ANNALS OF ECONOMICS AND FINANCE **14-2(A)**, 587–608 (2013)

A Study on the Relationship between Short-Term International Capital Flow and the Volatility of China's Stock Market

Hong Zhou

Central University of Finance and Economics, School of Accountancy

Guoping Li*

Central University of Finance and Economics, Department of Investment, Beijing 100081, China.
E-mail: gpli100@yahoo.com

and

Wanfa Lin

Central University of Finance and Economics, School of Accountancy

Using data from 2003 to 2011, this paper investigates the impact of short-term international capital flow on the volatility of China's stock market under different RMB exchange rate regimes and the mechanism by which the impact is transmitted to stock market. The findings include that short-term international capital flow has greater impact on stock market volatility under managed floating regime than under pegged-to-US dollar regime, and that liberalization of RMB exchange rate may significantly increase stock market volatility. The findings have some implications for reforms of RMB exchange rate regime.

Key Words: RMB exchange rate regime; Stock market volatility; Short-term international capital flow.

JEL Classification Numbers: F31, F32, G10.

* We acknowledge financial supports from National Science Foundation of China (Project No. 71172152), "Trans-Century Training Programme Foundation for Talents of Humanities and Social Sciences" of Ministry of Education (Project No. NCET-10-0826), and "Youth Team for Research and Innovation Plan" of Central University of Finance and Economics.

1529-7373/2013

1. INTRODUCTION

In 1990, China established two stock exchanges, Shenzhen Stock Exchange (SZE, hereinafter) and Shanghai Stock Exchange (SSE, hereinafter). At the end of 2011, there were more than 2,000 companies listed on SZE and SSE. With a total market capitalization of over $5 trillions, China's stock market has become one of the largest stock markets in the world. During its short history of 20 years, China's stock market has experienced several cycles of bubble and burst, which implies the severe volatility of China's stock market. The severe volatility of China's stock market has attracted the attention of both Chinese and foreign scholars (e.g., Su and Fleisher, 1999; Lee, Chen and Rui, 2001; Liu, Lee and Lee, 2009; Zhang, Zhang and Breece, 2011; de Bondt, Peltonen, and Santabárbara, 2011). Compared to other major stock markets around the world, China's stock market is much more volatile. The reason of the unusually high volatility of China's stock market, according to Su and Fleisher (1999), is that a large number of investors tend to trade on "news" flow. de Bondt, Peltonen, and Santabárbara (2011) find that policy actions taken by Chinese government, either in the form of deposit rate changes, equity market reforms or excess liquidity, seem to have significantly contributed to the volatility of China's stock market.

A great number of studies have been carried out on the relationship between stock market volatility and macro-economy. To date, a general consensus is that stock market volatility has a negative effect on the recovery of the real economy (e.g., Cecchetti, et al, 2000; Filardo, 2004; Gilchrist and Saito, 2006; Zhang, Zhang, Breece, 2011). It is empirically well documented that an increase in stock market volatility is followed by a slowdown of output growth (Liang and Teng, 2005; Campbell et al., 2001; Beetsma, 2012). In addition, Tan and Floros (2012) find that in China, stock market volatility can translate into bank performance.

A few studies have examined the relationship between stock market volatility and short-term international capital flow under different exchange rate regimes and the findings are mixed. Using data from developing countries such as Brazil, Thailand and Malaysia, Edison and Carmen (2001) find that under pegged-to-US dollar regime, international capital flow increases the fluctuation of stock prices in home countries. Using data from 1980 to 1996, Jansen (2003) empirically tests the impact of capital inflow on Thai economy under pegged-to-US dollar regime and finds that capital inflow is correlated with higher asset prices and lower interest rates in home countries. However, Jansen (2003) finds no significant impact of capital inflow on stock market volatility, which is consistent with Khan and Reinhart (1995).

Studies which come to the conclusion that there is a significant correlation between short-term international capital flow and stock market volatility have also investigated the mechanism by which short-term international capital flow exerts influence on stock market. Bilson, Brailsford and Hooper (2001) argue that macro economic variables such as exchange rate, interest rate and money supply affect the return of stock market, and these macro economic variables are in turn subject to the influence of short-term international capital flow. In addition, a large body of literature have found clear connections between macroeconomic fundamentals and stock market volatilities, with volatile fundamentals translating into volatile stock markets (e.g., Officer, 1973; Pearce and Roley, 1985; Chen, Roll and Ross, 1986; Cutler, Poterba and Summers, 1989; Diebold and Yilmaz, 2008).

Another related field of studies is the relationship between exchange rate regime and destination of short-term international capital flow. Using data on 70 countries during years from 1980 to 2009, Sy (2011) finds that short-term international capital flow is more likely to flow into countries with pegged-to-US dollar regime.

This paper aims to investigate the impact of short-term international capital flow on the volatility of China's stock market under different RMB exchange rate regimes and the mechanism by which the impact is transmitted into stock market. This paper finds that short-term international capital flow has greater impact on stock market volatility under managed floating regime than under pegged-to-US dollar regime. Empirical tests show that under managed floating regime, the adjustment of macroeconomy to inflow of short-term international capital is faster and more dramatic, which eventually causes more fluctuations in stock market. Another finding of this paper is that liberalization of RMB exchange rate may significantly increase the volatility of China's stock market.

This paper contributes to the existing literature on China's ongoing financial liberalization (e.g., reform of RMB exchange rate regime and the opening of capital accounts) in four aspects. First, being the first to study the relationship among RMB exchange rate regime, short-term international capital flow and stock market volatility, this paper helps deepen our understanding of the interaction among these three macroeconomic variables. Second, while previous studies on volatility of China's stock market did not separate market volatility caused by market irrationalities from that caused by macroeconomic variables, this paper focuses on the irrational part of market volatility, which will help us better understand the impact of short-term international capital flow on China's stock market. Third, by measuring the changes in stock market volatility resulted from changes in RMB exchange rate regime, this paper makes the first attempt to quantify the impact of short-term international capital flow on China's

stock market under different exchange rate regimes. Specifically, this paper finds that about one-third of the volatility of China's stock market can be explained by short-term international capital flow. Forth, using generalized impulse response analysis, this paper clearly shows how changes in RMB exchange rate regime affect the volatility of China's stock market by exerting impact on macroeconomic variables such as domestic interest rates. These findings will provide a more solid foundation for decision-making relevant to China's efforts to liberalize its financial system.

