000

The results show that the money supply M1, M2, financial institution’s one-year benchmark lending rate, interbank offered interest rates, the Shanghai Composite Index, there is a linear relationship between the two.

3.3 Unit Root Test

Then this paper carry out unit root test for each variable to test whether the data is stable and has a trend of time, so as to avoid the false regression phenomenon in the following regression analysis. In practice, the time series are often not stable. In this paper, we use ADF statistics, using eviews7.2 measurement software to do unit root test for M1, M2, R1, R2, SP respectively. Test results are in Table II.

Table 2. Test results of unit root test

The results of ADF	T-statistics	Prob.	5% Critical Level	Time Lag
M1	-0.375 5	0.906 9	Contains unit root, non-stationary	1
D（M1）	-10.568 46	0.000 1	Excluding unit root, stable	0
M2	-1.813 005	0.371 4	Contains unit root, non-stationary	0
D（M2）	-9.880 969	0	Excluding unit root, stable	0
R1	-0.287 945	0.920 6	Contains unit root, non-stationary	2
D（R1）	-3.351 32	0.016 3	Excluding unit root, stable	1
R2	-3.378 78	0.015	Excluding unit root, stable	0
D（R2）	-8.221 654	0	Excluding unit root, stable	1
SP	-1.719 646	0.417 1	Contains unit root, non-stationary	1
D（SP）	-6.025 473	0	Excluding unit root, stable	0

Note: D () is first order difference. The lag period is determined according to SIC guidelines. The T-test had a critical value of -3.527045 at 1% significance level and -2.903 566 at the 5% significance level, and -2.985 227 at the 10% significance level.

The results in Table 4 show that M1, M2, R1, SP are not stable time series and have a time trend, but R2 is a stationary series. However, the first-order differences of M1, M2, R1, R2 and SP are all stable, so we can think that all of these five variables as first order sequence I (1).

3.3 Co-integration Test

Since the money supply M1, M2, R1, R2, SP are first-order single integer sequences, if they have the co-integration relationship, then the regression model can be established. Therefore, we do co-integration test for the five variables. In this paper, Johansen test is used, and the lag number is 2 based on AIC and SC criteria. Test results are shown in Table Ⅲ.

Table 3. the results of co-integration test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.380 763	79.644 73	69.818 89	0.006 7
At most 1	0.275 126	46.575 32	47.856 13	0.065 6
At most 2	0.173 756	24.374 1	29.797 07	0.185 1
At most 3	0.129 374	11.204 41	15.494 71	0.199 3
At most 4	0.023 557	1.644 918	3.841 466	0.199 7

According to the Johamsen co-integration likelihood ratio test, the null hypothesis is rejected at the 5% significance level because of 79.64> 69.82, that is, the co-integration equation exists between the five variables and they has a long-term stable relationship.

3.4 Granger Causality Test

Through the co-integration test, we can draw a causal relationship between these five variables, but the specific relationship should be determined by Granger causality test of non-stationary sequences. The test results are shown in Table IV.

Table 4. The results of Granger causality test

Null Hypothesis:	Obs	F-Statistic	Prob.
SP does not Granger Cause M1	70	1.688 19	0.192 9
M1 does not Granger Cause SP		1.5481	0.220 4
SP does not Granger Cause M2	70	0.427 76	0.653 8
M2 does not Granger Cause SP		1.454 13	0.241 1
SP does not Granger Cause R1	70	0.203 34	0.816 5
R1 does not Granger Cause SP		0.738 93	0.481 6
SP does not Granger Cause R2	70	1.866 34	0.162 9
R2 does not Granger Cause SP		0.116 07	0.890 6

The test results shows that M1 and M2 were the cause of SP at the significance level of 22.04% and 24.11% respectively, while SP was Granger reason of M1 at the significance level of 19.29%. That is to say, M1 and SP exist two-way causal relationship while M2 and SP exist one-way causal relationship from M2 to SP. R1 is the cause of SP at a significance level of 48.16%, but SP is not the Granger cause of R1. That is, there is only one-way reason from R1 to SP between R1 and SP. SP is the Granger cause of R2 at a significance level of 16.29%, but R2 is not significant to the Shanghai Composite Index, that is, there is only one-way reason from SP to R2. To sum up, the changes of M1, M2, R1 affect SP, but the change of R2 has no significant effect on SP. The change of SP will affect M1 and R2, but will not be significant of M2 and R1.

