Sun Wei[1], Xie Qichao[2]

IMPACT OF MONETARY POLICY ON STOCK MARKET IN CHINA[3]

This study aims to analyze the impact of Chinese monetary policy on the stock market by establishing the error correction model which includes money supply, interest rate and stock price index. In this paper, we use the quarterly data during 2000-2010, using M1 and M2 respectively as indicators of money supply, choosing trading volume weighted 7 days interbank offered rate as the indicator of interest rate, and selecting Shanghai composite index as the indicator of stock price index. After the ADF, Granger causality and Johansen cointegration test, the paper establishes the error correction model and portrays the dynamic process by pulse analysis and variance decomposition. The research shows that stock price index has the long-term stable relationship with money supply and interest rate; the narrow money supply and the interest rate is the Granger cause of stock price change; transmission lag of money supply is about half a year.

Keywords: *monetary policy; stock market; error correction model; cointegration test; pulse analysis; variance decomposition; Granger causality test.*

JEL: *C58, E52, G18.*

Сунь Вей, Се Цичао

ВПЛИВ ГРОШОВО-КРЕДИТНОЇ ПОЛІТИКИ НА ФОНДОВИЙ РИНОК КИТАЮ

У статті проаналізовано вплив китайської монетарної політики на фондовий ринок. Побудовано модель корекції помилок, яка включає грошову масу, процентні ставки та індекси фондових цін. Використано квартальні дані за 2000-2010 рр., включаючи дані M1 і M2 як показники грошової маси, об'єм торгів по міжбанківській ставці як індикатор процентної ставки і Шанхайський складений індекс як індикатор індексу фондових цін. Здійснено аналіз за методом Діки-Фуллера, Грейнджера на причинність і Йохансена на коінтеграцію, побудовано модель корекції помилок і змодельовано динамічний процес шляхом аналізу імпульсу і розкладання дисперсії. Показано, що індекс фондових цін демонструє довгострокову стабільну залежність з грошовою масою і процентною ставкою; вузький показник грошової маси і процентна ставка впливають на зміни фондових цін по Грейнджеру; часовий лаг впливу макроекономічних показників складає в середньому півроку.

Ключові слова: *грошово-кредитна політика; фондовий ринок; модель корекції помилок; тест на коінтеграцію; імпульсний аналіз; розкладання дисперсії; тест на причинність за Грейнджером.*

Таб. 5. Фор. 2. Літ. 10.

Сунь Вэй, Се Цичао

ВЛИЯНИЕ ДЕНЕЖНО-КРЕДИТНОЙ ПОЛИТИКИ НА ФОНДОВЫЙ РЫНОК КИТАЯ

В статье проанализировано влияние китайской монетарной политики на фондовый рынок. Построена модель коррекции ошибок, которая включает в себя денежную массу,

[1] Doctor of Management Science, Professor, School of Economics & Management, Harbin Engineering University, China.
[2] Graduate Student, School of Economics & Management, Harbin Engineering University, China.
[3] Supported by the Youth Foundation for Humanities and Social Sciences of Ministry of Education of China (Grant No. 12YJC790168).

процентные ставки и индексы фондовых цен. Использованы квартальные данные за 2000-2010 гг., включая данные M1 и M2 в качестве показателей денежной массы, объем торгов по межбанковской ставке как индикатор процентной ставки и Шанхайский составной индекс как индикатор индекса фондовых цен. Проведен анализ по методу Дики-Фуллера, Грейнджера на причинность и Йохансена на коинтеграцию, построена модель коррекции ошибок и смоделирован динамический процесс путем анализа импульса и разложения дисперсии. Показано, что индекс фондовых цен демонстрирует долгосрочную стабильную зависимость с денежной массой и процентной ставкой; узкий показатель денежной массы и процентная ставка влияют на изменения фондовых цен по Грейнджеру; временной лаг влияния макроэкономических показателей составляет в среднем полгода.