The rest of the paper is organized as follows: Section 2 provides some brief background information on China's reforms of RMB exchange rate regime and capital control policies. Section 3 describes the data and models used in empirical tests. Section 4 presents the results of empirical tests on the impact of short-term international capital flow on China's stock market under different exchange rate regimes and the mechanism by which the impact is transmitted into stock market. Section 5 estimates the potential impact of future reforms to RMB exchange rate regime on the volatility of China's stock market. Section 6 concludes the paper with a brief discussion on the implications of the findings of this paper for reforms of RMB exchange rate regime.

2. RMB EXCHANGE RATE REGIME AND CAPITAL CONTROL IN CHINA

For most of its history, RMB was pegged to the U.S. dollar. In 1997, Chinese government revalued RMB and set a peg of RMB 8.27 yuan per US dollar. In July 2005, as a move toward a more fully free-market economy, Chinese government lifted the peg and adopted managed floating regime. As a result, RMB was allowed to float within a small band around a central rate. The central rate is set on basis of a basket of foreign currencies selected by People's Bank of China (PBoC), the central bank of China. Without providing details, PBoC has stated that the basket is dominated by the United States dollar, Euro, Japanese yen and South Korean won. PBoC sets the central rate and announces it to the public everyday in the morning. After the outbreak of 2008 financial crisis, PBoC narrowed the band in July 2008. In June 2010, PBoC restarted reforms of RMB exchange rate regime and expanded the band. In early 2012, the band was expanded to 1%. A tally of the number of months in which China was under the two different exchange regimes shows that during the nine years from 2003 to 2011, China was under pegged-to-US dollar regime for 31 months and under managed floating regime for 78 months. Moreover, during the 78 months when RMB was under managed floating regime, there were 40 months in which the floating band was 0.3% and 38 months in which the floating band was 0.5%.

China's policies on RMB exchange rate regime since 1997 are presented in Table 1.

TABLE 1.

RMB exchange rate regimes since 1997

Time periods	RMB exchange rate regime	Details
1997 to July 2005	Fixed exchange rate	RMB was pegged to US dollar at a rate of RMB 8.27 yuan per USD
July 2005 to May 2007	Managed floating exchange rate	RMB was allowed to float around a central rate within a band of 0.3%
May 2007 to October 2008	Managed floating exchange rate	RMB was allowed to float around a central rate within a band of 0.5%
October 2008 to June 2010	Managed floating exchange rate	RMB was allowed to float around a central rate within a band of 0.3%
June 2010 to April 2012	Managed floating exchange rate	RMB was allowed to float around a central rate within a band of 0.5%
April 2012 to present	Managed floating exchange rate	RMB is allowed to float around a central rate within a band of 1%

After more than 30 years of reforms and opening up, China still keeps in place strict capital control. However, the effectiveness of such policies has been impaired gradually as various ways have been found to circumvent capital control. In recent years, short-term international capital flows into and out of China on an increasingly large scale (Wang and He, 2007). According to our estimation, the amount of short-term international capital flowing into China in 2011 was RMB 338.8 billion yuan, 5.5 times the amount in the year of 2001 when China joined World Trade Organization.

Table 2 presents the statistics on short-term international capital flow crossing Chinese border during the nine-year period.

TABLE 2.

Descriptive statistics on monthly short-term international capital flow crossing Chinese border

Sample periods	No. of observations	Mean	S.D.	Min.	Max.
When RMB is in pegged-to-US dollar regime	31	.2367	.4518	.0010	2.5417
When RMB is in managed floating regime with a band of 0.3%	40	.3397	.3493	.0009	1.1291
When RMB is in managed floating regime with a band of 0.5%	38	2.2691	2.5558	.0197	9.4978

Note: All statistics except the numbers of observations in the table are standardized and squared. The method of standardization is described in footnote 1[1].

As China moves to become a more free-market economy, domestic voice calling for liberalizing capital accounts is getting stronger. In February 2012, the Statistics Division of PBoC published a report evaluating the possibility of lifting capital control. According to the report, time is ready for China to speed up the liberalization of capital accounts (PBoC, 2012).

3. DATA AND MODELS

3.1. The models

Since financial time series such as stock prices tend to have problems such as time-varying volatility clustering, EGARCH(1.1) is thus used to conduct empirical analyses.

Some studies believe that for estimations to be robust, ARCH family models require the sample to have a minimum of 250 observations (e.g., Bao and Ullah, 2004; Hwang and Pereira, 2006; Bianchi et al., 2011). Other studies, however, think that a sample with more than 100 observations are large enough for ARCH family models (e.g., Abdullah, et al. 2011; Iglesias and Phillips, 2011). Iglesias and Phillips (2011) argues that as long as a sample has at least 50 observations, the estimations will be robust. In addition, it has been only eight years since China started reforms of RMB exchange rate regime in 2005, which limits the availability of more data. Based on both the review of related literature and the reality of China's reforms of RMB exchange rate, we think that although our sample which has about 100 observations is not as large as those used in previous studies such as Bao and Ullah (2004), it is still a worthwhile effort to study the relationship between short-term international capital flow and the volatility of China's stock markets using currently available data.

The models are presented in Equations (1) and (2). Equation (1) is used to measure the residual unexplained by variables specified in Equation (1) and Equation (2) is then used to empirically test the relationship between stock market volatility and short-term international capital flow under different exchange rate regimes.

$$R_t = \eta_1 RD_t + \eta_2 ER_t + \eta_3 IR_t + \eta_4 INF_t + \varepsilon_t \quad (1)$$

$$\begin{aligned} LN(\sigma_t^2) &= C_1 + \theta_1 |\varepsilon_{t-1}/\sqrt{\sigma_{t-1}}| + \theta_2(\varepsilon_{t-1}/\sqrt{\sigma_{t-1}}) \\ &+ \tau_1 SCF_t + \tau_2 CJL_t + \tau_3 GDP_t \end{aligned} \quad (2)$$

The variables in the two equations are defined as follows.

[1]The statistics are standardized as $y_j = \frac{x_j - \overline{x_j}}{\sigma_j}$, where $\overline{x_j}$ is the mean of the series, and σ_j is the variance of the series.