3.5 Establish a VAR Model

VAR model can be used to test the influence and the direction of influence of different variables. We can get the following test results at an optimal lag of 2 determined according to the AIC and SC guidelines. The test results are shown in Table Ⅴ.

Table 5. The results of VAR model

	M1	M2	R1	R2	SP
M1(-1)	0.592 295	-0.042 355	0.961 241	8.140 33	-0.969 544
M1(-2)	0.308 373	0.044 38	1.423 375	1.916 521	0.583 257
M2(-1)	0.003 735	0.716 715	-0.879 23	-2.659 399	-0.720 153
M2(-2)	0.036 654	0.272 843	-0.857 883	-1.817 654	0.931 236
R1(-1)	-0.035 499	-0.013 515	0.579 583	1.555 445	0.001 81
R1(-2)	0.024 953	0.016 811	0.313 859	-0.795 359	-0.030 433
R2(-1)	-0.000 713	-0.002 546	0.020 409	0.561 734	0.000 744

R2(-2)	0.001 849	0.002 12	0.041 317	-0.242 997	0.004 035
SP(-1)	0.012 668	0.006 945	0.037 403	-1.340 595	1.273 92
SP(-2)	-0.013 775	0.000 54	-0.276 422	1.385 494	-0.352 701
C	0.771 72	0.055 897	-3.839 291	-67.458 58	2.750 035
R-squared	0.991 491	0.999 214	0.979 421	0.677 522	0.927 23
Adj. R-squared	0.990 049	0.999 08	0.975 933	0.622 865	0.914 896
Sum sq. residual	0.009 76	0.002 877	0.421 643	17.275 6	0.180 079
F-statistics	687.521 2	749 7.735	280.796 4	12.395 85	75.177 66

The test results show that in addition to the fifth column of data, the adjusted R ^ 2 of other equations are greater than 90%. So we can get the conclusion that the fitting result is pretty good.

In the first equation, doubling the previous period of SP will cause the money supply of M1 to increase by 1.27%, doubling the previous two periods of SP, causing the M1 to decrease by 1.38%. In the fifth equation, the previous period of M1 doubled, causing SP to decrease by 96.95%, the first two periods of M1 doubled, causing SP to rise 58.32%. This also shows that there is a two-way causal relationship between M1 and SP, consistent with the Granger test.

In the second equation, doubling the previous period of SP will result in an increase of 0.69% in the M2. The doubling of the first two periods of SP will cause a rise of 0.05% in M2, that is, the change in SP will hardly affect M2. In the fifth equation, doubling M2 in the previous period will cause the SP to fall by 72.02%. In the first two periods, the doubling of M2 will result in an increase of SP by 93.12%. That is, the change of M2 will significantly affect the SP. There is one-way causality from M2 to SP, which is consistent with the Granger test.

In the third equation, doubling the previous period of SP will cause R1 to rise by 3.74%, doubling the previous two period of SP will cause R1 to decrease by 27.64%. In the fifth equation, doubling R1 in the previous period will increase the SP by 0.18% and doubling the R1 in the first two periods will cause the SP to decrease by 3.04%. That is to say, the change of R1 does not have a significant impact on SP, and there is a one-way causal relationship from SP to R1, which is inconsistent with Granger test results.

In the fourth equation, doubling the previous period of SP will cause R2 to fall by 1.34. Doubling the first two period of SP will cause R2 to rise by 1.39. That is, the change of SP will significantly affect the level of R2. In the fifth equation, a doubling of R2 in the previous period will cause an increase of 0.74% in SP, and a doubling of R2 in the first two periods will cause SP to rise by 0.40%. That is, the change in R2 hardly affect the SP. So there is a one-way causal relationship from SP to R2, which is consistent with the result of Granger causality test.

