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Study on the Dual Asymmetric Effect of Monetary Policy Shocks: Empirical Test Based on China's Stock and Bond Market

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Abstract
The research on dual asymmetric effects of monetary policy shock has important practical significance for laying down capital market regulation monetary policy. This paper uses two-step OLS method to empirically test the dual asymmetric effects of monetary policy shock on stock and bond markets. The test results show that the expansionary and tight monetary policy shocks on the stock and bond markets have dual asymmetric effects; the expansionary and tight monetary policy shocks have dual asymmetric effects during the rise and fall periods. Therefore, when laying down capital market regulation and control policies, government needs to consider the dual asymmetric effects of monetary policy shock, and adopts appropriate monetary policies.

Key words: Monetary policy shocks; Dual asymmetric effects; Two-step OLS method; Empirical test

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INTRODUCTION

More and more scholars begin to focus on the effects of monetary policy shocks on capital markets, including the effects of expansionary and tight monetary policy shocks on the same market and on different markets. This has a profound theoretical basis and practical background: theory is based on economists' deepening understanding the role of the monetary transmission mechanism on the capital market; the reality background is that when the Central Bank implements the expansionary or tight monetary policy, the capital markets react strongly to the implementation of monetary policy. Therefore, studying the asymmetric effects of monetary policy shocks can profoundly understand monetary policy transmission mechanism on the capital market, and provide a useful reference for the government's policy making about capital markets.

A large number of foreign scholars have extensively studied the effects of monetary policy shocks. Early research focused on the existence of monetary policy shocks on the stock market (see Thorbecke (1997)[1], Miyao (2000)[2], Gilchris and Leahy (2002)[3], Bomfim (2003)[4] etc.). Chen (2007)[5] used the general money supply growth and the federal funds rate and other variables to measure the monetary policy, and used Markov-switching models to examine whether monetary policy had asymmetric effects on the U.S. S & P500 index returns. Their empirical results showed that in bear market period, the monetary policy would have a greater effect on stock return; while tight monetary policy would lead to a higher probability of the bear-market regime. Using latent VAR model, Bordo, Dueker and Wheelock (2008)[6] tested the connection of U.S. monetary policy and stock market in mid 20th century, and studied how the macro economy and monetary policies affected market conditions. The results showed that the money supply shocks had a strong impact on the stock market conditions, and the central bank monetary policy could reduce the unexpected volatility of the market. Gregoriou et al (2009)[7] examined the expected and unexpected monetary policy shocks on UK stock return. The time series analysis and panel analysis indicated that the relationship between stock return and monetary policy existed structure breakpoint, and the shocks of monetary policy changes on stock return were more evident at the structure breakpoint. With the change of investors sentiment, Kurov (2010)[8] analyzed the reaction of stock market to monetary policy change, and found that the different investors sentiment in the bull and bear market led to monetary policy during the bear market having a greater impact on stock market.

Chinese scholars also have done some beneficial researches on the effect of monetary policy shocks. Cui Chang (2007)[9] used SVAR model to identify dynamic shocks of different monetary policy tools and analyzed the reaction of asset price in expansionary period and downturn period to monetary policy shocks. The empirical results showed that monetary policy had validity for the stock price. In price inflation period, interest rates can be used to regulate the stock market, and in price bubble period, the tightening of money supply could receive immediate results. Using cointegration theory, Li Xing and Chen Leyi (2009)[10] tested the impacts of monetary policy on the main variables in stock market. The testing results showed there was significant positive impact on the stock index. Based on GARCH model and diagonal BEKK model, from the perspective of money supply, Zhou Hui (2010)[11] empirically studied the dynamics of stock market, money supply and economic growth dynamics. They found that there were significant characteristics of time-varying variance and volatility persistence between the Shanghai Index and the money supply; the central bank can indirectly regulate the stock market because of the effects of monetary policy on economic growth.

From the above research scholars, the existing researches on the effects of monetary policy shocks have focused on the effects of monetary policy shocks on the stock markets. While the effects of monetary policy shock on the bond markets are paid less attention. Also there is lack of simultaneously testing the effects of monetary policy shock on different capital markets under one same study framework. Meanwhile, the dual asymmetric effect of monetary policy shock has not been seriously received attention. On the basis of the above literatures, this paper will test the dual asymmetric effect of monetary policy shock in stock and bond markets.