Ключевые слова: *денежно-кредитная политика; фондовый рынок; модель коррекции ошибок; тест на коинтеграцию; импульсный анализ; разложение дисперсии; тест на причинность по Грейнджеру.*

Introduction. Prudent monetary policy with Chinese characteristics has been gradually formed since 1998. Its ultimate goal is to keep the stability of the currency and thereby promote economic growth. Stability of the currency should include both the real economy and the virtual asset price stability. In other words, in the formulation and implementation of monetary policy, it should concern the impact on the stock market. This paper will analyze this empirically.

Homa and Jaffee (1971) studied the linear relationship between money supply and stock price and thought that money supply had a significant impact on stock price. Jensen and Johnson (1995) deviated from previous discount rate change studies by examining long-term market performance following discount rate changes, they found that stock returns following discount rate decreases were higher and less volatile than returns following rate increases. Thorbecke (1997) used innovations in monthly federal funds rate and non-borrowed reserves to capture the effects of monetary shocks on industry level returns over the period 1967 to 1990. Lastrapes (1998) found that monetary policy had an impact on stock price. Rigobon and Sack (2004) used daily data on stock returns and federal funds interest rates to measure the effect of monetary policy shocks on equity returns, and discovered that monetary policy (interest rates) had the reverse effect on the stock price index. Ehrmann and Fratzscher (2005) presented evidence that individual stocks reacted in a highly heterogeneous fashion to the US monetary policy shocks by analyzing the effects of the US monetary policy on stock markets. Bohl, Siklos and Sondermann (2008) analyzed the reaction of European stock market returns to unexpected interest rate decisions by the European Central Bank (ECB) and found a negative and significant relation between unexpected ECB decisions and European stock market performance. Bjornland and Leitemo (2009) estimated the interdependence between the US monetary policy and the S&P 500 and found great interdependence between the interest rate setting and real stock prices. The study of Kholodilin et al. (2009) showed that the ECB's monetary policy had a heterogeneous impact on the sectoral stock market indexes in the Euro area. Syed (2011) investigated the return and volatility response of major European and US equity indices to monetary policy surprises and found that the monetary policy decisions generally exerted immediate and significant influence on stock index returns and volatilities.

Methodology and Data. According to the literature review, we determine the impact of monetary policy on the stock market research path as Fig.1 shows.

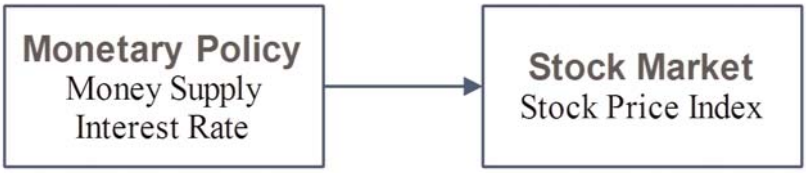

Figure 1. **Path of the Impact of Monetary Policy on Stock Market**

Based on the literature review and combined with general monetary policy, this paper studies the impact of monetary policy on stock market starting with money supply and interest rate, establishes an error correction model which includes money supply, interest rate and stock price index and portrays the dynamic process by pulse analysis and variance decomposition.

Both narrow money supply M1 and broad money supply M2 can affect the capital of the stock market, so it uses M1 and M2 respectively as indicators of money supply in the research model of the paper. In this paper, we choose trading volume weighted 7 days interbank interest rate, as it is a higher marketization indicator and can reflect capital supply and demand market conditions. We select Shanghai composite index as the indicator of stock price index.

In order to eliminate heteroscedasticity, we take the logarithm of the above variables and they are separately written as lnINDEX, lnM1, lnM2 and lnR. Using DRCNet, China Stock Market & Accounting Research Database (CSMAR), official website of the People's Bank of China and National Bureau of Statistics of China as our data source, we select 44 groups of the quarterly data during 2000-2010 and use Eviews 6 software for data processing.

Empirical Results.

1. ADF Test. In order to avoid spurious regression and ensure that each time-series variable can conduct cointegration analysis, we have to make sure they are smooth sequence or smooth sequence of the same order. So we need to have ADF test. The results of test are shown in Table 1.