4. Conclusions

Firstly, the change in M1 has a significant impact on the Shanghai Composite Index. The increase in the previous period will cause the Shanghai Composite Index to fall. The first two period increases will make the Shanghai Composite Index rise. However, the Shanghai Composite Index has a smaller impact on M1. In theory, an increase in the money supply will cause the stock market to rise. However, empirical results show that the increase of M1 in the first two periods leads to a marked rise in the Shanghai Composite Index, which can be interpreted as the lag effect of the monetary policy transmission. That is, Chinese stock market is not yet mature and the channel for monetary policy is not yet mature. Shanghai Composite Index has an impact on M1, but smaller, which can be interpreted as the result of the positive effects of wealth effect, portfolio effect and transaction effect being offset by the negative effect of alternative effect.

Secondly, changes of M2 will significantly affect the Shanghai Composite Index, and the previous period increase will cause the Shanghai Composite Index to fall, the first two period increase will cause the Shanghai Composite Index to rise. Shanghai Composite Index has no effect on M2. The impact of M2 on the Shanghai Composite Index is the same as that of M1, which also verifies the existence of lag effect of the monetary policy transmission.

Thirdly, Changes in the benchmark interest rate of one-year loans of financial institutions do not affect the Shanghai Composite Index. Changes in the Shanghai Composite Index will affect the one-year benchmark lending rates, the previous period of the Shanghai Composite Index will lead one-year benchmark lending rates to rise, the first two period increase will cause a decline. In theory, declines in one-year lending rates of financial institutions will result in an increase in corporate investment, resulting in an increase in corporate profits and the

value of corporate shares, which will result in a rise in the stock price and an increase in the Shanghai Composite Index. However, the empirical result is that the level of one-year lending rates do not affect the Shanghai Composite Index. This also shows that China's monetary policy does not have a proper channel of transmission to the stock market and there is little connection between Chinese capital market and the monetary market. Since the benchmark lending rate of China is the official interest rate before interest rate liberalization finished and the change of Shanghai Composite Index arouses the adjustment of the benchmark interest rate, which means to a certain extent that the Chinese monetary authorities are concerned about and act on the stock market.

Fourthly, the changes in interbank interest rates do not affect the Shanghai Composite Index. Changes in the Shanghai Composite Index will significantly affect interbank lending rates. The rise of the former period of Shanghai Composite Index will cause the interbank lending rate to fall. The rise of the first two periods of the Shanghai Composite Index will cause the interbank lending rate to rise. The one-way causal relationship from Shanghai Composite Index to the interbank offered rates shows that there is a linkage between the Chinese capital market and the monetary market. According to Tobin's q theory, rising share prices will result in increased corporate investment, which in turn will result in higher interest rates. The effect of the previous two period change in the Shanghai Composite Index are same with the theory, which also proved the existence of the lag effect of transmission channels from the stock market to monetary market.

5. Suggestions

From the above analysis, it can be seen that the adjustment of the money supply (both in M1 and M2 levels) will have a significant impact on the stock market, but the fluctuation in the stock market has less impact on the money supply. Interest rate adjustments, whether the one-year benchmark lending rates of financial institutions or the inter-bank lending rate adjustments have no effect on the stock market, but the stock market ups and downs have an impact on the interest rate. Based on this, this article makes the following policy recommendations:

Firstly, China's transmission channel between the monetary market and the stock market exists but is not yet complete and has a long time lag. The monetary authorities should not include the adjustment of the stock market within the scope of monetary policy adjustment.

Secondly, as the drastic changes in the capital market will have a great impact on the real economy and affect the normal operation of the national economy. When the monetary authorities must take measures to intervene the capital market, it is suggested that the monetary supply policy is more effective.

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