R is the stock market return at time t, which is likely to be affected by macroeconomic variables like exchange rate, interest rate and inflation rate (Jayasuriya, 2005). Stock market return at time t is calculated as $R_t = \ln P_t t - \ln P_{t-1}$, where P_t is the closing price of SSE Composite Index at time t. ε_t is the residual and i is the number of lag period.

RD is the difference between stock market return of China which is represented by the monthly return of SSE Composite Index and that of United States of America which is represented by the monthly return of S&P 500. The coefficient of RD_t is expected to be positive.

ER is the monthly exchange rate of RMB to US dollar and is calculated as the arithmetic average of daily exchange rates. Kim (2003) finds a negative relationship between stock price and real exchange rate. Thus, we expect the coefficient of ER_t to be negative.

IR is domestic interest rate in China, which in this paper is represented by monthly inter-bank overnight borrowing rate. Since Kim (2003) finds that there is a negative relationship between stock price and interest rate, the coefficient of IR_t is thus expected to be negative.

INF is domestic inflation rate and the monthly consumer price index published by National Bureau of Statistics of China is used in this paper. Schmeling and Schrimpf (2008) find that inflation has positive impact on stock returns, while Hiraki (1985) has findings to the contrary. We expect the coefficient of INF_t to be positive.

CJL represents the square of standardized monthly stock market trading volume[2], which is used to measure the state of stock market (i.e., whether it is a bull market or a bear market). Wang and Huang (2012) finds that trading volume accounts for a considerable portion of stock market volatility in most markets and the effect of trading volume on stock market volatility depend on the state of market. The coefficient of CJL_t in Equation (2) is expected to be positive.

GDP is the square of the standardized GDP and it is obtained by first taking the logarithm of annual GDP and then standardize the logarithm using the formula presented in footnote 1. Based on previous studies, we expected GDP_t, a measurement of macroeconomic condition, to have negative correlation with stock market volatility.

SCF is the square of standardized net flow of short-term international capital. Using the method of Wang and He (2007) and monthly data, net flow of short-term international capital is estimated as follows: net flow of short-term international capital = monthly increase in funds outstanding for foreign exchanges — monthly goods trade surpluses- monthly actually utilized foreign investments. The coefficient of SCF_t is supposed to be positive.

[2]Trading volume is standardized using the equation described in footnote 1.

σ_t^2 is the part of stock market volatility unexplained by macroeconomic variables, i.e., the part of market volatility caused by market irrationalities. Stock market volatility is measured by the variance of the monthly returns of SSE Composite Index.

The second and the third terms on the left side of Equation (2) measure the impact of "good news" and "bad news" on stock market volatility, respectively. If the coefficient of θ_1 is statistically significant, it then can be concluded that "good news" has impact on stock market volatility; if the coefficient of θ_2 is statistically significant, it then means that "bad news" has impact on stock market volatility. Furthermore, in either case, investors exhibit herding behavior.

Equation (1) and Equation (2) answer the following questions: whether short-term international capital flow contributes to the irrational part of market volatility, and if it does, how much the impact is. To estimate the impact of short-term international capital flow on the total market volatility (i.e., both rational and irrational market volatility), we also construct two models which are specified in Equation (3) and Equation (4).

$$R_t = R_{t-1} + SQRT_t(garch) + \varepsilon_t \tag{3}$$

$$\begin{aligned} LN(\sigma_t^2) &= C_1 + \theta_1|\varepsilon_{t-1}/\sqrt{\sigma_{t-1}}| + \theta_2(\varepsilon_{t-1}/\sqrt{\sigma_{t-1}}) + \theta_3 \ln(\sigma_{t-1}) \\ &+ \eta_1 RD_1 + \eta_2 ER_t + \eta_3 IR_t + \eta_4 INF_t \\ &+ \tau_1 SCF_t + \tau_2 CJL_t + \tau_3 GDP_t \end{aligned} \tag{4}$$

where R_{t-1} is stock market return at time $t-1$ and $SQRT(garch)$ is the σ on the left side of Equation (4). The definitions of other variables are the same as these specified in Equation (1) and Equation (2).

Following the thinking of Edison and Carmen (2001), we construct a five by one VAR(1) model to analyze the mechanism by which short-term international capital flow exerts influence on China's stock market under different foreign exchange rate regimes as follows:

$$Y_t = A_0 + A_1 Y_{t-1} + \cdots + A_p Y_{t-i} + u_t \tag{5}$$

Where: $Y_t = (RD_t, ER_t, IR_t, INF_t, SCF_t)$ is a vector of five variables and definitions of the variables are the same as those in the EGARCH model presented above. Y_{t-i} is Y_t in i^{th} order lag. A_0 represents a five by one constant matrix. A_1 is the four by i coefficient matrix. u_t is the residual term, subject to independent identical distribution, i.e., $u_t \sim iid(0, \Omega)$.

To avoid the shortcoming of Cholesky orthogonal decomposition that the results of decomposition depend heavily on the sequence of the variables in the five by one VAR(1) model, the generalized impulse method with disturbance orthogonal matrix, which is independent of the sequence of variables, is thus applied to the five by one VAR(1) model.

3.2. Data Description

A sample of 108 monthly observations over the period from 2003 to 2011 are collected from Chinese Economic Statistic Database, Statistics and Analysis Department of PBoC and CSMAR. Figure 1 and Figure 2 display data on short-term international capital flow and returns of China's stock market, respectively.

FIG. 1. Short-Term International Capital Flow Across China's Border

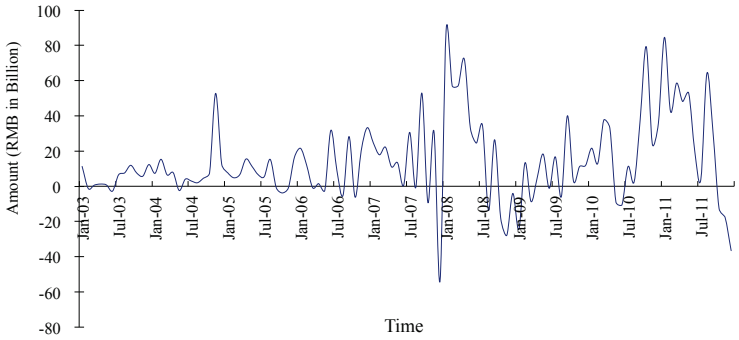
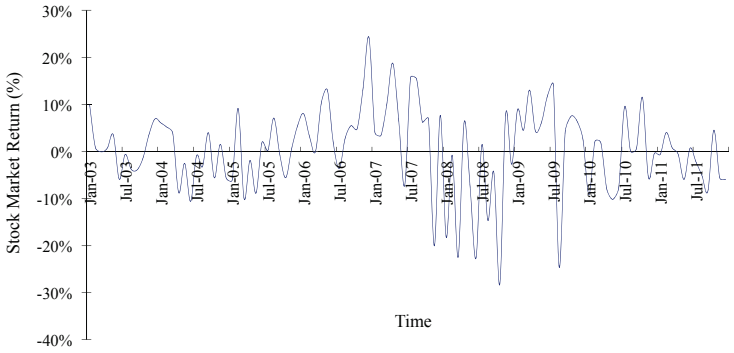