This paper is structured as follows: The second part is the statistical observation of dual asymmetric effects of monetary policy shock. We intuitively analyze asymmetric effects of monetary policy shock by statistical data and graphics; the third part is empirically test on the dual asymmetric effects of monetary policy. Firstly, we separate positive and negative monetary policy shocks. Secondly, we test the dual asymmetric effects of monetary policy shock in stock and bond markets. Lastly, we further examine the dual asymmetric effects of monetary policy shock under different market conditions; the fourth part is conclusions.

1. STATISTICAL OBSERVATIONS OF DUAL ASYMMETRIC EFFECTS OF MONETARY POLICY SHOCK

This paper firstly investigates dual asymmetric effects of monetary policy shock by statistical observations in order to intuitively analyze different effects of monetary policy shock in stock and bond markets.

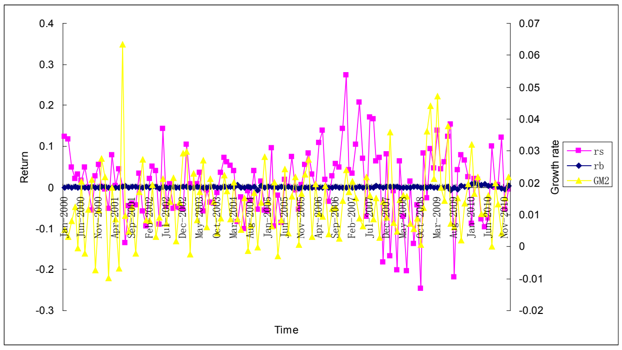

Figure 1
Dual Asymmetric Effects of Monetary Policy Shock

From Figure1, we can see that there are dual asymmetric effects of monetary policy shock in stock and bond markets: With the change in money supply growth, the rise and fall of stock and bond markets show no synchronization. Monetary policy in stock and bond markets has different degrees of impact. The monetary policy shock in stock market is larger, while the monetary policy shock in bond market is smaller.

We divide money policy into expansionary and tight monetary policy to further investigate dual asymmetric effects of monetary policy shock in stock and bond markets. Table 1 and Figure 2 show dual asymmetric effects of tightening and expansionary monetary policy shock in stock and bond markets. From Table 1 and Figure 2, we can see that there are asymmetric effects of monetary policy shocks in different markets and under different market conditions, tightening and expansionary monetary policy shock in different markets is asymmetric.

Table 1
Asymmetric Effects of Tightening and Expansionary Monetary Policy Shock in Stock and Bond Markets

Year	Amplitude of stock return	Amplitude of bond return	Amplitude of M2
2000	0.0163	0.0051	0.0025
2001	-0.0597	-0.0020	-0.0003
2002	0.0050	0.0016	0.0020
2003	-0.0987	0.0083	0.0109
2004	-0.1180	0.0059	0.0200
2005	0.1152	-0.0048	0.0178
2006	0.1909	-0.0197	-0.0083
2007	0.0386	-0.0015	0.0093
2008	-0.1400	0.0132	-0.0105
2009	0.0677	0.0041	0.0095
2010	-0.0435	-0.0052	0.0134

Note: Amplitude = Current growth rate – previous growth rate

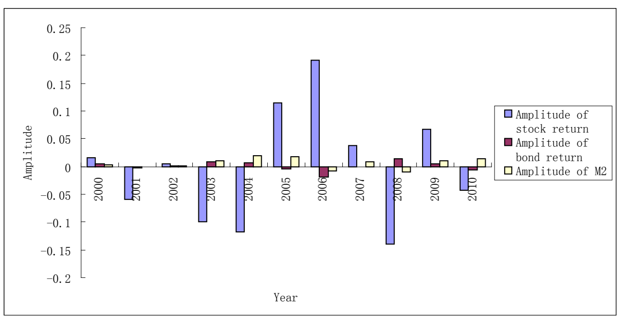

Figure 2
Asymmetric Effects of Tightening and Expansionary Monetary Policy Shock in Stock and Bond Markets

