【論文】

Asymmetric Effects of Monetary Policy Shocks on Stock Markets:
An Empirical Test for China

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1 Introduction

It is well known that monetary policy shocks have negative impacts on stock markets. Most world scholars (Thorbecke (1997), Rigobon and Sack (2003), Basistha and Kurov (2008)) follow the wisdom of Bernanke and Blinder (1992) and have adopted interest rate (federal funds rate in the U.S.) changes as the primary monetary policy tool when conducting assessments of how monetary policy shocks impact the stock market. Bernanke and Kuttner (2005) found that a hypothetical, unanticipated 100-basis-point cut in the federal funds rate target would cause a 4% increase in the U.S. stock market. Honda and Kuroki (2006) conducted an analysis in a Japanese context that also suggested a significant negative relationship between interest rate shocks and stock market performance.

However, Chen (2007) innovatively demonstrates that monetary policy shocks do not always produce linear impacts on the U.S. stock market. Instead, shocks cause asymmetric effects on the stock market, with larger effects on stock returns in a bear market than in a bull market. In addition, Henry (2009) and Kurov (2010) reveal further results that prove the asymmetric effects of monetary policy shocks on stock markets in both the U.K. and the U.S. This new evidence is opposed with classical financial economics such as Fama (1965) who promulgates that the monetary policy produces asymmetric effects on the stock market.

Unfortunately, no systematic empirical analysis addressing China's stock market currently exists. In addition, much literature indicates that developed countries' experiences are not always applicable to the case of China[1], and thus, the effects of monetary policy on stock returns in China may differ greatly from the traditional responses observed in developed countries. Therefore, two questions arise regarding the relationship between monetary policy and stock market returns in China. One of these questions is whether monetary policy could negatively affect the Chinese stock market, and the other is whether monetary policy has similar asymmetric impacts on the

1 In section 2, we will introduce the differences between China and developed countries in detail.

stock market in China as it does in other nations. Addressing these questions is very important for both the Chinese government and investors.

We employ a two-step process to answer these questions. The first of these steps is to identify China's stock market regimes. We adopt a Markov Regime Switching model to distinguish between market regimes, as the Markov model is the most famous and widely used method for determining distinct categories that encompass various market scenarios (Hamilton (1989)). In accordance with traditional classifications, stock market performance in developed countries can generally be divided into Bull Market (higher mean, lower variance[2]) and Bear Market (lower mean, higher variance) conditions (Chen (2007) and Henry (2009)). However, China's market does not display this type of structure. In China, higher average variance of the market is typically correlated with the highest and lowest mean stock market returns. By contrast, a lower market variance corresponds to intermediate values of the mean return. Thus, we capture the specialized character of China's stock market by dividing this market into three regimes: Bull Market (highest mean, intermediate variance), Volatility Market (intermediate mean, lowest variance) and Bear Market (lowest mean, highest variance)[3]. We then classify time periods from 1997 to 2011 into these three regimes, a categorization that not only is useful for us but may also prove valuable to researchers investigating the asymmetric reactions of China's stock market to other economic indicators.

After dividing China's stock market into regimes, we move to the second stage of this study, which explains the specialized asymmetric effects of monetary policy shocks observed in the Chinese stock market. In this investigative phase, event study methodology (Bernanke and Kuttner (2005)) is applied. We find that monetary policy shocks do not have significantly negative impacts on the stock return either in the Bull Market regime or No-Market-Regime-Division data as a whole. However, a significant negative relation between monetary policy shocks and stock return does exist in both the Bear and Volatility Market regimes.

Overall, this paper's main contribution can be divided into two aspects, the first of which is the aforementioned division of China's stock market regimes. We explain that China's stock market should be divided into three regimes rather than two regimes. We also analyze the reasons underlying these regime divisions and demonstrate the differences between the Chinese and U.S. markets. This paper's findings regarding regime division provide indications that it would be incorrect to directly apply developed countries' stock market experiences to analyses of China's stock market.

Secondly, this paper finds that China's official interest rate shocks also produce asymmetric impacts on stock market return. However, these types of asymmetric effects are different from those observed in the U.S. or other developed countries. In the U.S., the asymmetric effects cause interest rate shocks to always negatively affect the market, but these effects are larger in the Bear Market than in the Bull Market. By contrast, in China, interest rate shocks do not always negatively

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2 The mean of the stock market is the average return of the stock market, and the variance of the stock market is always a measure of market risk.

3 The paper will explain this regime division for China in details in section 3.

affect the stock market; in particular, a negative relationship can only be confirmed in Bear Market and Volatility Market, whereas a nonnegative reaction occurs in the Bull Market. Therefore, the impact of interest rate shocks demonstrates more obvious asymmetries between Bull Markets and Bear or Volatility markets in China than in the U.S.

The remainder of the paper is structured as follows. Section 2 presents several characteristics of China's stock market, monetary policy and the data used in this study. Section 3 specifies the basic models of Markov Regime Switching and the identification of China's stock market regimes (Bull, Volatility, and Bear). Section 4 demonstrates asymmetric effects from China's monetary policy shocks on its stock market performance. Section 5 tests subsample data to establish the robustness of the study's conclusions. Section 6 extends this robustness check by controlling for firm- and industry-specific effects. Finally, the conclusions and policy implications are summarized in Section 7.

2 China's Stock Markets, Monetary Policy and Data

2.1 China's Stock Markets

China has two stock exchange markets, the Shanghai Stock Exchange Market and the Shenzhen Stock Exchange Market. The Shanghai Stock Exchange Market was established on November 26th, 1990, and opened on December 19th of the same year. The Shenzhen Stock Exchange Market was opened on July 3rd of the following year. As a result of the past twenty years of development, 949 companies are now listed on the Shanghai Stock Exchange Market, and 1378 companies are listed on the Shenzhen market. The market values of the Shanghai and Shenzen markets have reached 16.9 trillion and 8.4 trillion RMB, respectively.

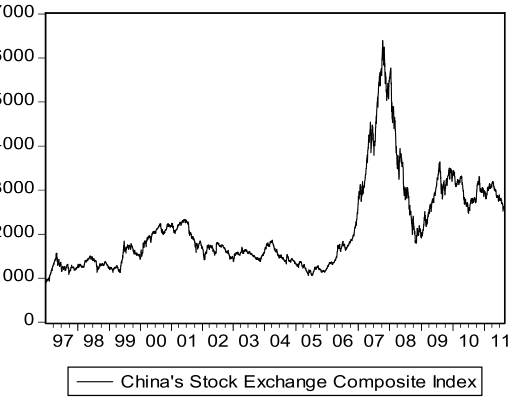
As China represents the world's largest emerging market, Chinese stock markets possess many specific characteristics and drawbacks. First, Laurence, Cai and Qiang (1997), Lee and Rui (2000) and Lee Chen, and Rui (2001) indicated that Chinese stock markets are weak-form efficient[4]. This weak-form efficiency likely results from information asymmetry (Long, Payne and Feng (1999)). In addition, Chen et al. (2010) argued that China's markets are difficult to predict and that only five firm-specific variables have been shown to be significant in Chinese markets. Lee and Rui (2001), Lee, Chen and Rui (2001) demonstrated that China's markets feature no relationship between risk and return. Overall, China's stock markets are large, inefficient, and almost unpredictable, differing in many ways from markets in the U.S. and other developed countries.