FIG. 2. Stock Market Returns in China



Because tests show that the returns of SSE Composite Index are not normally distributed, EGARCH model is thus chosen to analyze the volatility

of the returns. Test results[3] indicate that the optimal lag orders for the five by one VAR(1) under pegged-to-US dollar regime and managed floating regime are 2 and 1, respectively. In addition, tests for stationarity indicate that VAR model on the original series is stationary under pegged-to-US dollar regime, while under managed floating regime, VAR model on first-order differenced series is stationary. Thus, the series are suitable for impulse response analyses.

4. EMPIRICAL RESULTS

4.1. Test results of Equations (1) and (2)

We first test the relationship between stock market volatility and the variables specified in Equation (2) on the full sample. The test results which are presented in the first column of Table 3 are as follows: first, the coefficient of SCF is statistically significant and positive, which means that changes in the amount of short-term international capital flow will make stock market more volatile. The coefficient of GDP is statistically significant but negative, which means that good macroeconomic condition tends to have diminishing effects on stock market volatility.

Literature survey shows that stock market volatility has a negative effect on the recovery of the real economy and may lead to slowdown in output growth. On basis of results presented in Table 3, it can be found that an increase of RMB100 billion yuan in short-term international capital flow can lead to an increase of 1.52% in SSE Composite Index and a change of 0.3% in China's GDP. Among the 5,778 trading days since SSE was opened in 1990, there have been a total of 1,659 trading days with a daily changes of equal to or greater than 1.5% in SSE Composite Index, which accounts for only 28.7% of the total trading days. Taking all these into consideration, it can be concluded that the impact of SCF on China's stock markets' volatility is also of economic significance.

Second, in Equation (2), SCF, GDP and CJL are exogenous factors that may have impact on stock market volatility. Tests show that only the coefficients of SCF and GDP are statistically significant, and that the absolute value of the coefficient of GDP is twice as large as that of SCF. If SCF and GDP are assumed to account for all of the stock market's volatility caused by exogenous variables, it can be concluded that of the contributions to stock market volatility made by exogenous factors, SCF and GDP account for about 33.3% and 66.7%, respectively.

Third, the fact that θ_1 is positive and significant at 10% level while θ_2 is not significant indicates that "good news" and "bad news" tends to have

[3]Test results are not presented in this paper, but they are available from the author upon request.

asymmetric impact on stock market volatility. In other words, "good news" tends to make market more volatile, but "bad news" does not have such an effect. It seems that investors are more likely to exhibit herding behavior when "good news" comes to stock market.

The sample is then divided into two sub-samples, i.e., one of the years in which China was under pegged-to-US dollar regime and another of the years in which China was under managed floating regime. Test results on these two sub-samples are presented in the second column and the third column of Table 3, respectively.

Test results presented in the second column of Table 3 show that under pegged-to-US dollar regime, neither SCF nor CJL has significant impact on stock market volatility, while GDP has significant impact at 1% level. That both θ_1 and θ_2 are statistically significant means that news, "good" or "bad", makes stock market more volatile. Further investigations demonstrate that the impact of "good news" increases the logarithm of conditional variance of stock market returns by $-0.097\varepsilon_{t-1}/\sqrt{\sigma_{t-1}}$ (i.e., push the index down by $0.097\varepsilon_{t-1}/\sqrt{\sigma_{t-1}}$) while "bad news" increases the logarithm of conditional variance of stock market returns by $-1.486\varepsilon_{t-1}/\sqrt{\sigma_{t-1}}$ (i.e., force the index down by $1.486\varepsilon_{t-1}/\sqrt{\sigma_{t-1}}$). As a result, under pegged-to-US dollar regime, the fluctuation of stock market is largely caused by investors' positive feedback trading, i.e., herding behavior.

The third column of Table 3 shows that under managed floating regime, short-term international capital flow has significant positive impact on stock market volatility. As is the case of pegged-to US dollar regime, news, "good" or "bad", tends to have significant impact on stock market volatility when RMB is under managed floating regime. Therefore, under managed floating regime, the fluctuation of China's stock market can be attributed to short-term international capital flow and investors' herding behavior.

Test results of Equation (3) and Equation (4) are presented in Table 4.

The coefficients of SCF presented in Table 4 are statistically insignificant, while these of macro economic variables are significant. Such results are in contrast to those presented in Table 3. Bilson, Brailsford and Hooper (2001) find that macro economic variables are subject to the influences of short-term international capital flow. Therefore, a possible explanation for differences in results present in Table 3 and Table 4 is that SCF may have impact on macro economic variables. To prove such an explanation, we next analyze the mechanisms through which SCF exerts influences on stock market volatility using Equation (5).

4.2. Test results of Equation (5)

Using Equation (5), we test for the impact of SCF on macro economic variables and present the results in Table 5.

TABLE 3.