2. EMPIRICAL TESTS ON DUAL ASYMMETRIC EFFECTS OF MONETARY POLICY SHOCK

2.1 Data and Variable Selection

This paper selects monthly time-series data from January, 2000 to December, 2010, including the return of Shanghai Composite Index and the S & P CITIC Bond Index (rs, rb), the stock market and bond market order flow (OFs, OFb), generalized money supply (M2), consumer price index (P), exports (EX) and the national real output (Y). Stock market and bond market order flow, the general money supply, consumer price index, export and national real output are taking the natural logarithm. We select the return of Shanghai Composite Index to measure the movement of the stock market, and select the return of S & P CITIC Bond Index to measure the movement of bond market. The reason for selecting S & P CITIC Bond Index is based on the following considerations: firstly, S & P CITIC Bond Index chose the actively trading bonds as a sample species, which can sensitively, comprehensively and directly reflect the market's movement; secondly, S & P CITIC Bond Index is release earlier than Shanghai Composite Bond Index and so on. Therefore, it includes more samples. The empirical data is from the CCER economic and financial research database.

2.2 Stationary Test

This paper uses the most commonly used augmented Dickey - Fuller test (ADF) to test the stationary of the variables. Test results are presented in Table 2. The test results show that the return of Shanghai Composite Index and S & P CITIC Bond Index is stationary time-series, while the stock market and bond market order flow, the general money supply, consumer price index, export and national real output are non-stationary time-series. However, their first differences are stationary.

Table 2
Stationary Test Results

Variable	Test type (c,t,p)	ADF Statistics	Significance level	Test conclusion
rs	(c,0,0)	-5.8652	0.0000	Stationary
Rb	(c,0,1)	-8.5329	0.0000	Stationary
OFs	(c,0,0)	6.1562	0.9128	Non-stationary
OFb	(c,0,0)	4.2682	0.7528	Non-stationary
ofs	(c,0,0)	-10.5583	0.0000	Stationary
ofb	(c,0,0)	-6.1022	0.0000	Stationary
m2	(c,0,2)	4.8542	0.8661	Non-stationary
gm2	(c,0,0)	-3.2618	0.0107	Stationary
p	(c,0,0)	3.1168	0.7216	Non-stationary
gp	(c,0,0)	-4.1688	0.0120	Stationary
ex	(c,0,0)	-1.2531	0.6257	Non-stationary
gex	(c,0,0)	-9.1337	0.0000	Stationary
y	(c,0,1)	-0.3291	0.2983	Non-stationary
gy	(c,0,0)	-8.2641	0.0000	Stationary

2.3 Empirical Models and Results Analysis

This paper uses the two-step OLS method to empirically test the dual asymmetric effects of monetary policy shock. The first step: we separate the positive and negative shocks of money supply, estimate money supply equation. So, we can get positive or negative shock of money supply series to describe the expansion and tightening of monetary policy shocks; the second step: According to the positive and negative shock of money supply, we estimate return equations of stock and bond markets, and analyze the effects of the positive and negative money supply shock on market return.

2.3.1 Estimate the Money Supply Shock

Applying the methods of Cover (1992)[12] and Chen Jianbin (2006)[13], we establish the following model to separate the positive and negative money supply shocks:

$$GM = c_0 + \sum_{i=1}^{p} \alpha_i GM_{t-i} + \sum_{k=1}^{q} \beta_i X_{t-k} + \varepsilon_t \quad (1)$$

Where, GM is the general money supply; X is the explanatory variable vector $\{GP, GEX, GY\}$, GP, GEX and GY are the inflation rate, export growth and national real output growth rate; p, q are lag order; ε_t is residual term; c_0 is constant. Residual term ε_t represents money supply shock. Positive residual term represents positive money supply shock (pos), on behalf of expansionary monetary policy. Negative residual term represents negative money supply shocks (neg), on behalf of tight monetary policy.

We estimate Model (1) and the results show in Table 3.