Table 1. **Results of ADF Test**

Variable	Test Form (C,T,N)	ADF Value	5% Critical Value	Conclusion
lnM1	(C,T,1)	-1.591840	-3.520786	Not smooth
DlnM1	(C,T,0)	-10.096965	-2.933158	Smooth
lnM2	(C,T,5)	-0.475160	-3.536601	Not smooth
DlnM2	(C,T,4)	-3.136865	-2.943427	Smooth
lnINDEX	(C,0,0)	-2.498612	-2.931404	Not smooth
DlnINDEX	(C,0,0)	-8.149775	-2.933158	Smooth
lnR	(C,0,8)	-2.164470	-2.948404	Not smooth
DlnR	(C,0,9)	-3.866380	-2.954021	Smooth

Note: a. C, T, N are representing the constant term, time trend and the lag order.
b. DlnM2 express lnM2 sequence of the first-order difference sequence, as well as the remaining variables.
c. The lag order is determined by AIC or SC guidelines.

In Table 1 we find that all 4 time series (lnINDEX, lnM1, lnM2, lnR) are not smooth, but at the 5% significance level, their first-order difference all are smooth. Therefore, we can proceed with co-integration analysis.

2. Granger Causality Test. Granger causality test can help us understand whether one variable has a greater influence on another variable in the equations. As the first-order difference of lnINDEX, lnM1, lnM2 and lnR is smooth, we have Granger causality test on their first-order difference. According to AIC guidelines, we use 2 lag sequences to test. The results are shown in Table 2.

Table 2. **Results of Granger Causality Test**

Lags = 2	*F* Value	*P* Value	Conclusion
M1 isn't the reason for stock price index change	2.45884	0.09721	Refuse
M2 isn't the reason for stock price index change	0.44349	0.64463	Accept
Interest rate isn't the reason for stock price index change	4.23046	0.02087	Refuse

In Table 2 we find that narrow money supply (M1) and interest rate are the Grainger cause for stock price index change. But broad money supply (M2) isn't.

3. Johansen Cointegration Test and Error Correction Model. In order to determine the cointegration relationship between the variables, we need to conduct a Johansen cointegration test. According to AIC, SC guidelines, we select 4 lag order. As taking time trends into consideration in ADF test, this test no longer contains a time trend and intercept. The results of the test are shown in Table 3.

Table 3. **Test Results of lnINDEX, ln M1 and lnR**

Eigenvalue	Likelihood Ratio	5% Critical Value	1% Critical Value	Hypothesized No. of CE(s)
0.392618	36.12450	24.31	29.75	None**
0.148493	12.69044	12.53	16.31	At most 1*
0.103505	5.135320	3.84	6.51	At most 2*

Note: *, ** denote significance at the 5% and 1% levels.

From Table 3 we know that it has long-term stable cointegration relationship between lnINDEX, lnM1 and lnR. Taking the equations which contain all the variables, its standard cointegration coefficients are shown in Table 4.

Table 4. **Standard Cointegration Coefficients of lnINDEX,ln M1 and lnR**

LNINDEX	LNM1	LNR
1.000000	-0.561593 (0.05317)	0.972267 (0.47858)
Log-likelihood Ratio	197.3378	

Then, we get a long-term stable cointegration equation:

$$VECM = \ln INDEX - 0.5616 \ln M1 + 0.9723 \ln R + \varepsilon \qquad (1)$$

From (1) we know that stock price index has stable relationship with narrow money supply and interest rate in the long term, in which the stock price index has positive relationship with M1, while having negative relationship with interest rate.