Results of EGARCH estimation

Variables	Full sample	Sub-sample 1: pegged-to-US dollar period	Sub-sample 2: Managed floating period
RD	0.6319^{***}	0.2860^{***}	0.4208^{***}
	(0.00)	(0.004)	(0.003)
IR	-0.0131	-0.0377^{***}	-0.0162
	(0.11)	(0.004)	(0.11)
ER	0.0043^{**}	0.0107^{***}	0.0066^{**}
	(0.04)	(0.003)	(0.02)
INF	0.0188^{***}	0.0235^{***}	0.0188
	(0.008)	(0.003)	(0.31)
$C1$	-0.2762^{**}	-0.5702	-0.2476^{***}
	(0.03)	(0.44)	(0.00)
θ_1	-0.2708^{*}	-0.7913^{*}	-0.3477^{***}
	(0.06)	(0.08)	(0.00)
θ_2	0.1043	0.6948^{*}	0.4096^{**}
	(0.34)	(0.06)	(0.04)
θ_3	0.9002^{***}	0.6113^{***}	0.8992^{***}
	(0.00)	(0.001)	(0.00)
GDP	-0.1232^{***}	-0.5025^{***}	-0.0793
	(0.00)	(0.007)	(0.60)
SCF	0.0656^{***}	-0.2385	0.0891^{**}
	(0.01)	(0.55)	(0.04)
CJL	-0.0008	-0.1878	-0.1435
	(0.98)	(0.11)	(0.39)
L	149.0518	77.3825	73.0683
AIC	-2.5565	-2.505	-2.2988
SC	-2.2833	-2.0961	-1.8936
Obs.	108	53	55
Adj. R^2	0.255	0.19	0.298

Note: *, **, *** represent the significance levels of 10%, 5% and 1%, respectively. P-values are in parentheses.

Table 5 demonstrates that in some cases, there indeed exist significantly positive correlations between $SCF(-1)$ and macro economic variables. It thus proves the above-mentioned explanation.

In order to better understand how short-term international capital flow affects stock market volatility by exerting impact on macro economic variables, we apply generalized impulse response method to Equation (5) to investigate the mechanism by which short-term international capital flow ex-

TABLE 4.

Results of EGARCH-M estimation

Variables	Full sample	Sub-sample 1: pegged-to-US dollar period	Sub-sample 2: Managed floating period
$R(-1)$	0.1459^{**}	0.1542^{***}	0.2352^{***}
	(0.02)	(0.00)	(0.00)
$SQRT(garch)$	0.1777^{*}	0.0254	-0.0048^{***}
	(0.07)	(0.85)	(0.00)
RD	-3.3732^{**}	-5.3699^{***}	-7.8587^{***}
	(0.04)	(0.00)	(0.00)
IR	0.2250^{**}	0.7992^{***}	0.1877
	(0.04)	(0.00)	(0.29)
ER	-0.0087	-0.1734	-0.6652^{***}
	(0.42)	(0.27)	(0.00)
INF	-0.0865	-0.1558	0.2271
	(0.42)	(0.27)	(0.19)
C	-0.5795^{*}	-0.7886	3.0945
	(0.1)	(0.19)	(0.11)
θ_1	-0.4504^{***}	-1.4072^{***}	-1.2528^{***}
	(0.00)	(0.00)	(0.00)
θ_2	0.2611	0.7071^{*}	1.2711^{***}
	(0.34)	(0.07)	(0.00)
θ_3	0.8564^{***}	0.5829^{***}	0.4343^{***}
	(0.00)	(0.00)	(0.00)
GDP	-0.2174^{*}	-0.5939^{***}	-0.4511^{***}
	(0.01)	(0.00)	(0.00)
SCF	-0.015	-0.4701	-0.0408
	(0.64)	(0.18)	(0.35)
CJL	0.0538	-0.1878	-0.1743
	(0.33)	(0.11)	(0.25)
L	130.8722	67.3825	65.47
AIC	-2.2032	-1.9985	-1.9800
SC	-1.8784	-1.5961	-1.4967
Obs.	108	53	55
Adj. R^2	0.172	0.131	0.19

Note: *, **, *** represent the significance levels of 10%, 5% and 1%, respectively. P-values are in parentheses.

erts impact on China's stock market under different exchange rate regimes. The results are shown in Figures 3-6.

Figure 3 displays how RD responds to SCF under different exchange rate regimes. A negative value on the vertical axis means a widening d-

TABLE 5.

Test results of Equation (5)

Sample	Variables	RD	IR	INF	ER
Full sample	$SCF(-1)$	-0.0000	0.0003^{**}	0.0004^{*}	-0.0000
		(0.15)	(0.04)	(0.07)	(0.11)
Sub-sample 1: pegged-to-US	$SCF(-1)$	-0.013^{*}	-0.047	-0.1611	0.0544
dollar period		(0.07)	(0.62)	(0.47)	(0.42)
Sub-sample 2: Managed	$SCF(-1)$	0.0000	0.0000	0.0006^{**}	0.0000^{**}
floating period		(0.98)	(0.75)	(0.05)	(0.02)

Note: *, **, *** represent the significance levels of 10%, 5% and 1%, respectively. P-values are in parentheses.

ifference in returns between China's stock market and the United States stock market, while a positive value means the opposite. In addition, the larger the absolute value of the value on the vertical axis, the stronger the impact of SCF on RD. Figure 3 shows that under pegged-to-US dollar regime, SCF has strong negative impact on RD in the first two periods. However, the impact has largely died down in the third period. Figure 3 also shows that when RMB is under managed floating regime, RD responds to SCF in a highly violent way and the impact of SCF on RD do not die away until the seventh period. A comparison of RD responses to SCF under different exchange rate regimes thus demonstrates that when RMB is under managed floating regime, short-term international capital flow tends to have stronger and longer-lasting impact on RD and accordingly on stock market volatility.

FIG. 3. RD Response to SCF

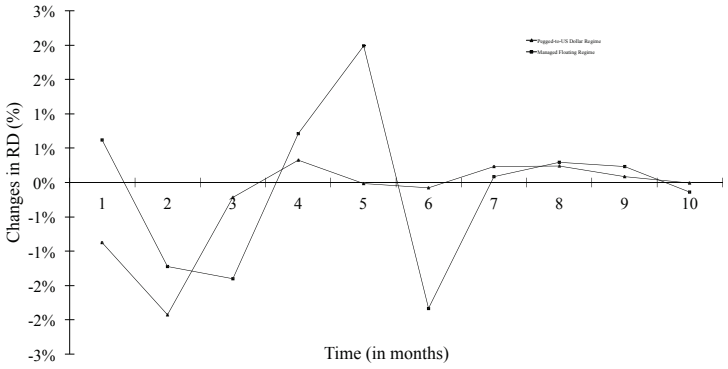


Figure 4 shows how ER responds to SCF. When RMB is pegged to US dollar, RMB exchange rate adjusts to changes in short-term international capital flow slowly and does not become stable until the sixth period. On the other hand, when RMB is under managed floating regime, RMB exchange rate moves up and down in the first three periods. However, the impact of short-term international capital flow on ER dies down in the fourth period. Compared with when RMB is under pegged-to-US dollar regime, short-term international capital flow has stronger but short-lived impact on stock market.

