INTEREST RATE ADJUSTMENT AND STOCK MARKET – THE CASE STUDY OF CHINA

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Abstract: *This paper examines the impact of interest rate adjustment on the stock market in China. We collect the interest rate adjustment periods from April 21, 1991 to October 24, 2015 since the establishment of the stock market. Through an Error Correction model together with Granger causality, we investigate responses of the stock index to interest rate adjustment. Our findings suggest that there is existing a long-term reverse relationship between interest rate adjustment and stock index. The impact of interest rate adjustment on stock index returns could not be long-term disequilibria, which will be corrected in short-time. Also, the interest rate is the granger cause of the stock price index, while the stock price index is not the granger cause of interest rate.*

Keywords: *Interest Rates Adjustment, Shanghai Composite Index, Error correction model.*

1. INTRODUCTION

As one of the key components of financial markets, the stock market is closely watched by central banks (Blinder, 1988). Through the implementation of monetary policy such as interest rate adjustment, stock prices and returns could be affected swiftly and directly (Zeng & Xie, 2006; Hu & Ma, 2019). Consequently, macroeconomic variables may also be targeted and thus to stimulate the economy (Anwer, Azmi, & Mohd, 2019).

In the literature, empirical results demonstrate that there exists an inverse relationship between interest rates and stock returns (Spiro & Peter, 1990; Afful & Opoku, 2020). When interest rates increase, investors tend to transfer their capital from financial markets to banks with relatively higher returns and lower risks, which leads to a decline in stock price (Hu, Jiang, & Pan, 2020); whereas stock prices increase in respond to a decrease of interest rates. Humpe and McMillan (2020) conducted a pooled mean group estimator, and employed panel ARDL cointegration to explore nexuses between G7 stock prices and macroeconomic variables. Their findings suggested that stock prices are positively related to industrial production and consumer prices, and negatively associated with real 10-year interest rates, coinciding with the result of Willem and Thorbecke (2012). Afful and Opoku (2020) also found that foreign interest rates have negative effects on market returns in Sub-Saharan African (SSA).

However, such a relationship between interest rates and stock returns remains debatable and complex. Asravor and Fonu (2020) indicated that interest rates have a positive impact on stock market development in Ghana, using an ARDL cointegration approach. The positive relations between interest rates and the stock index were detected in Nigeria as well (Ejem, Ogbonna, & Ogbulu, 2020). Moreover, Rahman and Mustafa (1997) examined the series of interest rates and stock prices for

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several countries, and they showed that there is a significant cointegration relationship between the two variables in the long run while no significant Granger causality. By contrast, Rigobon and Sack (2004) described a short-term relation between the US interest rates and stock returns.

The connection between interest rates and stock prices could help central banks to achieve monetary policy goals, as well as to reduce the generation of systemic and financial risks. In particular, the People's Bank of China (PBC) has imposed ceilings on deposit rates, which is a notable binding constraint on price discovery in the financial markets. Fang and An (2019) argued that monetary policy may have a significant mean spillover effect on the stock market and can effectively guide the market in the short run. Hu, Jiang and Pan (2020) suggested that the Chinese stock market reacts positively (negatively) to interest rate increases (cuts) by the central bank in short run. Specifically, Hu and Lai (2020) established a time-varying VAR system model of China's monetary policy and stock market for 20 years, and results pointed out the link between the two variables as "irrelevance, positive correlation and negative correlation".

In process of interest rate liberalization, how the stock market responds to changes in interest rates is an essential part of PBC's policy making, and hence to achieve the objective of the monetary policy – "maintain the stability of the value of the currency and thereby promote economic growth". This paper encapsulates an Error Correction model with Granger causality, filling in the gap in the literature, to investigate the response of the stock price index to the interest rate. Our findings suggest that there is a long-term reverse relationship between-interest rate and stock index in China, and the disequilibria from the previous shock of interest rate will be corrected in a short period, which provides central banks with useful information for policy-making.

The rest of the work is organized as follows: Section 2 introduces the interest rate and stock index, the Error Correction Model procedure is outlined in Section 3, which is followed by the description of the data and discussion of the estimation results in Section 4, and offers some concluding remarks.