Although China has two stock exchange markets, investors and financial institutions generally devote greater attention to the Shanghai Stock Exchange Market index, largely because China's larger and more mature companies are almost exclusively listed on the Shanghai Stock Exchange Market, whereas small and medium-sized enterprises are listed on the Shenzhen Stock Exchange Market. As a result, the market value of Shanghai's market is also much larger than that of Shenzhen's market, with a ratio between the two values of nearly 2:1. Therefore, this paper primarily addresses the behavior of the Shanghai Stock Exchange

4 A weak-form efficient market generally implies that the stock market cannot reflect macroeconomic conditions.

Market. Fig. 1 describes the Shanghai Stock Exchange Composite Index. This figure makes it clear that China's stock market index does not show long-run growth character, however, it frequently demonstrates volatility levels that do not correlate with China's sustainable economic growth.

Fig. 1: China's Stock Exchange Composite Index

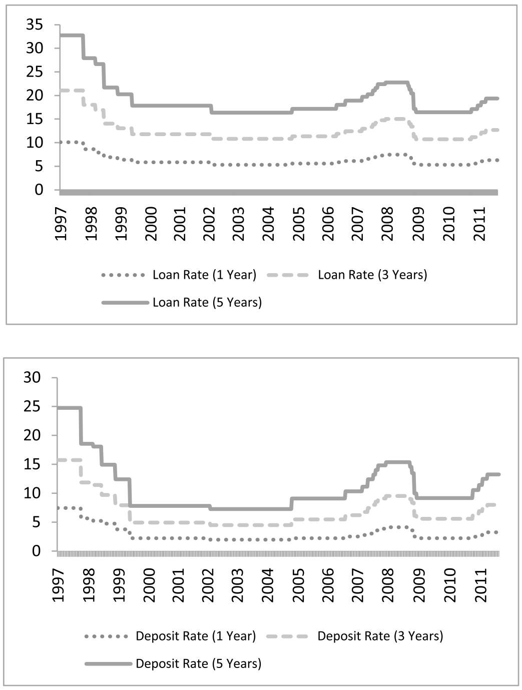


2.2 China's Monetary Policy

Under its highly planned economic system, China initially had no true central bank. However, this situation changed in 1984, when the People's Bank of China (PBC) became the central bank and started to play an important role in fine-tuning economic activities. Between 1984 and 1994, the main objectives of the PBC were to stimulate economic growth and to maintain stability in commodity prices. However, after the outbreak of three serious inflation events during this period, the PBC revised its policy goals in 1995 to make the control of inflation its major priority. This shift of the PBC's main objectives coincided with changes in China's main monetary policy instruments. Variations in interest rates have always been the monetary policy instruments in China. When beginning to implement economic reforms, China initially adopted a credit plan for bank lending as the primary monetary policy instrument. This situation continued until the PBC replaced the credit plan with the creation of a deposit reserve system that featured a required ratio for the refinancing of banks. Subsequently, the PBC began utilizing market methods to implement monetary policy, and open market operations have become one of the main monetary policy levers in China.

The PBC has long claimed that "The monetary policy instruments applied by the PBC include reserve requirement ratio, central bank base interest rate, rediscounting, central bank lending, open market operation and other policy instruments specified by the State Council". This paper follows traditional methods in considering interest rates to be the primary lever of monetary policy[5]. Among the various interest rates available, we choose China's official deposit and loan rates as

Fig. 2: Official Deposit Rate and Loan Rate Changes



indicative of monetary policy. Fig. 2 shows the deposit and loan rates for different maturity times.

2.3 Data

The paper utilizes Shanghai Stock Exchange Composite Index data, individual firms' stock return data, deposit rate data, loan rate data, firm-level data and industry-level data. The Markov Regime Switching model will use the Shanghai Stock Exchange Composite Index data and it is from January 2nd, 1997 to August 16th, 2011. In addition, individual firms' stock return data, deposit rate data, loan rate data, firm-level data and industry-level data are used in event study model. The full sample period of these data contains 1035 days from January 1st, 1997 to December 31st, 2010. Although the data used in Markov model has different length with the data used in event study model, it will not affect the empirical result. Because the Stock Exchange Composite Index data is just used to divide the market regimes, it is independent with the event study data.

Data regarding the Shanghai Stock Exchange Composite Index, individual firm stock returns, loan rates, and deposit rates are collected from the Wind Information Database. During the period investigated, the deposit rate changed 20 times and the loan rate changed on 22 occasions. The sample incorporates a total of 14486 observations.

The firm-level data indicate the Tobin's q ratio, cash flow to income ratio, price-earnings ratio, debt-to-total-capital ratio, and market value of each individual firm. The industry-level data differentiate between the industries of agriculture, mining, manufacturing, electricity, building, transport, IT, retail, finance, real estate, social service, and culture. The classification of industries is based upon the rules of the China Securities Regulatory Commission (CSRC). Both firm- and industry-level data are collected from the China Center for Economic Research (CCER) Database.

3 The Identification of China's Stock Market Regimes (Bull, Volatility, and Bear)

3.1 Methodology of Market Regime Divisions

The paper adopts the widely used Markov Regime Switching model to identify market regimes. Hamilton (1989) presented the Markov Regime Switching model to describe the changes in regime for time series data. The Markov Regime Switching model describes probabilistic inference in the form of a nonlinear iterative filter, and this filter, together with its smoothed filter probabilities, can be estimated by the maximum likelihood method. The Markov Regime Switching model of China's stock returns can be shown:

$$R_t = R_{S_t,t} = \mu_{S_t} + \epsilon_t, \quad \epsilon_t \sim \mathrm{i.i.d.}\ t\left(0, \sigma^2_{S_t}, K_{S_t}\right)$$

$$R_t = \frac{\mathrm{Index}_t - \mathrm{Index}_{t-1}}{\mathrm{Index}_{t-1}} \qquad (3.1)^{6}$$

where R_t denotes China's stock market return and S_t identifies different stock market regimes. In this paper, we assumed that

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5 Although the China's monetary policy does not merely indicate official interest rates, this paper only adopts the official interest rates, in accordance with Bernanke and Kuttner (2005). The effect of other monetary policy tools, such as changes in the monetary supply, will be tested using certain other empirical models (but not event study) in our future research papers.