Table 3
The Estimation Results of Money Supply Shock

Variable	Model 1	Model 2	Model 3
c	0.0251***	0.0923*	0.0286**
GM(-1)	0.2180**	0.0537**	0.6327*
GM(-2)		-0.2551	-0.3954*
GM(-3)			0.6207
GP(-1)	-0.3304*	-0.3018	-0.3641
GP(-2)		-0.4019*	-0.4328*
GP(-3)			-0.3280
GEX(-1)	-0.1053*	-0.5217*	-0.4582*
GEX(-2)		-0.3821	-0.5009*
GEX(-3)			-0.4286
GY(-1)	0.3518**	0.4120*	0.2685**
GY(-2)		0.3855	0.4208
GY(-3)			0.2284
AdjR2	0.4911	0.3859	0.4282
AIC	-5.9124	-6.1205	-6.0851
SC	-6.0151	-6.2954	-6.1851
F-statistic	6.4527	5.3331	5.2156

Note: ***,** and * denote 1%, 5% and 10% significant level.

By analyzing parameters significance, goodness of fit, AIC and SC information criterion values and F-statistics of model 1, model 2 and model 3, we select residuals of Model 1 to calculate the money supply shock, as shown in Figure 3 below.

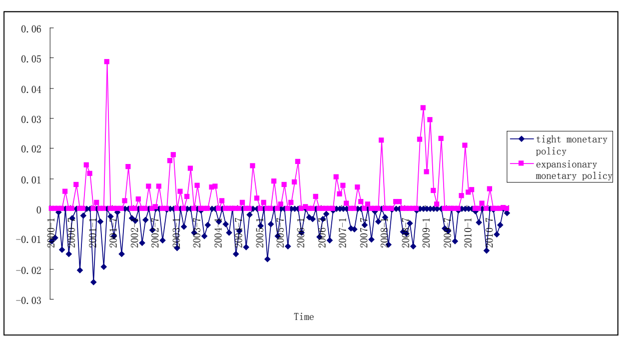

Figure 3
The Shock of Expansionary and Tight Policy

Figure 3 intuitively depicts the money supply shocks measuring the direction and size of expansionary and tight monetary policy.

2.3.2 Estimation of Dual Symmetric Effects of Monetary Policy Shock

Taking into account the lag of return and money supply shocks will affect the market return; we establish the following model testing the dual asymmetric effects of money supply shocks on the markets and the market reaction:

$$r_{jt} = c_{jt} + \sum_{i=1}^{m}\alpha_{ji} r_{jt-i} + \sum_{i=0}^{p}\theta_{ji} of_{jt-i} + \sum_{i=0}^{n}\beta_{ji} pos_{jt-i} + \sum_{i=0}^{n}\gamma_{ji} neg_{jt-i} + \mu_{jt} \quad (2)$$

Where, r_{jt} ($j = s, b$) represents stock and bond market return respectively; c_{jt} is constant; α_j, θ_j, β_j, γ_j, are coefficients of explanatory variables.

β_j and γ_j represent coefficients of money supply shocks that can capture the size of monetary policy shocks on market return. $\sum_{i=0}^{n}\beta_{ji} \neq 0$ represents that expansionary monetary policy have a shock on return, or that expansionary monetary policy does not have a shock; $\sum_{i=0}^{n}\gamma_{ji} \neq 0$ represents tight monetary policy have a shock on return, or that tight monetary policy does not have a shock. $\sum_{i=0}^{n}\beta_{ji} \neq \sum_{i=0}^{n}\gamma_{ji}$ means that there are asymmetric effects of expansionary monetary policy and tight monetary policy shock on return. $\left|\sum_{i=0}^{n}\beta_{ji}\right| < \left|\sum_{i=0}^{n}\gamma_{ji}\right|$ means that tight monetary policy shock is stronger than expansionary monetary policy. We build Wald statistic for testing. The test results of dual asymmetric effects of monetary policy shock are shown in Table 4.