2. INTEREST RATE AND STOCK INDEX

As the price representation of the fund, the interest rate indicates the rate of return of the fund provider's transfer of funds, and the cost of the borrower's use of funds. Changes in interest rate, therefore, represent the demand situation of market capital supply, and ultimately would have a certain impact on financial markets as well as the aggregate economy.

Central banks set Bank Rate, which is known by many different terms depending on the country, to influence other interest rates, and thus to achieve monetary goals and stimulate economic growth. If bank rate changes, banks normally change their interest rates on saving and borrowing. If bank rate is to be cut, the profits from financial markets such as the stock market will show a favorable trend due to the overall economic prosperity; if the bank rate is to be increased, an overheated economy is supposed to be cooling down, which may lower financial profits. In a low interest rates scenario, financial markets tend to be more liquid, and borrowing or lending is relatively easy; whereas an increase in the interest rates, the cost of financing will rise, and then may reduce the investment in financial markets.

Although a change in the bank rate usually takes time, around 12 months, to have a widespread economic impact, central banks keep a vigilant watch on stock market with its immediate response to a change. To observe stock markets, stock index is capable of a suitable proxy (Seo, Byun, & Kim, 2020). As a measure of a number of stock price statistics, stock index typically measures the performance of a basket of securities intended to replicate a certain area of the market and hence reflects the overall price level of the stock market and its changing trend. It could be a broad-based index that captures the entire market, such as the Standard & Poor's 500 Index or Dow Jones Industrial Average. When the stock index rises, it indicates that the average price level of the stock rises as well, which decreases as stock index falls. The stock index often serves as a benchmark for assessing the performance of portfolio returns and is also created to measure other economic data such as interest rates, inflation, or manufacturing output.

3. THE MODEL

To describe the impact of interest rate adjustment on China's stock market and equilibrium deviation adjustment mechanism, accommodate all relevant variables in the error correction model (ECM), which is written as

$$\Delta LNP_t = a_0 + b_0 \Delta LNR_t + \gamma(LNP_{t-1} - LNR_{t-1}) + e_t \quad (1)$$

where LNP is the logarithm of Shanghai Composite Index, LNR is the logarithm of China's one-year fixed deposit interest rate, $\gamma\ (LNP_{t-1} - LNR_{t-1})$ is an error correction term, e_t is a random error term. Error correction model is used to describe the autoregressive relationship between a variable and its lagging variable, which reflects the error adjustment process when the short-term shock occurs.

ECM is applicable to nonstationary series with known cointegration relations. Engle and Granger (1987) summarize and define the cointegration relationship: if two or more non-stationary time series are linearly combined to form a stationary time series, then these non-stationary time series have a cointegration relationship. If the variables x_t and y_t are co-integrated, the short-term disequilibrium relationship between them can always be expressed by an error correction model. For an ARDL (1,1) model, which is written as

$$y_t = a_0 + a_1 y_{t-1} + b_0 x_t + b_1 x_{t-1} + e_t \quad (2)$$

the first difference of equation (2) is outlined by the following

$$\Delta y_t = a_0 + b_0 \Delta x_t + \gamma(y_{t-1} - x_{t-1}) + e_t \quad (3)$$

where $\gamma = a_{l-1}$ and $1 - a_l = b_0 + b_1$, if y_t and x_t are both I (1) process, so Δy_t and Δx_t in equation (3) are both I (0) process,the right side of equation (2) is also I (0) only if y_t and x_t are cointegrated.

Cointegration test can prevent the occurrence of spurious regression, among which EG (Engle and Granger) two-step test method is commonly used. It is based on the regression test of the predicted residuals from the regression model and estimating the cointegration relationship between variables by checking the stability of the residual sequence. If the residual sequence is stable through the unit root test, it can be considered that there is a cointegration relationship.

To sum up, the establishment of the error correction model requires the cointegration analysis of the variables first, so as to find the long-term equilibrium relationship between the variables, and thus constitute the error correction term. Then the error correction term is regarded as an explanatory variable, and the short-term model established together with other explanatory variables reflecting short-term fluctuations is the error correction model.

4. EMPIRICAL ANALYSIS

Equation (1) is estimated by taking China's one-year fixed deposit interest rate (R) and Shanghai Composite Index (P) from Official Website of the People's Bank of China and the China Stock Market & Accounting Research Database. P and R are processed in logarithm to alleviate the heteroscedasticity that may exist in the model, which is written as LNP and LNR. The People's Bank of China has adjusted interest rates 36 times since the official release of the Shanghai Composite Index, so we use these 36 sets of data from April 21, 1991 to October 24, 2015 in this study.