6 The stock return in our paper is calculated using the equation "$R_t = \frac{\mathrm{Index}_t - \mathrm{Index}_{t-1}}{\mathrm{Index}_{t-1}}$", and its value is nearly equal to that given by "$R_t = \mathrm{Ln}(\mathrm{Index}_t) - \mathrm{Ln}(\mathrm{Index}_{t-1})$", which is used in several other papers.

$S_t = 1,2,3$ indicated the Bull Market, Volatility Market, and Bear Market regimes, respectively; in addition, μ_{S_t} and $\sigma^2_{S_t}$ represent the state-dependent mean and variance of $R_{S_t,t}$, respectively, whereas ϵ_t innovatively follows the student's t-distribution (Hamilton and Susmel (1994)). The model can thus be written separately:

$$R_{S_t=1,t} = \mu_1 + \epsilon_t, \quad \epsilon_t \sim \text{i.i.d. } t(0, \sigma_1^2, K_1),$$
$$S_t = 1 \text{ denotes Bull Market,} \tag{3.2}$$
$$R_{S_t=2,t} = \mu_2 + \epsilon_t, \quad \epsilon_t \sim \text{i.i.d. } t(0, \sigma_2^2, K_2),$$
$$S_t = 2 \text{ denotes Volatility Market,} \tag{3.3}$$
$$R_{S_t=3,t} = \mu_3 + \epsilon_t, \quad \epsilon_t \sim \text{i.i.d. } t(0, \sigma_3^2, K_3),$$
$$S_t = 3 \text{ denotes Bear Market,} \tag{3.4}$$

Additionally, China's stock returns have the following transition probability matrix:

$$P = \begin{bmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ P_{31} & P_{32} & P_{33} \end{bmatrix}, \tag{3.5}$$

where

$$P_{11} = P(S_t = 1|S_{t-1} = 1), P_{12} = P(S_t = 1|S_{t-1} = 2), P_{13} = P(S_t = 1|S_{t-1} = 3),$$
$$P_{21} = P(S_t = 2|S_{t-1} = 1), P_{22} = P(S_t = 2|S_{t-1} = 2), P_{23} = P(S_t = 2|S_{t-1} = 3),$$
$$P_{31} = P(S_t = 3|S_{t-1} = 1), P_{32} = P(S_t = 3|S_{t-1} = 2), P_{33} = P(S_t = 3|S_{t-1} = 3), \tag{3.6}$$

Based on Hamilton's calculation method, we can obtain the smoothed probability for each state:

$$P_1 = P(S_t = 1|R_t, R_{t-1}, R_{t-2}, \ldots\ldots) \quad \text{Bull Market Probability,}$$
$$P_2 = P(S_t = 2|R_t, R_{t-1}, R_{t-2}, \ldots\ldots) \quad \text{Volatility Market Probability,}$$
$$P_3 = P(S_t = 3|R_t, R_{t-1}, R_{t-2}, \ldots\ldots) \quad \text{Bear Market Probability,} \tag{3.7}$$

We then divide the market into regimes by comparing P_1, P_2 and P_3. For the initial regime, the division is simply determined by the value of smoothed probability. However, in the next several regimes, the state periods start at the equivalence point of two of the three probabilities and end at the next equivalence point for each probability. For example, if the first stage is considered to be a Bull Market, P_1 will be greater than P_2 and P_3 at this period. However, in the next regime, P_1 will no longer be greater, as P_1 will have decreased and one of the other probabilities will have increased. This equivalence point (where P_1 is equal to one of the other probabilities) is defined as the end of the Bull Market and the start of another regime. We will follow this rule to divide all periods into different regimes.

3.2 The Choice between Two and Three Market Regimes

Based on the Markov Regime Switching model (Hamilton (1989)), we construct Markov Regime Switching models for Chinese stock returns (equation (3.1) to (3.7)). When applying the Markov's models to Chinese data, we found that we should not divide China's stock market performance into two regimes, as is typically performed for markets in the U.S. or other developed countries. However, it is reasonable to divide China's stock market performance into three regimes. Fig. 3 describes the smoothed probabilities if we only divide Chinese market conditions into two regimes. These two smoothed probabilities cannot model China's real market situation well. For example, during the years between 2006 and 2009, the smoothed probabilities of regime two in Fig. 3 are much higher than the probabilities of the other regime, nearly reaching one at times. This high regime probability would indicate that the stock market remains in a similar state during this time interval. However, from Fig. 1, we can observe that the stock index first increased greatly and then decreased sharply between 2006 and 2009, belying the notion that its state was unchanged during this period. Thus, it is clear that considering the stock market from a two-regime perspective may not adequately model real economic data.

Fortunately, when we divide China's market into three regimes, we find that the three-regime division matches the real situation well. Fig. 4 describes the smoothed probabilities of this three-regime division. From Fig. 4, we can observe that the first smoothed probability (the first picture) is greatest during the periods when the stock market sharply increases and