Error correction model can reflect the impact of changes of money supply and interest rate on stock price index in the short term. After doing difference, each variable is first-order stable series and it can avoid multicollinearity problem at the same time. So we make the first-order difference of each cointegration relationship vari-

able. Then according to the principle of dynamic modeling from general to special, we begin to delete non-significant variables from 4 lag order model. At last, we get the following error correction model of M1:

$$\begin{aligned} D(\ln INDEX) = &-0.0458[VECM(-1)] + 0.2770D[\ln INDEX(-1)] \\ &+ 0.2530D[\ln INDEX(-2)] + 0.2438D[\ln INDEX(-3)] \\ &+ 1.9907D[\ln M1(-2)] + 0.3430D[\ln R(-1)] \\ &- 0.3688D[\ln R(-2)] - 0.2939D[\ln R(-3)] \end{aligned} \quad (2)$$

of which,

$$VECM(-1) = \ln INDEX(-1) - 0.5616\ln M1(-1) + 0.9723\ln R(-1)$$

From (2) we find there is a reverse adjustment process in VECM(-1) to D(lnINDEX) and the amendment of long-term over short-term stock price index is about 4.6%. In the short term, D(lnM1) of 2 lag order has a more significant impact on D(lnINDEX), which illustrates that change of money supply can transmit to the stock market more fully after half a year (2 seasons). Interest rate of 1 to 3 lag order all have a more significant impact on D(lnINDEX), which describes that change of interest rate can affect the stock market during 3 seasons.

4. Impulse Response Analysis. We conduct the pulse response analysis of lnINDEX to lnM1 and lnR in order to describe the dynamic response of stock price index to the money supply and interest rate. The results are shown in Fig.2.

From Figure 2 we know that stock price index basically has no reaction on money supply M1 in the previous two quarters, after that the impact of money supply begin to appear. Stock price index will rise gradually as the rise in money supply reach its peak around the 7th quarter, and gradually declines following the impact of money supply. It matches the conclusion of error correction model that change of money supply can transmit to the stock market more fully after half a year.

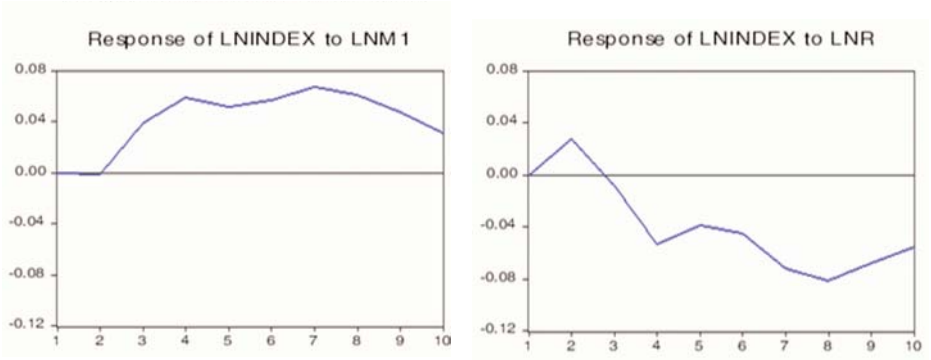

Figure 2. **Response of lnINDEX to lnM1 and lnR**

When interest rate changes with a positive standard deviation, it will have a positive impact on the stock market in the previous 2 quarters. To some extent, that reflects that transmission of interest rate changes to the stock market is still not very smooth. After the previous 2 quarters, tightening the monetary policy by the authorities begins to show effects that corporate financing costs rise, profits fall, macroeco-

nomic begin to cool, and stock price index begin to decline. The effect peak in the 8th quarter (similar to the effect of money supply) and then effect of interest rate shocks gradually become weak.

5. Variance Decomposition. Variance decomposition can take the contribution of various factors to dependent variable into consideration at different times. This paper uses this method to examine the contribution of money supply and interest rate to the stock price index. The results are shown in Table 5.