Table 4
The Estimation Results of Dual Asymmetric Effects

Variable	Model 1		Model 2		Model 3	
	rs	rb	rs	rb	rs	rb
C	0.0398**	0.0992	0.9651**	0.0853	0.1520*	-0.1192
rj(-1)	0.2014***	0.2150*	0.4512***	0.2549*	0.1082*	0.6328**
ofj(t)	0.1028***	0.0591**	0.08517*	0.0721*	0.0152**	0.1025
ofj(-1)	0.2219*	0.0094	0.0066*	0.3351	0.1805*	0.0337*
pos(t)	0.4526 **	0.3588	0.8576*	0.2018	0.4018**	0.2846
pos(-1)	0.1193*	-0.2584	0.4843**	-0.0506*	0.5592*	0.2647
pos(-2)			-0.9515*	-0.1273	-0.2020*	-0.0254

To be continued

Continued

Variable	Model 1		Model 2		Model 3	
	rs	rb	rs	rb	rs	rb
pos(-3)					0.2352	0.3637
neg(t)	-0.4582**	-0.5219*	-0.6451*	-0.2894**	-0.8271*	-0.4508*
neg(-1)	-0.2281	-0.1159	-0.3371*	-0.6113*	-0.6805	-0.6084*
neg(-2)			-0.5715	-0.4705	-0.3058	-0.2982
neg(-3)					-0.0281	-0.2208
AdjR2	0.3695	0.4952	0.4018	0.5042	0.4118	0.4827
AIC	-3.5210	-5.2951	-3.5629	-4.6509	-3.2055	-5.4190
SC	-3.3581	-5.1207	-3.3234	-4.4028	-3.1274	-5.1847
F-statistic	11.0521	9.0255	10.2580	9.5410	10.0584	8.9529
$\sum(pos_j)$	0.5719	-0.6378	0.3904	0.0239	0.9942	0.8876
$\sum(neg_j)$	-0.6863	-0.6378	-1.5537	-1.3712	-1.8415	-1.5782
Hyposesis H0						
$pos_j = neg_j$	4.2699** (0.0328)	2.0185 (0.1521)	4.4581* (0.0613)	5.4526* (0.0547)	7.3191*** (0.0090)	5.3744** (0.0392)
$pos_j = 0$	0.1528 (0.6285)	0.9514 (0.3102)	7.1524** (0.0228)	0.7522 (0.3357)	6.9816** (0.0485)	0.6471 (0.4583)
$neg_j = 0$	2.4156 (0.1352)	4.1285** (0.0394)	3.1254 (0.1098)	3.0124 (0.1280)	2.3543 (0.3842)	2.2187 (0.3512)
$\sum(pos_j) = 0$	3.1960* (0.0985)	3.3351* (0.0801)	12.8540*** (0.0074)	3.5483* (0.0901)	8.2650** (0.0086)	3.4218* (0.0905)
$\sum(neg_j) = 0$	3.6264** (0.0474)	5.2691** (0.0284)	3.6588** (0.0471)	2.0417* (0.1861)	15.2132*** (0.0037)	3.7258** (0.0427)
$\sum(pos_j) = \sum(neg_j)$	10.2889*** (0.0089)	7.3618** (0.0197)	28.3541*** (0.0001)	3.9562* (0.0791)	28.1564*** (0.0004)	5.0284** (0.0306)

Note: The values in ( ) are standard deviation, ***, ** and * denote 1%, 5% and 10% significant level. (1) Under H0 hypothesis constraints doing Wald statistic test, Wald statistic approximately obey the Chi-square (q) distribution, q is the number of constraints. The first line is the value of Wald statistics in hypothesis test, and the values in parentheses the second line are the corresponding P-value.
(2) The null hypotheses of Wald test in turn are: the coefficients of positive and negative shocks are equal; positive shock coefficients are zero; negative shock coefficients are zero; the sum of positive shock coefficients are zero; the sum of negative shock coefficients are zero; positive and negative shock coefficient are equal.

The estimation results in Table 4, we can see that for the expansionary monetary policy shock, the reaction of the stock and bond markets is different. The reaction of the stock market is positive in current period, and the shock coefficients are statistically significant until the second lag period. This indicates that expansionary monetary policy shock in stock market lasts for a long time. While the shock coefficients of bond market are basically not statistically significant both in the current period and lag period, and the shock coefficients are small. For the tight monetary policy shocks, the reaction of the stock market is negative in current period, but not statistically significant. The reaction is significantly negative in the lag period. This indicates that tight monetary policy in the stock market has lagged effect; On the contrary, the reaction of bond market is negative in the current, and the shock coefficients are statistically significant. However, the shock coefficients in lag periods are mostly insignificant. This means that tight monetary policy on the bond market does not have a lag effect. At the same time, the shocks in expansionary monetary policy and tight monetary policy on the stock market and bond market have non-symmetric effects: expansionary monetary policy has a shock on the stock market, but does not have a shock on the bond market; tight monetary policy has a shock on the two markets. Furthermore, the expansionary and tight monetary policy exist asymmetric effects both in the stock and bond markets.