Fig. 3: Smoothed Probabilities of Two-Regime-Division

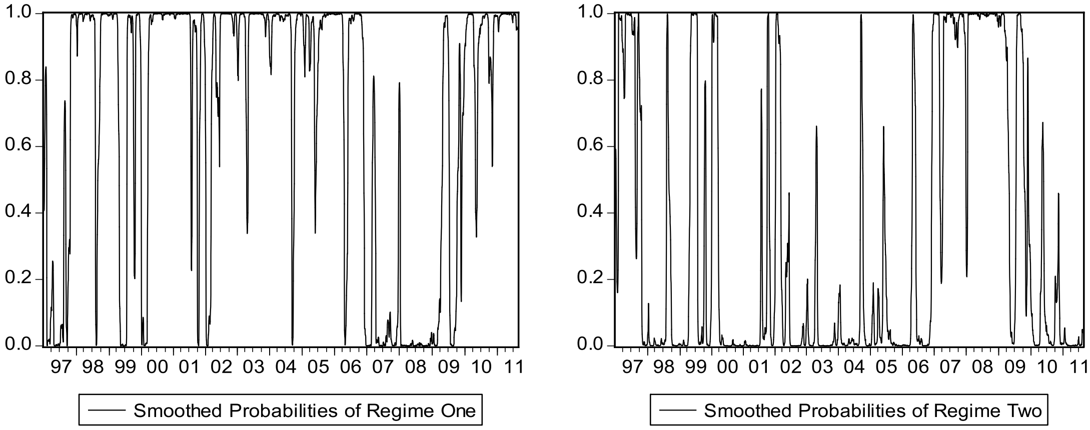
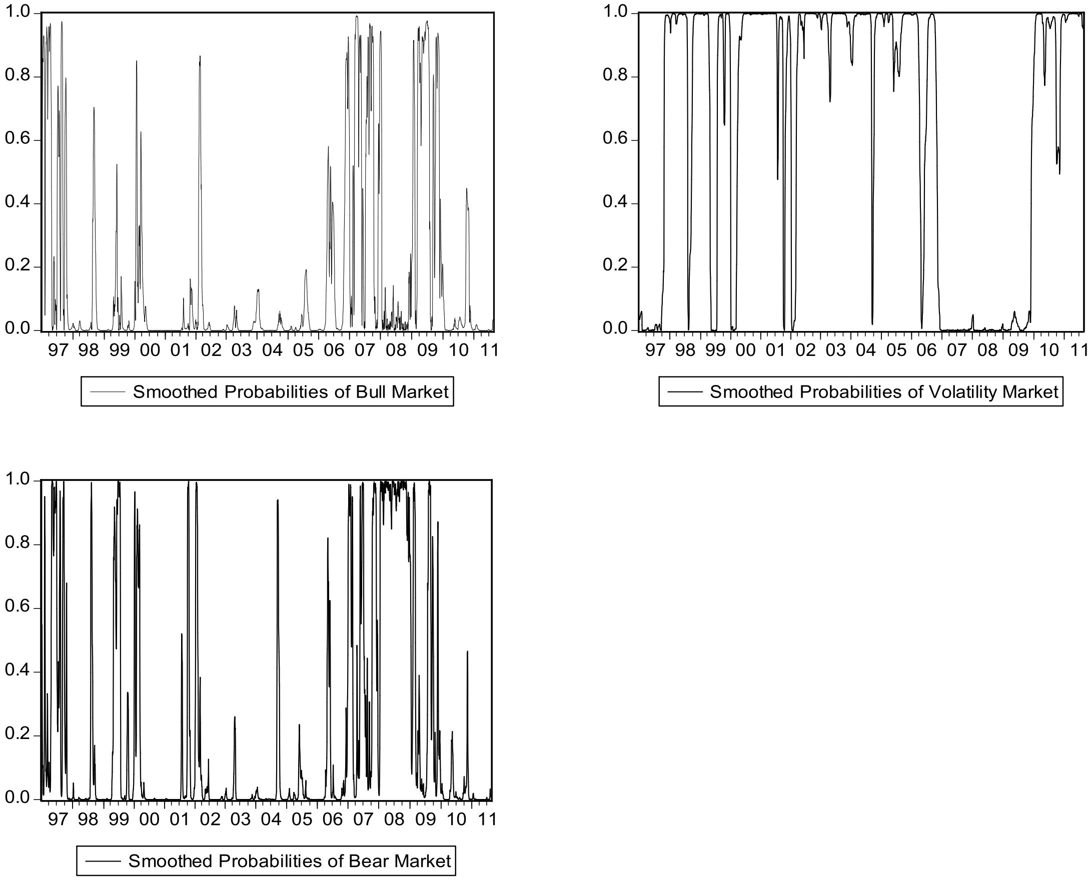


Fig. 4: Smoothed Probabilities of Three-Regime-Division



the third probability (the third picture) is greatest during the periods when the stock market sharply decreases. The second probability (the second picture) accurately depicts times when the stock market moves up and down. Therefore, it appears reasonable to divide China's stock market into three regimes.

3.3 Why China's Stock Market Does Not Show the U.S.'s Two-Regime Character

When applying the Markov models to China's data, we found that Chinese market structure differs greatly from the market structure found in the U.S. To explain China's regime divisions, we compare China's market regimes with the U.S. market regimes. Table 1 depicts the results of this comparison.

If the Chinese market is divided into two regimes, the higher mean (μ_1=0.0015) is found to correspond with higher variance (σ_1^2=0.000436), and the lower mean (μ_2=0.0003) corresponds to lower variance (σ_2^2=0.000088). By contrast, the U.S. market evinces completely different features, with higher mean corresponding to lower variance and lower mean corresponding to higher variance.

The third column in Table 1 depicts China's three market regimes. Based on this regime division method, China's stock market incorporates three risk-return combinations: Bull Market (highest mean, intermediate variance), Volatility Market (intermediate mean, lowest variance) and Bear Market (lowest mean, highest variance). Two of these combinations display the same characteristics as regimes of the U.S. market.

The question remains of why the Chinese market possesses similar characteristics to the U.S. markets in a three-regime division, but appears to behave totally differently in a two-regime division. The main reason for this

Table 1: Comparison between China's Market Regimes with the U.S. Regimes

	China's Market		The U.S. Market	
	Two Regimes	Three Regimes	Two Regimes	Three Regimes
μ_1	0.0015** (0.0007)	0.0066*** (0.0010)	0.0006*** (0.0001)	0.0008*** (0.0003)
μ_2	0.0003 (0.0002)	-0.0002 (0.0003)	0.0001 (0.0003)	0.0005*** (0.0002)
μ_3		-0.0021* (0.0013)		-0.0011 (0.0007)
σ_1^2	0.000436*** (0.0000)	0.000143*** (0.0000)	0.000027*** (0.0000)	0.000090*** (0.0000)
σ_2^2	0.000088*** (0.0000)	0.000089*** (0.0000)	0.000126*** (0.0000)	0.000024*** (0.0000)
σ_3^2		0.000574*** (0.0001)		0.000238*** (0.0000)
p^{11}	0.98	0.94	1.00	0.99
p^{22}	0.99	0.99	1.00	1.00
p^{33}		0.94		0.98
LogLik	9867.6666	9900.7528	11557.3616	11614.8593

Notes: the number in parentheses is stand error, *,** and *** indicate 10%, 5% and 1% levels of significance, respectively.

phenomenon is that in the long term, China's market shows volatility, whereas the U.S. market demonstrates growth. If we adopt Markov's model to these two markets, the Markov method will first set volatility as the Chinese market's basic status and growth as the basic status for the U.S. market, then compare the status of other periods with this basic status. Thus, the U.S. market's growth status is higher return and lower variance, and the other state must necessarily be lower return and higher variance. However, for China's market, the basic volatility status does not show growth, but rather indicates fluctuations within an interval. If we divide China's market into only two regimes by comparing other periods with this volatility state, booming and slump states will be bracketed together because both booming and slump states differ sufficiently from the volatile state. In addition, the period of the booming state is also longer than that of the slump state; therefore, on the whole, mean returns from the booming state will overwhelm returns from the slump state when these states are grouped. Thus, the two-regime division classifies the basic volatility state as the lower variance condition and the combination of booming state and slump state as higher mean and higher variance. However, if we divide China's market into three regimes, the model can separate the booming state and slump state into a higher mean and intermediate variance category and a lowest mean and highest variance category, respectively.