Figure 1 plots the scatter diagram of the logarithm of China's one-year fixed deposit interest rate and Shanghai Composite Index from April 21, 1991 to October 24, 2015. It shows that the two variables generally show opposite trends, as the interest rate (R) increases, the composite index (P) decreases. Table 1 shows that the standard deviation of LNP is higher than LNR, normality test shows that LNR is normally distributed, and there is no heteroscedasticity between the variables by White test.

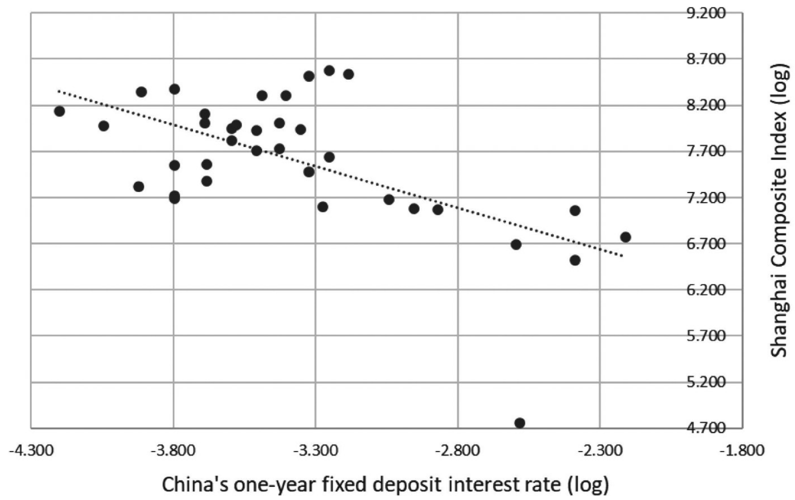

Figure 1. Data Scatter Diagram

Source: own processing

Table 1. Data Descriptive Statistics

	LNP	LNR
Obs.	36	36
Mean	7.606	-3.375
Std. Dev.	0.734	0.483
Normality	42.840	3.838
	[0]	[0.147]
Obs*R-squared	1.847	1.847
	[0.397]	[0.397]

Notes: Obs. denotes the number of observations. Std. Dev denotes the standard deviations.
The numbers in brackets are p-values.

Source: own processing

To better capture the stability of the series, several unit root tests are applied. As reported in Table 2, the ADF test fails to reject the null hypothesis at 5% level for LNP and LNR and rejects the null hypothesis at 1% level for DLNP and DLNR. The PP test fails to reject the null hypothesis at 5% level for LNR, but rejects the null hypothesis at 1% level for LNP, DLNP and DLNR. The KPSS test rejects the null hypothesis at 5% level for LNP and LNR and fails to reject that the variables are stationary at 10% level for DLNP and DLNR. Therefore, all the tests imply that LNP and LNR are both non-stationary series, meanwhile each variable in this paper can be described as following an I (1) process and can be tested by cointegration except PP test.

Table 2. Unit Root Tests

	ADF	PP	KPSS
LNP	-1.497	-4.801*	0.166
DLNP	-10.457*	-9.417*	0.112
LNR	-3.275	-1.720	0.522
DLNR	-3.436*	-2.970*	0.096

Notes: *Significant at 1% level; **Significant at 5% level; ***Significant at 10% level.

As reported in Table 3, the variables pass the E-G cointegration test at 1% level, implying that there is a long-term stable equilibrium relationship between LNR and LNP, which is written as

$$LNP = \alpha_0 + \alpha_1 LNR + \varepsilon \tag{4}$$

where α_0 is a constant term α_i is a coefficient term, ε is a random error term. As reported in table 4, there exists a reverse relationship between the two variables, one unit of interest rate adjustment will cause a nearly 90% change of the stock index reversely.

Table 3. E-G Cointegration Test

	Value	P-value
Engle-Granger tau-statistic	3.610	0.008*
Engle-Granger z-statistic	-15.840	0.026*

Notes: *Significant at 1% level; **Significant at 5% level; ***Significant at 10% level.