Table 5. **Variance Decomposition of lnINDEX**

Period	S.E.	LNINDEX	LNM1	LNR
1	0.122638	100.0000	0.000000	0.000000
2	0.203959	98.14027	0.001380	1.858317
3	0.274720	96.84540	2.037781	1.116824
4	0.366030	93.43417	3.778872	2.786954
5	0.440618	93.29512	4.016913	2.687963
6	0.506419	92.88246	4.300707	2.816830
7	0.562153	91.16801	4.922247	3.909742
8	0.603313	89.49196	5.308978	5.199062
9	0.637486	88.89646	5.305809	5.797735
10	0.663110	88.81497	5.125875	6.059150

In Table 5 we can see that the biggest factor affecting the stock price index is still its own endogenous factor (such as expected factor, psychological factor and so on), the proportion of which has been more than 85%, but this trend gradually reduces over time. The impact of money supply and interest rate on the stock price index is not obvious in the short term, but it gets bigger as time goes on. The result shows that the stock market itself determines its trend.

Conclusion. Summing up the above empirical analysis, we can draw the following conclusions:

1) Stock price index has long-term stable relationship with money supply and interest rate. Although money supply and interest rate can't achieve the desired results at early stage of money policy implementation, in the long run they are consistent with the theoretical analysis that stock price index has a positive relationship with money supply, as the increase in money will cause a rise in the stock price index; and that it has a reverse relationship with interest rate, as the increase in interest rate will cause stock market index down in the long run.

a) As Granger causality test results shows, narrow money supply M1 and interest rate are proved to be the reason of stock price index change, which further prove that tools of monetary policy are able to affect the stock market; however, broad money supply M2 are not the reason of stock price index change, the main reason of which is that funds causing stock price index movements mainly are from resident sector instead of corporate sector, so stock price index has more correlation with cash and quasi-cash and has less correlation with quasi-currency.

3) Transmission lag of money supply is about half a year, which has some reference for making monetary policy to Chinese monetary authorities. As the block of interest rate transmission mechanism and strong speculative atmosphere, the case that investors are still increasing investment and even speculation on the stock market when monetary authorities decide to raise interest rate, is still happening in our

stock market. Investors fail to understand the warning meaning earlier and change the investment strategy in time, which make impulse response of interest rate to stock price index be positive. During the upsurge of scalping in stocks in 2007, this phenomenon occurred frequently, which causes that many investors are still trapped now.

Acknowledgements. *This study is supported by the Youth Foundation for Humanities and Social Sciences of Ministry of Education of China (Grant No. 12YJC790168).*

References:

1. *Homa, K.E. and Jaffee, D.M.* (1971). The Supply of Money and Common Stock Prices, Journal of Finance 26, 1046-1066.

2. *Jensen, G.R. and Johnson, R.R.* (1995). Discount Rate Changes and Security Returns in the U.S., 1962-1991, Journal of Banking and Finance 19, 79-95.

3. *Thorbecke, W.* (1997). On Stock Market Returns and Monetary Policy, Journal of Finance 52, 635-654.

4. *Lastrapes, W. D.* (1998). International Evidence on Equity Prices, Interest Rates and Money, Journal of International Money and Finance 17, 377-406.

5. *Rigobon, R. and Sack, B.P.* (2004). The Impact of Monetary Policy on Asset Prices, Journal of Monetary Economics, 51, 1553-1575.

6. *Ehrmann, M. and Fratzscher, M.* (2005). Equal Size, Equal Role? Interest Rate Interdependence Between the Euro Area and the United States, Economic Journal, 115, 928-948.

7. *Bohl, M.T., Siklos, P.L., and Sondermann, D.* (2008). European Stock Markets and the ECB's monetary Policy Surprises, International Finance 11, 117-130.

8. *Bjornland, H.C. and Leitemo, K.* (2009). Identifying the Interdependence between US Monetary Policy and the Stock Market, Journal of Monetary Economics, 56, 275-282.

9. *Kholodilin, K., Montagnoli, A., Napolitano, O., and Siliversotvs, B.* (2009). Assessing the Impact of the ECB's Monetary Policy on the Stock Markets: a Sectoral View, Economics Letters, 105, 211-213.

10. *Syed, M.H.* (2011). Simultaneous Monetary Policy Announcements and International Stock Markets Response: an Intraday Analysis, Journal of Banking & Finance, 35, 752-764.

Стаття надійшла до редакції 30.09.2012.