FIG. 4. ER Response to SCF

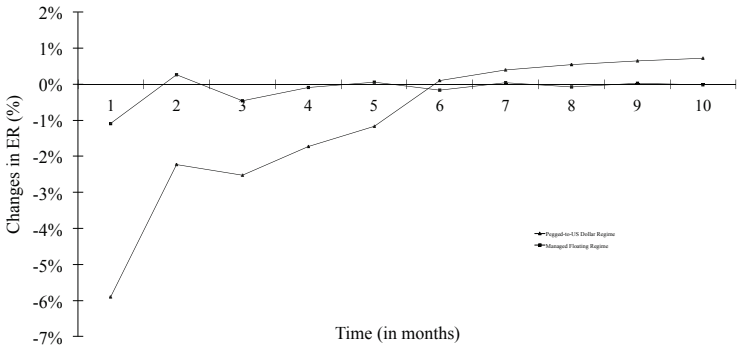
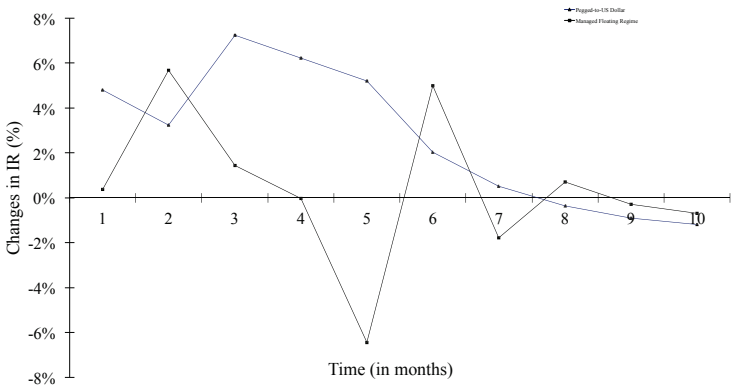


Figure 5 presents the different patterns of how IR responds to SCF. Under pegged-to-US dollar regime, short-term international capital flow causes significant impact on China's domestic interest rate but the impact diminishes almost monotonically. On the contrary, under managed floating regime, the impact of short-term international capital flow on domestic interest rates alternates dramatically between positive and negative until it begins to die down in the seventh period. Thus, under managed floating regime, short-term international capital flow seems to have larger impact on domestic interest rate. The impact is then transmitted into stock market and ultimately increases stock market volatility.

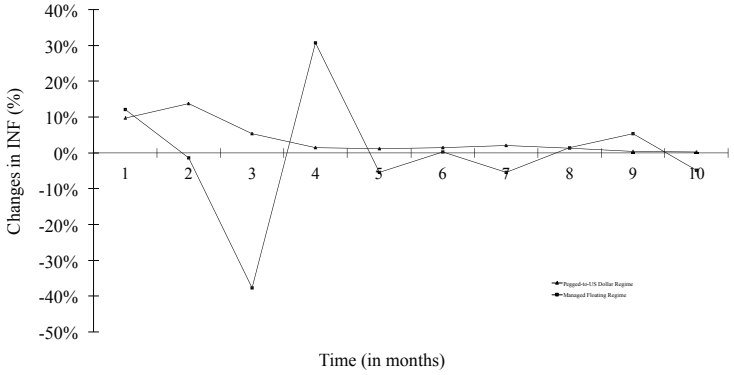
Figure 6 shows how short-term international capital flow effects domestic inflation rate. Figure 6 indicates that when RMB is pegged to US dollar, domestic inflation rate increases sharply in the first two periods and then decreases monotonically until becomes negligible in the fourth period. Under managed floating regime, under the influence of short-term international capital flow, inflation rate moves in severe swings in the first five periods and becomes stable thereafter. Therefore, compared with when

FIG. 5. IR Response to SCF



RMB is begged to US dollar regime, short-term international capital flow has greater impact on domestic inflation and thus on stock market volatility when RMB is under managed floating regime.

FIG. 6. INF Response to SCF



Fernández-Arias and Montiel (1995) find that international capital inflow may result in increase of bank credits, the appreciation of home currency and higher domestic inflation rate. The findings presented in this section are consistent with Fernández-Arias and Montiel (1995). Besides, this section finds that when RMB is pegged to US dollar, the impact of short-term international capital flow on China's macroeconomy is small and the im-

pact is absorbed by macroeconomy gradually and smoothly over a long period. On the contrary, when RMB is under a managed floating regime, short-term international capital flow usually tends to cause dramatic fluctuations in macroeconomic variables such as the foreign exchange rate of RMB, China's domestic interest rates and inflation rate in a short period. The findings of this paper suggest that under managed floating regime, short-term international capital flow may considerably affect the return of China's stock market and ultimately the volatility of China's stock market.

4.3. Robustness check

We use $EGARCH(1.0) - M$ model to test the robustness of the results presented in Table 3. The test results are presented in Table 6.

Overall, the results presented in Table 6 are consistent with these presented in Table 3. The first column shows that the impact of SCF on stock market volatility is statistically significant at 5% level; the second column indicates that under pegged-to-US dollar regime, none of the three variables, i.e., GDP, SCF and CJL, has significant impact on stock market volatility; the third column shows that under managed floating regime, the impact of SCFon stock market volatility is statistically significant at 5%. Thus, the results are robust to both the full sample and the two sub-samples.

5. LIBERALIZATION OF RMB EXCHANGE RATE AND STOCK MARKET VOLATILITY

Expand the floating band of RMB exchange rate and ultimately make RMB fully free floating is inevitable as China moves steadily toward a fully free-market economy. In this section, we investigate the potential impact of future reforms of RMB exchange rate regime on the volatility of China's stock market.

Our investigation is based on statistics presented in Table 2 and the following assumptions: (1) China's capital control policies remain unchanged; (2) there is a linear relationship between the width of floating band and the amount of short-term international capital flow. For example, Table 3 shows that when the floating band was widened from 0.3% to 0.5%, the mean of short-term international capital flow increased from 0.3397 to 2.2691, i.e., the mean experienced an increase of 1.93 standardized square. We thus assume for every increase of 0.2% in the floating band, the mean of short-term international capital flow will accordingly increase by 1.93 standardized square. (3) there is a linear relationship between the width of floating band and the variance of short-term international capital flow. For example, Table 3 shows that when the floating band was widened from 0.3% to 0.5%, the variance of short-term international capital flow increased

TABLE 6.