3.4 The Identification of China's Stock Market Regimes

After dividing China's market into three regimes, Hamilton's Markov Regime Switching model offers a very accurate way to present these three market regimes; namely, it can calculate the smoothed probability for each day. For example, the probability of a Bull Market on January 2nd, 1997 is approximately 50%, and, the probabilities for a Volatility Market or a Bear Market are estimated at 45% and 5%, respectively. The stock market regime on January 2nd, 1997 is therefore defined as a Bull Market. We calculate the daily smoothed probabilities of all three regimes from January

Table 2: Details of Division of Market Regimes

	Time	Duration	Change Rate of Return
Bull Market	1997.01.02---1997.05.07	4 Months	+63.08%
(Highest Mean, Media	1999.05.21---2000.04.19	11 Months	+56.57%
Variance)	2006.04.03---2008.01.15	22 Months	+312.96%
Mean: 0.0066	2008.11.26---2010.01.07	13 Months	+67.99%
Volatility Market	1997.10.31---1999.05.20	19 Months	-1.58%
(Media Mean, Lowest	2000.04.20---2001.07.23	15 Months	-15.20%
Variance)	2002.03.21---2006.03.31	48 Months	-22.59%
Mean: -0.0002	2010.01.08---2011.08.16	20 Months	-22.18%
Bear Market	1997.05.08---1997.10.30	6 Months	-16.00%
(Lowest Mean, Highest	2001.07.24---2002.03.20	8 Months	-21.36%
Variance)	2008.01.16---2008.11.25	10 Months	-65.28%
Mean: -0.0021			

2nd, 1997 to August 16th, 2011 and present them in Fig. 4. Based on these results, China's stock market (the Shanghai Stock Exchange Market) performance can be classified into 4 Bull Market periods, 4 Volatility Market periods, and 3 Bear Market periods during 1997 to 2011. These divisions of market performance are listed in table 2.

Table 2 represents our definition for different regimes. The main characteristics of the Bull Market are the highest mean and intermediate variance. Moreover, the stock returns increase dramatically within a short time, such as returns of +312.96% in only 22 months. In contrast, the Bear Market has the lowest mean and highest variance. The Bear Market accompanies sharp declines in return within a short time, such as returns of -65.28% in only 10 months. Compared with the two regimes mentioned above, the Volatility Market is characterized as possessing an intermediate mean and the lowest variance. That is, this regime is revealed to exhibit low volatility and declines in return of intermediate magnitude. The results of China's stock market regime divisions in Table 2 contribute to the field of investigating asymmetric effects within China's stock market.[7]

7 There are many methods of defining market regimes. This paper's contribution is to indicate that we could not effectively use the two-regime definition that is typically employed to describe U.S. markets because the division of China's market performance into two regimes does not correspond well to real economic data. However, it should be noted that market regime divisions are not unique.

4 The Asymmetrical Impact of Monetary Policy Shocks on the Stock Market

4.1 The Simple Event Study Model

The widely used methodology we employ to investigate the relationship between monetary policy and stock market performance is the event study model initially introduced by Bernanke and Kuttner (2005). We first define the relevant sample of events as the days on which the PBC announced adjustments to the official interest rates between 1997 and 2010. We then include all individual companies listed on the Shanghai Stock Exchange Market as part of the data sample by determining stock returns for all of these individual firms after changes in China's official interest rates. As suggested by Ehrmann and Fratzscher (2004), this method can enlarge the data sample to satisfy the demand for large sample statistics. According to this method, our total sample size reaches nearly 13800, and each regime's subsample size is larger than one thousand. The simple event study model can be expressed as follows:

$$R_{s_t,i,t} = C + \beta_{s_t,1}^{deposit} \Delta i_t^{deposit} + \varepsilon_{i,t} \qquad s_t = 0,1,2,3 \quad (4.1)$$

$$R_{s_t,i,t} = C + \beta_{s_t,1}^{loan} \Delta i_t^{loan} + \varepsilon_{i,t} \qquad s_t = 0,1,2,3 \quad (4.2)$$

where $R_{s_t,i,t}$ is the stock return of firm i in market regime s_t and the values of $s_t = 0,1,2,3$ represent No-Market-Regime-Division, Bull Market regime, Volatility Market regime, and Bear Market regime, respectively[8]. In this case, $\Delta i_t^{deposit}$ and Δi_t^{loan} denote official deposit rate change and official loan rate change, respectively.

8 The No-Market-Regime-Division data include the entirety of the data without regimes divisions; thus, it contains all bull, volatility and bear market data.

Both $\Delta i_t^{deposit}$ and Δi_t^{loan} are nominal values, but not real values. Nominal values are used because we employ the event study methodology (Bernanke and Kuttner (2005)) and wish to test how changes in the macroeconomic indicator immediately (the next day) affect the stock market. Generally, changes in real interest rates result from long and subtle developments and are thus much more difficult to track than the 'shock' of nominal interest rate changes. Therefore, we cannot accurately define the time of real interest rate changes, which should be viewed as complex and continuous processes that cannot be defined as "macroeconomic shocks" or "monetary policy shocks".

The empirical results from the simple event study model are illustrated in Table 3 and Table 4. Table 3 represents the effects of monetary policy shocks on individual stock returns for No-Market-Regime-Division data, and Table 4 depicts the results from the data of each of the three market regime divisions identified earlier. From Table 3, the estimates of $\beta_{S_t=0,1}^{deposit}$ and $\beta_{S_t=0,1}^{loan}$ are significant and positive values that are approximately 0.02, implying

Table 3: The Results of Simple Event Model (No-Market-Regime-Division)

	Deposit Rate (One Year)	Deposit Rate (Three Years)	Deposit Rate (Five Years)
C	-8.86E-05 (-0.0123)	-0.0029 (-0.4087)	-0.0030 (-0.4266)
Official Rate Change	0.0417*** (3.3134)	0.0295*** (2.7527)	0.0266*** (2.7511)
Adjust-R^2	0.0007	0.0005	0.0005
	Loan Rate (One Year)	Loan Rate (Three Years)	Loan Rate (Five Years)
C	-0.0004 (-0.0553)	-8.18E-05 (-0.0119)	0.0006 (0.0924)
Official Rate Change	0.0277** (1.9614)	0.0242* (1.9544)	0.0281** (2.4767)
Adjust-R^2	0.0002	0.0002	0.0004

Notes: the number in parentheses is t-value, *,** and *** indicate 10%, 5% and 1% levels of significance, respectively.