2.3.3 Estimation of Dual Symmetric Effects of Monetary Policy Shock Under Different Market Conditions

In order to study on dual symmetric effects of monetary policy shocks under different market conditions, we introduce market condition into the model establishment, and construct the following model to test the asymmetric effects of monetary policy in rise and fall periods:

$$r_{jt} = c_{jt} + \varphi_{jt} D_{jt} \times pos_{jt} + \phi_{jt} D_{jt} \times neg_{jt} + \sum_{i=0}^{p} \theta_{ji} of_{jt-i} + \sum_{i=0}^{n} \beta_{ji} pos_{jt-i} + \sum_{i=0}^{n} \gamma_{ji} neg_{jt-i} + \mu_{jt}$$

Where, D is dummy variable:

$$D_{jt} = \begin{cases} 1 & \text{if market j in fall period} \\ 0 & \text{if market j in rise period} \end{cases}$$

The interaction terms of D and pos, D and neg, describe the shocks of monetary policy on each market return under different market conditions. When φ and θ are not significant equal 0, it indicates that monetary policy has a shock on each market in the rise and fall periods. $\varphi > 0$ means that expansionary monetary policy shock is stronger during fall period than rise period. $\theta > 0$ means tight monetary policy shock is stronger during fall period than rise period.

Taking into account the lag length of the explanatory variables may affect the model estimation result, the paper estimates the explanatory variables' lag from 0 to 4. The estimation results are shown as below.

Table 5
The Estimation Results of Dual Asymmetric Effects of Monetary Policy Under Different Market Conditions

Lag length of monetary policy shock	0	1	2	3	4
$D_{s,t} \times pos_t$	-12.6005*** (0.0000)	-12.4696*** (0.0000)	-13.1165*** (0.0000)	-14.0105*** (0.0000)	-13.9791*** (0.0000)
$D_{s,t} \times neg_t$	16.5430*** (0.0000)	15.9118*** (0.0000)	16.3596*** (0.0000)	16.0968*** (0.0000)	16.8052*** (0.0000)
$D_{b,t} \times pos_t$	-0.8228** (0.0149)	-0.7840** (0.0247)	-0.7856** (0.0283)	-0.8115** (0.0344)	-0.8076** (0.0363)
$D_{b,t} \times neg_t$	1.3364*** (0.0011)	1.3131*** (0.0018)	1.2135*** (0.0047)	1.2022*** (0.0053)	1.2309*** (0.0041)

Note: The values in ( ) are corresponding P-values.

It can be seen from the estimation results that the parameter coefficients are all significant under the 10% significance level. So, monetary policy has an impact on each market during the rise and fall period. Monetary policy has a greater impact on stock market, and has a smaller impact on bond market. Furthermore, $\varphi < 0$ indicates that the expansionary monetary policy shocks are stronger during the rise period than the fall period. During the rise period, expansionary monetary policy stimulates the market prices to increase; $\theta > 0$ indicates that the tight monetary policy shocks are stronger during the fall period than the rise period. Therefore, during the fall period, tight monetary policy promotes the market to accelerate the decline. These results show that the expansionary and tight monetary policy shocks in the markets have dual asymmetric effects during the rise and fall period.

CONCLUSION

This paper empirically tests the dual asymmetric effects of monetary policy shock on stock and bond markets. The test results show that not only monetary policy has asymmetric effects in the direction, that is there are asymmetry effects between expansionary and tight monetary policy, but also there are asymmetry effects between different markets. By examining asymmetric effects of monetary policy shock under different market conditions, the results show that the expansionary and tight monetary policy shocks have asymmetric effects during the rise and fall period. Therefore, when government formulates monetary policy that regulates capital market, government needs to consider the asymmetric effects of monetary policy shock on stock and bond markets of during the rise and fall periods, and adopt different monetary policies during the rise and fall periods.

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