Robustness check using $EGARCH(1.0) - M$

Variables	Full sample	Sub-sample 1: pegged-to-US dollar period	Sub-sample 2: Managed floating period
LOG(GARCH)	-0.0179^{***}	0.0256^{**}	0.0233^{**}
	(0.00)	(0.04)	(0.04)
RD	0.6031^{***}	0.8626^{***}	0.5827^{***}
	(0.00)	(0.00)	(0.00)
IR	-0.0273^{***}	-0.0349^{**}	-0.0029
	(0.00)	(0.02)	(0.81)
ER	-0.0043	0.0296^{***}	0.0194^{**}
	(0.15)	(0.00)	(0.04)
INF	0.0199^{***}	0.0194^{**}	0.0163
	(0.001)	(0.03)	(0.33)
$C1$	-4.3261^{***}	-6.6137^{***}	-5.9729^{***}
	(0.00)	(0.00)	(0.00)
θ_1	-0.9214^{***}	1.1626^{***}	0.9245^{***}
	(0.00)	(0.00)	(0.00)
θ_2	0.5062^{***}	0.5608^{***}	0.1801^{**}
	(0.00)	(0.00)	(0.53)
GDP	-0.2150^{***}	-0.2573	-0.0109
	(0.00)	(0.25)	(0.98)
SCF	0.1153^{**}	0.5147	0.2489^{**}
	(0.03)	(0.24)	(0.04)
CJL	-0.1912^{***}	-0.0445	-0.7189
	(0.00)	(0.71)	(0.11)
L	136.3721	76.0541	68.335
AIC	-2.3217	-2.4548	-2.1235
SC	-2.0485	-2.0459	-1.7184
Obs.	108	53	55
Adj. R^2	0.199	0.08	0.10

Note: *, **, *** represent the significance levels of 10%, 5% and 1%, respectively. P-values are in parentheses.

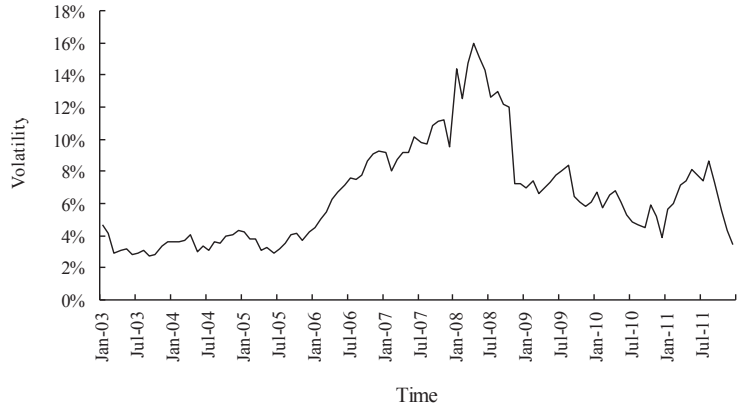
from 0.3493 to 2.5558, i.e., the variance experienced an increase of about 2.1 standardized square. We thus assume for every increase of 0.2% in the floating band, the variance of short-term international capital flow will accordingly increase by 2.1 standardized square.

Our calculation shows that if the floating band is widened to 1%, the monthly volatility of China's stock market resulted from market irrationalities will increase by 13.74% (e.g., given that the volatility of China's stock market in December 2011 was 3.4%, which is showed in Figure 7, had the

floating band been widened to 1%, the volatility in that month would have increased to 17.14%)[4]. If a monthly volatility of 20% is the highest level acceptable for China's stock market, then the floating band of RMB exchange rate can be widened to 5.5% at the most. Finally, our tests show that if RMB exchange rate becomes fully floating, the monthly volatility of China's stock market caused by market irrationalities will increase by as much as 21.88% (e.g., the volatility in December 2011 would have been 25.28%).

In order to better evaluate the magnitude of the increase in the volatility of China's stock market resulted from the liberalization of RMB exchange rate, we calculate the actual irrational part of the monthly volatilities of China's stock market during the period from 2003 to 2011 and the results are presented in Figure 7. As Figure 7 shows, in most of the months during the sample period, the irrational part of the monthly volatilities of China's stock market has been about 6%. Liberalization of RMB exchange rate will thus make China's stock market at least three times more volatile than it has been in recent years.

FIG. 7. Monthly Volatility of China's Stock Market



6. CONCLUSIONS

In the past several years, RMB exchange rate has experienced a fundamental change as China abandoned its age-old pegged-to-US dollar exchange rate regime and adopted managed floating regime. As a result, China has seen a significant appreciation of RMB and a huge increase in inflow

[4]To save space, the calculation is not present in here, but it is available from the author upon request.

of short-term international capital. Against such a background, this paper examines the impact of short-term international capital flow on China's stock market under different RMB exchange rate regimes and the mechanism by which the impact is transmitted to China's stock market. We find that short-term international capital flow has greater impact on stock market volatility under managed floating regime than under pegged-to-US dollar regime and that short-term international capital flow affects China's stock market by exerting impact on China's macroeconomic variables such as domestic interest rate, domestic inflation rate and so on.

On basis of the above-mentioned findings, we further investigate the potential impact of future reforms of RMB exchange rate regime on China's stock market. Our investigation shows that if China's capital control policies remains unchanged, liberalization of RMB exchange rate will significantly increase the volatility of China's stock market.

Previous theoretical analyses have shown that excessive fluctuation of stock market can have undesirable effect on macroeconomy (e.g., Cecchetti, et al, 2000; Filardo, 2004; Gilchrist and Saito, 2006). Based on their study on the relationship between China's monetary policies and domestic stock market volatility, Zhang, Zhang and Breece (2011) suggest that the central bank of China should incorporate stock market volatility into its policy-making process. Therefore, from perspective of the relationship between stock market volatility and macroeconomic stability, the decision to liberalize RMB exchange rate should take into consideration the extent to which increase in short-term international capital flow will affect the volatility of China's stock market and ultimately the stability of China's macroeconomy.

REFERENCES

Abdullah, Khalid Amin, Mohamed Khaled Al-Jafari, Hatim Al Tai, and Abdullah Al Ahmad, 2011. The relationship between risk and return: an empirical study of Kuwait stock exchange. *International Research Journal of Finance and Economics* **66(1)**, 22-29.