Table 4: The Results of Simple Event Model (Three-Regime-Division)

	Deposit Rate (One Year)			Deposit Rate (Three Years)			Deposit Rate (Five Years)		
	Bull	Volatility	Bear	Bull	Volatility	Bear	Bull	Volatility	Bear
C	0.0033 (0.2528)	-0.0053*** (-12.2464)	-0.0305*** (-27.4371)	0.0014 (0.1050)	-0.0033*** (-7.4947)	-0.0287*** (-26.4639)	0.0020 (0.1533)	-0.0031*** (-6.8490)	-0.0273*** (-25.8038)
Official Rate Change	0.0782*** (3.4366)	-0.0196*** (-20.2611)	-0.0193*** (-12.4062)	0.0701*** (3.2195)	-0.0110*** (-16.3923)	-0.0142*** (-10.6725)	0.0643*** (3.2363)	-0.0098*** (-16.0081)	-0.0108*** (-9.3455)
Adjust-R^2	0.0014	0.0998	0.0550	0.0012	0.0676	0.0412	0.0013	0.0646	0.0318
	Loan Rate (One Year)			Loan Rate (Three Years)			Loan Rate (Five Years)		
	Bull	Volatility	Bear	Bull	Volatility	Bear	Bull	Volatility	Bear
C	0.0025 (0.2095)	-0.0059*** (-13.4996)	-0.0428*** (-34.3805)	0.0038 (0.3159)	-0.0062*** (-13.9588)	-0.0369*** (-31.2129)	0.0044 (0.3662)	-0.0060*** (-13.5608)	-0.0353*** (-30.9292)
Official Rate Change	0.0670** (2.4016)	-0.0181*** (-20.2768)	-0.0436*** (-22.1768)	0.0738*** (2.7172)	-0.0120*** (-18.3497)	-0.0316*** (-17.9906)	0.0805*** (3.3050)	-0.0107*** (-17.6409)	-0.0269*** (-17.3195)
Adjust-R^2	0.0006	0.0999	0.1574	0.0008	0.0832	0.1094	0.0012	0.0775	0.1022

Notes: the number in parentheses is t-value, *,** and *** indicate 10%, 5% and 1% levels of significance, respectively.

that a 100-basis-point increase in the interest rate will cause stock returns to increase by 0.02. However, in the U.S., an unanticipated 100-basis-point increase in the federal funds rate target is associated with a 0.04 decrease in broad stock indexes. This result shows that on the whole, monetary policy shocks have a nonnegative impact on stock returns in China, which is markedly different from the results noted for the U.S. markets.

The question of how to explain this curious phenomenon poses a thorny problem. To address this issue, we first need to analyze the asymmetric effects of monetary policy shocks on stock markets in China. The detailed results regarding these asymmetric effects are provided in Table 4. The statistical estimates based upon Bull Market conditions demonstrate significant and positive responses of market returns to monetary policy shocks, a very similar conclusion to that obtained from the No-Market-Regime-Division data as a whole. In particular, both coefficient $\beta^{deposit}_{S_t=1,1}$ and $\beta^{loan}_{S_t=1,1}$ are significant near 0.07. This indicates that monetary policy changes do not negatively affect the stock market during the Bull Market regime. However, the estimated coefficients during Volatility or Bear Market regimes demonstrate a very different pattern, as all of the estimates of $\beta^{deposit}_{S_t=2,1}$, $\beta^{loan}_{S_t=2,1}$, $\beta^{deposit}_{S_t=3,1}$, and $\beta^{loan}_{S_t=3,1}$ are negative and significant. This result suggests that monetary policy shocks can produce a meaningful negative influence on stock market returns in the Volatility and Bear Market regimes. Furthermore, we find that monetary policy shocks, particularly loan rate shocks, produce much more negative impacts on the stock returns during Bear Market regimes than during Volatility Market regimes; for example, the estimated coefficient for the one-year loan rate is -0.0436 for Bear Market regimes but only -0.0181 during Volatility Market regimes.

Thus, it is clear that the impacts of monetary policy shocks on the stock market show enormous differences between a Bull Market regime and Volatility or Bear Market regimes. The results from Volatility or Bear Market regimes are similar to the results obtained from markets in developed countries, whereas the impact of monetary policy shocks during a Bull Market regime is very much distinct from the impact noted in the U.S. or U.K. markets. In particular, monetary policy changes negatively affect stock returns during Volatility or Bear Market regimes, but not during a Bull Market regime. In addition, half of the monetary policy changes in China during the examined time period occurred during a Bull Market period (interest rates changed 10 times during Bull Market regimes). This situation will cause the results from the overall No-Market-Regime-Division data to be similar to results from a Bull Market, with a nonnegative relationship between monetary policy shocks and stock returns. Therefore, we conclude that China's stock market demonstrates asymmetric effects of monetary policy shocks on stock returns in the three different market regimes specified earlier, and these asymmetric effects cause a generally nonnegative reaction of China's stock market as a whole to monetary policy changes, which differs greatly from stock market reactions observed in developed countries.

However, this simple event study model may be contaminated by serious endogenous problems, as suggested by Bernanke and Kuttner (2005) and Honda and Kuroki (2006); therefore, we adopt the specified event study model and subsample methodology discussed in the next two sections to correct for potential endogenous problems.

4.2 The Specified Event Study Model

We find asymmetric effects of monetary policy shock on stock market in China and predict that these asymmetric effects may cause no negative relationship between monetary policy and stock returns for the No-Market-Regime-Division case. However, this conclusion may not hold true because of endogenous problems within our empirical models. In this section, we therefore follow Honda and Kuroki's (2006) logical setup and construct a specified event study model to control for endogenous issues.

In general, event periods include days on which macroeconomic news beyond interest rate changes is also announced, a situation that creates endogenous problems. We therefore assessed whether the event periods considered in this study were associated with macroeconomic news. Note that we define all economic news announcements occurring near an interest rate change event day as "associated", regardless of whether the announcements actually fall on, before, or after the day of the event in question. China's macroeconomic news or indicators are primarily announced by the National Bureau of Statistics of China. Every year, the National Bureau of Statistics of China summarizes a schedule of economic statistical information. We summarize the economic news that is released during each of the event periods based on this schedule. The economic news that may create endogenous problems relates to Industrial Production (IP), the Consumer Price Index (CPI), and/or the Industrial Price Index (IPI). However, IPI is always announced on the same day as CPI; thus, we chose the same dummy variable to measure CPI and IPI. The resulting Specified Event Study model is expressed as follows:

$$R_{S_t,i,t} = C + \beta_{S_t,1}^{deposit}\Delta i_t^{deposit} + \beta_{S_t,2}^{deposit}X_{S_t,CPI} + \beta_{S_t,2}^{deposit}X_{S_t,IP} + \varepsilon_{i,t},\quad S_t = 0,1,2,3 \tag{4.3}$$

$$R_{S_t,i,t} = C + \beta_{S_t,1}^{loan}\Delta i_t^{loan} + \beta_{S_t,2}^{loan}X_{S_t,CPI} + \beta_{S_t,2}^{loan}X_{S_t,IP} + \varepsilon_{i,t}\quad S_t = 0,1,2,3 \tag{4.4}$$

where $X_{S_t,CPI}$ is a dummy variable of CPI or IPI in market regime S_t, which equals 1 when there is a CPI or IPI announcement during event periods and 0 otherwise; similarly, $X_{S_t,IP}$ represents a dummy variable of IP in market regime S_t, which takes the value of 1 if IP announcement happens during event periods and is 0 otherwise.