Source: own processing

Table 4. Regression Test

Variable	Coefficient	Std. Error	t-Statistic	P-value
C	4.568*	0.716	6.381	0.000
LNR	-0.899*	0.210	-4.285	0.001

Notes: *Significant at 1% level; **Significant at 5% level; ***Significant at 10% level.
R-Squared=0.351 S.E. of regression=0.600 Schwarz criterion=1.959 F-statistic=18.363
Durbin-Watson stat=0.747

Source: own processing

Next, we apply the Granger causality test (Granger, Ghysels, Swanson & Watson, 2001) to investigate if the adjustment of China's one-year fixed deposit interest rate can influence the Shanghai Composite Index. As the test results displayed in Table 5, we reject the null hypothesis that LNR has a significant influence on LNP at 10% level. Therefore, changes in interest rates will have a certain impact on the Shanghai Composite Index.

Table 5. Granger Causality Test

H_0	F-Statistic	P-value
LNR does not Granger Cause LNP	3.960*	0.055
LNP does not Granger Cause LNR	1.209	0.280

Notes: *Significant at 1% level; **Significant at 5% level; ***Significant at 10% level.

Source: own processing

Then, in order to analyze the short-term fluctuation relationship between interest rate and Shanghai Stock Index, the short-term fluctuation between variables is expressed by the error correction model, which is written as equation (1). The estimation results are presented in table 6, which suggests that the effects of short-term fluctuations can be represented by differential terms. Short-term changes can be seen as two parts, one is the effect of the short-term interest rate represented by the front coefficient of D(LNR), and the other is the effect of $ECM(-1) = \gamma(LNP_{t-1} - LNR_{t-1})$ on the long-term equilibrium deviation. The coefficient of the error correction term reflects the adjustment strength to the deviation from the long-term equilibrium. The regression fits at $R^2 = 57.5\%$, which implies that the impact of interest rate adjustment on stock index could not be long-term disequilibria, which will be corrected in short-time. When the Shanghai Composite Index deviates from the equilibrium state by 1 unit, the error correction term decreases by 56.1%, thus reducing its fluctuation and gradually restoring the equilibrium state.

Table 6. Error Correction Model

Variable	Coefficient	Std. Error	t-Statistic	P-value
C	0.131**	0.055	2.377	0.02
D(LNR)	0.669***	0.337	1.985	0.056
ECM(-1)	-0.561*	0.089	-6.279	0.000

Notes: *Significant at 1% level; **Significant at 5% level; ***Significant at 10% level.
R-Squared=0.575 S.E. of regression=0.312 Schwarz criterion=0.723 F-statistic=21.656
Durbin-Watson stat=1.307

Source: own processing

Results show that one unit of interest rate adjustment will cause around 90% change of the stock index reversely, which is in line with the previous evidence. Although the interest rate is the granger cause of stock price index at the significance level of 10%, the stock price index is not the granger cause of interest rate. So the stock price index can be explained by the past interest rate to a certain extent. The interest rate of the current period will have an impact on the stock price index of the next period and have a certain predictive effect on the stock price index. Meanwhile, the short-term fluctuation relationship between interest rate and stock price index can be obtained according to the error correction estimates. Once the short-term fluctuations deviate from the long-term equilibrium, the system will pull the index back to the equilibrium state from the non-equilibrium state with the adjustment intensity of –56.1%.

5. CONCLUSION

This paper investigates the response of the stock price index to interest rate through cointegration test and Granger causality test. An Error Correction model is also conducted to study the equilibrium deviation adjustment mechanism.

The estimated results in this study show that there is a long-term cointegration relationship between interest rate and stock index where they change in the opposite direction, which is in line with previous studies. Meanwhile we have demonstrated some significant results among the interactions between both variables: i) interest rate is the granger cause of stock price index, while stock price index is not the granger cause of interest rate; ii) the impact of the interest rate adjustment on the stock index returns could not be long-term disequilibria, and it will be corrected in a short period.

Our findings suggest that interest rate adjustment in China has a significant influence on stock index, which plays a key role in the movement of stock index. Thus, a central bank may set up interest rate, which could affect the price level of stock market; meanwhile such disequilibria caused by the interest rate adjustment cannot be a long term phenomenon, so the central bank may take other monetary actions to maintain financial stabilities. For further study, the bivariate framework could be extended to investigate a broader range of macroeconomic variables such as output growth, employment and thus to test market efficiency.

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