Bao, Yong and Aman Ullah, 2004. Bias of a Value-at-Risk estimator. *Finance Research Letters* **1(2)**, 241-249.

Beetsma, Roel, 2012. The changing macroeconomic response to stock market volatility shocks. *Journal of Macroeconomics* **34(2)**, 281-293.

Bianchi, Carluccio, De Giuli, Maria Elena, Dean Fantazzini, and M. Maggi, 2011. Small sample properties of copula-GARCH modelling: A monte carlo study. *Applied Financial Economics* **9(1)**, 1-72.

Bilson, Chris, Tim Brailsford, and Vincent J. Hooper, 2001. Selecting macroeconomic variables as explanatory factors of emerging stock market returns. *Pacific-Basin Finance Journal* **9(4)**, 401-426.

Campbell, J. Y., M. Lettau, B. G. Malkiel, and Y. Xu, 2001. Have individual itocks become more volatile? An empirical exploration of idiosyncratic risk. *Journal of Finance* **56(1)**, 1-43.

Cecchetti, Stephen G., Hans Genberg, John Lipsky, and Sushil Wadhwan, 2000. Asset Prices and Central Bank Policy. International Center For Monetary And Banking Studies, Brookings Institution Press, London.

Chen, Nai-Fu, Richard Roll, and Stephen A. Ross, 1986. Economic forces and the stock market. *Journal of Business* **59**, 383-403.

Cutler, David. M., James M. Poterba, and Lawrence H. Summers, 1989. What moves stock prices? *The Journal of Portfolio Management* **15**, 4-12.

de Bondt, Gabe J., Tuomas A. Peltonen, and Daniel Santabárbara, 2010. Booms and busts in China's stock market: Estimates based on fundamentals. European Central Bank, Working paper No. 1190.

Diebold, Francis X. and Kamil Yilmaz, 2008. Macroeconomic volatility and stock market volatility, worldwide. NBER, Working paper No. 14269

Edison, Hali and Carmen M. Reinhart, 2001. Stopping hot money. *Journal of Development Economics* **66(2)**, 533-553.

Fernández-Arias, Eduardo and Peter J. Montiel, 1995. The surge in capital inflows to developing countries: An analytical overview. *World Bank Economic Review* **10(1)**, 51-77.

Filardo, Andrew, 2004. Monetary policy and asset price bubble: Calibrating the monetary policy trade-offs. BIS, Working paper No.155, Basel.

Gilchrist, Simon and Masashi Saito, 2006. Expectation, asset prices, and monetary policy: The role of learning. NBER, Working paper No. 12442.

Hau, Harald and Hélène Rey, 2006. Exchange rates, equity prices, and capital flows. *The Review of Financial Studies* **19(1)**, 273-317.

Hwang, Soosung and Pedro L. Valls Pereira, 2006. Small sample properties of GARCH estimates and persistence. *The European Journal of Finance* **12(2)**, 473-494.

Hiraki, Takato, 1985. Testing the proxy effect hypothesis of inflation of stock returns for the Japanese market. *Quarterly Journal of Business and Economics* **24(2)**, 73-87.

Iglesias, Emma M. and Garry D. A. Phillips, 2011. Small sample estimation bias in GARCH Models with any number of exogenous variables in the mean equation. *Econometric Reviews* **11(2)**, 303 -336.

Jansen, W. jos, 2003. What do capital inflows do? Dissecting the transmission mechanism for Thailand, 1980-1996. *Journal of Macroeconomics* **25(4)**, 457-480.

Jayasuriya, Shamila, 2005. Stock market liberalization and volatility in the presence of favorable market characteristics and institutions. *Emerging Markets Review* **6(2)**, 170-191.

Kim, Ki-ho, 2003. Dollar exchange rate and stock price: Evidence from multivariate cointegration and error correction model. *Review of Financial Economics* **12(3)**, 301-313.

Khan, Mohsin and Carmen Reinhart, 1995. Capital flows in the APEC region. IMF Occasional paper 122 (Washington DC: International Monetary Fund) 3, 1-17.

Lee, Cheng F., Gong-meng Chen, and Olive M Rui, 2001. Stock returns and volatility on China stock markets. *Journal of Financial Research* **24(3)**, 523-543.

Liang, Qi, and Jianzhou Teng, 2005. Stock markets, banks and economic growth: An empirical study on China. *Journal of Financil Research (Jinrong Yanjiu)* **10, 9-19** (in Chinese).

Liu, Hung-Chun, Yen-Hsien Lee, and Ming-Chih Lee, 2009. Forecasting China stock markets volatility via GARCH models under skewed-GED distribution. *Journal of Money, Investment and Banking* **7**, 5-15.

Officer, R., 1973. The variability of the market factor of the New York Stock Exchange. *Journal of Business* **46**, 434-453.

Pearce, Douglas K. and V. Vance Roley, 1985. Stock prices and economic news. *Journal of Business* **58**, 49-67.

People's Bank of China (PBoC), Statistics Devision, 2012. Time is ready for speeding up the opening of capital accounts. *Caijing (Caijing magazine)* **10**, 71-75 (in Chinese).

Schmeling, Maik and Andreas Schrimpf, 2008. Expected inflation, expected stock returns, and money illusion: What can we learn from survey expectations. SFB 649 Discussion Papers SFB649DP2008-036, Sonderforschungsbereich 649, Humboldt University, Berlin, Germany.

Su, Dongwei and Belton M. Fleisher, 1999. Why does return volatility differ in Chinese stock markets? *Pacific-Basin Finance Journal* **7(5)**, 557-586.

Sy, Mouhamadou, 2011. Exchange rate regimes, capital controls and the pattern of speculative capital flows. Working paper, Paris School of Economics.

Tan, Yong and Christos Floros, 2012. Stock market volatility and bank performance in China. *Studies in Economics and Finance* **29(3)**, 211-228.

Wang, Shihua and Fan He, 2007. International short-term capital flow in China: Current situation, channels and influence factor. *Shijie Jingji (The Journal of World Economy)* **7**, 12-19 (in Chinese).

Zhang, Cheng-si, Da-yin Zhang, and Jeffery Breece, 2011. Financial crisis, monetary policy, and stock market volatility in China. *Annals of Economics and Finance* **12(2)**, 371-388.