Table 5 reveals that the variables of CPI and IP have significant impact on the stock returns of No-Market-Regime-Division data. In addition, Table 6 shows that these two economic indicators also significantly influence the stock returns in each of the three regimes. It is reasonable to control for changes in these two macroeconomic variables to avoid estimation bias, especially as the PBC has prominently mentioned that controlling inflation is its primary task. After controlling for macroeconomic news, however, the core empirical results shown in Table 5 and Table 6 remain the same as in the simple event study model. In particular, official interest rate changes continue to display no negative correlation to the stock market returns for either the No-Market-Regime-Division or Bull Market regime samples, but significant and negative effects on stock returns from monetary policy shocks are still observed during Volatility and Bear Market regimes.

The difference between these two types of models is that the specified event study models improve the adjusted R^2 value. The average adjusted R^2 value for the whole sample case examined in Table 5 is approximately 0.0008,

Table 5： Test for Endogenity （Specified Event Study Model, No-Market-Regime-Division）

	Deposit Rate （One Year）	Deposit Rate （Three Years）	Deposit Rate （Five Years）
C	-0.0016 (-0.1885)	-0.0032 (-0.3721)	-0.0033 (-0.3834)
Official Rate Change	0.0404*** (3.1978)	0.0291*** (2.7109)	0.0260*** (2.6845)
CPI	0.0448** (2.3917)	0.0448** (2.3928)	0.0443** (2.3662)
IP	-0.0254 (-1.5454)	-0.0294* (-1.7942)	-0.0292* (-1.7836)
Adjustt-R^2	0.0010	0.0008	0.0008
	Loan Rate （One Year）	Loan Rate （Three Years）	Loan Rate （Five Years）
C	-0.0003 (-0.0414)	0.0005 (0.0654)	0.0009 (0.1065)
Official Rate Change	0.0275* (1.9421)	0.0252* (2.0265)	0.0287** (2.5235)
CPI	0.0449** (2.4534)	0.0451** (2.4666)	0.0456** (2.4931)
IP	-0.0306* (-1.9181)	-0.0324* (-2.0376)	-0.0314* (-1.9765)
Adjustt-R^2	0.0006	0.0006	0.0008

Notes: the number in parentheses is t-value, *,** and *** indicate 10%, 5% and 1% levels of significance, respectively.

Table 6: Test for Endogenity （Specified Event Study Model, Three-Regime-Division）

	Deposit Rate （One Year）			Deposit Rate （Three Years）			Deposit Rate （Five Years）		
	Bull	Volatility	Bear	Bull	Volatility	Bear	Bull	Volatility	Bear
C	0.0069 (0.4539)	-0.0110*** (-22.0276)	-0.0712*** (-60.4505)	0.0053 (0.3532)	-0.0093*** (-18.3746)	-0.0700*** (-62.5850)	0.0055 (0.3618)	-0.0088*** (-17.4030)	-0.0693*** (-63.9197)
Official Rate Change	0.0682*** (2.8546)	-0.0266*** (-26.2923)	-0.0197*** (-13.3626)	0.0605*** (2.6677)	-0.0154*** (-23.0972)	-0.0152*** (-13.3626)	0.0554*** (2.6721)	-0.0138*** (-22.5240)	-0.0124*** (-13.3626)
CPI	0.0269 (0.6270)	0.0202*** (12.0221)	0.0401*** (27.6283)	0.0305 (0.7131)	0.0096*** (6.0383)	0.0428*** (32.2390)	0.0317 (0.7432)	0.0098*** (6.1679)	0.04457*** (35.2961)
IP	-0.0424 (-1.1588)	0.0026* (1.8632)	0.0466*** (34.5855)	-0.0458 (-1.2565)	0.0128*** (9.2974)	0.0452*** (35.0955)	-0.0441 (-1.2047)	0.0124*** (8.9378)	0.0443*** (35.3593)
Adjust-R^2	0.0014	0.2044	0.6020	0.0013	0.1747	0.6020	0.0013	0.1695	0.6020
	Loan Rate （One Year）			Loan Rate （Three Years）			Loan Rate （Five Years）		
	Bull	Volatility	Bear	Bull	Volatility	Bear	Bull	Volatility	Bear
C	0.0106 (0.7759)	-0.0113*** (-22.6227)	-0.0750 (-54.2047)	0.0115 (0.8353)	-0.0123*** (-23.6069)	-0.0729 (-57.6148)	0.0099 (0.7261)	-0.0124*** (-23.6519)	-0.0720*** (-59.2092)
Official Rate Change	0.0615** (2.1602)	-0.0266*** (-26.8191)	-0.0335 (-13.3626)	0.0663** (2.3850)	-0.0149*** (-23.1087)	-0.0257 (-13.3626)	0.0697*** (2.7642)	-0.0136*** (-22.7830)	-0.0223*** (-13.3626)
CPI	0.0249 (0.6048)	0.0274*** (15.2500)	0.0311 (15.8804)	0.0228 (0.5529)	0.0099*** (6.2159)	0.0355 (20.9183)	0.0234 (0.5706)	0.0067*** (4.2798)	0.03609*** (21.7266)
IP	-0.0708*** (-2.0972)	-0.0043*** (-2.8692)	0.0466 (34.5855)	-0.0672** (-1.9879)	0.0105*** (7.6150)	0.0466 (34.5855)	-0.0540 (-1.5734)	0.0135*** (9.7770)	0.04655*** (34.5855)
Adjust-R^2	0.0010	0.2094	0.6020	0.0011	0.1748	0.6020	0.0013	0.1718	0.6020

Notes: the number in parentheses is t-value, *,** and *** indicate 10%, 5% and 1% levels of significance, respectively.

whereas this value is only 0.0004 in Table 3 for the simple event study model. Although both of these numbers are very small, the increase in adjusted R^2 also suggests that specified event study models have certain advantages when estimating the relationship between monetary policy and stock returns. Overall, however, based on these preferred specified event study models, we also reach the conclusion that China's stock returns react to monetary policy shocks asymmetrically, as monetary policy negatively affects the stock market to a much larger degree in Volatility or Bear Market regimes than in Bull Market regimes. These asymmetrical effects result in no significant negative response for the overall stock returns (the No-Market-Regime-Division data) in China to monetary policy shocks.

5 Endogenous Problems and Subsample Stability

We have already mentioned one of the endogenous problems that can arise in empirical models and the resolution to this concern, namely, the specified event study model. However, another endogenous issue may arise because of the great length of the event periods examined in this study. When we examine data for China's monetary policy changes, we find that China's official interest rates frequently change just before holidays, and certain macroeconomic or other relevant news are announced during holidays, when the stock market is not open. Therefore, if we include the interest rate change events that happened just before holidays, the empirical results obtained may be disrupted by other economic or social events that occurred during the holiday in question. Thus, we consider constructing a subsample to exclude the eight interest rate changes announced just before holidays from our sample. Based on this subsample, we estimate both the simple and specialized event study models.

The subsample estimates for the simple event study models allow us to obtain very similar conclusions as those reached in the previous section, which indicates the robustness of our main argument. In particular, we find that the coefficients of monetary policy shock in the subsample become slightly smaller than in the models generated for the whole sample. For instance, the estimation of $\beta^{\mathrm{deposit}}_{S_t=0,1}$ of one-year deposit for the whole sample is 0.0417, but this value decreases to 0.034 for the subsample. The average values of $\beta^{\mathrm{deposit}}_{S_t=0,1}$ and $\beta^{\mathrm{loan}}_{S_t=0,1}$ decreases from approximately 0.03 in the full sample to 0.02 in the subsample. Although the values obtained from the subsample do not differ greatly from those obtained using the entire sample, the presence of an effect still suggests that the holiday news may affect the stock market, and the subsample method is thus preferred to the method using the entire sample.

When comparing the specialized event study model's results from the whole sample and the subsample, it should be noted that the specialized event study model for the subsample does not include the variable of CPI in both the Bull and Bear Market regimes. The reason for this change is that CPI announcements in Bull and Bear Markets always occurred during holidays, and these data are all excluded from the subsample. Thus, it suffices to include only the IP as a dummy variable in the specialized event study model for the subsample. However, even though we make these small changes to the model's form, the subsample model produces the same fundamental conclusions as the models detailed in the previous section. The values of $\beta^{\mathrm{deposit}}_{S_t=0,1}$ and $\beta^{\mathrm{loan}}_{S_t=0,1}$ decrease in both the specified event study model and the simple event study model when considering only subsample data. Moreover, monetary policy shocks produce less significant impacts on the stock returns in both the Bull Market Regime and the overall No-Market-Regime-Division conditions when using only subsample data. However, we still obtain the conclusion that monetary policy negatively affects the stock market to a much greater extent in Volatility or Bear Market regimes than in Bull Market regimes. Based on subsample estimates, we have succeeded in addressing the endogenous problems in a new way and ensuring that the main conclusion is free from these concerns.

6 Robustness Check－Controlling for Firm- and Industry-Specific Effects

We use individual, firm-level data to conduct the estimates in this paper. It would therefore behoove us to add certain other control variables to eliminate firm- and industry-specific effects. Controlling for these firm- and industry-specific effects can help us solve the problem of estimation bias. Following Ehrmann and Fratzscher's (2004) methodology, we control for 5 firm-specific variables and 12 industry-specific variables. The firm specific variables are the Tobin's q ratio, cash flow to income ratio, price earnings ratio, debt to total capital ratio and market value for each company. The industry-specific variables denote the separate industries of agriculture, mining, manufacturing, electricity, building, transport, IT, retail, finance, real estate, social service, and culture. We incorporate these firm- and industry-specific variables into equation (4.3) and (4.4). After controlling for these variables, we obtain the following empirical results.

We estimate the empirical results after controlling for the firm-specific effects for the specialized event study models and the empirical results after controlling for industry-specific effects in the specialized event study models. All of these empirical results indicate that our main conclusion is robust. In particular, the estimates of the effect of monetary policy shocks on stock returns remain nonnegative at approximately 0.03 when considering No-Market-Regime-Division data, and in this case, the coefficients of $\beta^{deposit}_{S_t=0,1}$ and $\beta^{loan}_{S_t=0,1}$ remain nonnegative, with values between 0.06 and 0.08. Monetary policy changes do continue to produce a significant negative effect on stock returns in the Volatility and Bear Market regimes, with an average estimated coefficient of approximately -0.01 in the Volatility Market regime and -0.02 in the Bear Market regime.

Note that nearly all of the firm- and industry-specific control variables appear to be insignificant. This result is consistent with the findings of Chen et al. (2010), whose conclusion is that China's stock market is too difficult to predict, as many predictive variables found in the U.S. market do not significantly affect the Chinese stock market.

7 Conclusion and Policy Implications

This paper adopts China's official interest rates as the monetary policy and tests how the interest rate changes affect the stock market. We first adopts Markov Regime Switching model to divide China's market into Bull Market (highest mean, media variance), Volatility Market (media mean, lowest variance) and Bear Market (lowest mean, highest variance). This finding implies monetary policy shocks do not have significantly negative impacts on the stock return either in the Bull Market regime or No-Market-Regime-Division data as a whole However, a significant negative relation between monetary policy shocks and stock return does exist in both the Bear and Volatility Market regimes.

The conclusions from this study yield certain policy implications for both China's central bank and investors. Firstly, from this paper, we conclude that official interest rate changes do not have a negative effect on the stock market during the Bull Market regime. Thus, central bank interest rate manipulations may not be able to cool down a bullish stock market; therefore, if the PBC wishes to prevent stock market from overheating through interest rate adjustments, the bank should implement its monetary policies as early as possible, before the stock market begins to increase dramatically. If a market bubble has already formed, the PBC should seek to affect matters through other policy tools instead of official interest rate changes.

Secondly, this paper's findings are very important for Chinese stock market investors. Based on the analyses presented in this study, we have demonstrated that stock market returns will drop dramatically in the bear and volatile market conditions if monetary policy becomes tight. Therefore, investors should sell their stock and decrease their share holdings if the PBC increases the official interest rates in bear or volatile markets, as these actions would allow investors to reduce their losses. Overall, this study's conclusions can provide significant revelations to individual investors and larger financial institutions alike regarding the impact of monetary policy shocks on Chinese stock market performance, permitting investors to accurately assess their courses of action in response to these shocks.

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Asymmetric Effects of Monetary Policy Shocks on Stock Markets: An Empirical Test for China

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Keywords: Stock Returns, Markov-Switching Model, Official Interest Rate
JEL Classification: G12, E52

Interest rates shock which is a measurement of monetary policy changes has significant effect on stock return. Most of the evidences are from the U.S., U.K, Japan and other developed countries. However, there is rare empirical analysis considering China's case. As an important emerging stock market, China's stock market shows many specific characters comparing with developed and strong efficient stock market. On the other hand, China's base interest rates are only controlled by the central bank but not the monetary market which also differ from developed countries. So China's specificities from both stock markets and interest rates determination mechanism motivate us to analyze the relationship between China's stock return and interest rates shock. We first adopts Markov Regime Switching model to divide China's market into Bull Market (highest mean, media variance), Volatility Market (media mean, lowest variance) and Bear Market (lowest mean, highest variance). And then we find monetary policy shocks do not have significantly negative impacts on the stock return either in the Bull Market regime or No-Market-Regime-Division data as a whole However, a significant negative relation between monetary policy shocks and stock return does exist in both the Bear and Volatility Market regimes.