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Stock Performance after the US Federal Reserve Raised its Benchmark Interest Rate: Evidence from the ChiNext market in China

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Abstract:

In 2022, the US Federal Reserve raised its interest rate, which influenced the ChiNext market due to the spillovers. This paper utilizes ARIMA model to analyze closing prices from 2010 to March 2022. It will find out the relationship between the interest rate raised by the Fed and the ChiNext market. Influences on the ChiNext market are different in the short run and the long run. In the short run, raised interest rate has a positive impact on the closing prices, while that in the long run has an inverse impact. On of the possible reasons is that some stocks are related to exports and are periodic. Another reason is the time lag. Raised interest rate has further impact on the ChiNext and China's stock market including RMB depreciation and capital flight. The research is a supplement for literature as it focus on the ChiNext market. Related studies lack. It will provide guidance to researchers who are exploring the correlation between interest rate and China's stock market. It find outs the different effects of short-run and long-run and provide more perspectives from the causes of the difference and long-run implications. Due to the time lag, policymakers may not respond to changing interest rates in time. To minimize the potentially detrimental effect, they could employ forward guidance to communicate with the public about the expected future direction of monetary policy.

Keywords: Raised interest rate; ChiNext market; RMB depreciation; Time lag; Capital flight.

1. Introduction

ChiNext is a newly established market, which is a significant supplement for the Main Board Market. The characteristics of the market include low thresholds and loose listing requirements. The market is responsible for providing financing opportunities for small and medium-sized enterprises with potential that are temporarily unable to list on the Main Board Market. In most cases, companies in the ChiNext market have relatively undesirable performances and high risks, but they possess considerable growth potential. As the reform of the economic system advances, enterprises focusing on technological innovation have emerged as one of the critical forces of economic growth in China [1]. It is crucial to promote the advancement of technology-based small and medium-sized enterprises to facilitate China's capital market development [1]. In addition, the ChiNext market can help form an investment and financing system suitable for high-tech enterprises and further influence the development of countries. Therefore, it is meaningful to explore factors that can affect the ChiNext market and make wise measures in response to shocks. The raised benchmark interest rate by the US Federal Reserve is a significant factor. The large-scale and prolonged outbreak of the epidemic beginning in 2020 has caused a considerable impact not only on the US economy but also on the global. Since then, inflation in the US has gradually increased until it becomes an issue that cannot be ignored. In 2022, when CPI saw a year-on-year rise of 8.5%, the US Federal Reserve stepped in and raised the interest rates by 25 basis points in March. This sharp rate hike brings a shock to China's stock market and influences its economy.

Many studies investigate the connection between interest rates and the stock market. For instance, real interest rates are crucial in determining business cycle fluctuations, particularly in emerging markets [2]. Variations in real interest rates, along with the consequent capital flows, could significantly influence how capital and labor are allocated among different companies and industries, thereby affecting overall productivity [2]. In addition to economic operation, interest rates and inflation have a detrimental impact on the domestic stock market [3]. Ali states that interest rates could reduce the efficiency of the stock market

in Pakistan [3]. Toraman and Başarir claim that increasing interest rates, which means high risks, would prevent some investors from making stock market investments [4]. Furthermore, the time variations have had a more pronounced impact on the interest rate-stock market causality since the 2008 global financial crisis [5]. When the US stock markets experience fluctuations, there is a tendency for this volatility to spill over into extended Chinese markets and potentially other global markets as well [6]. Most of the studies mention the negative impact that the interest rate has on the stock market, and they are concentrated on a particular country. This suggests that some effects are circumscribed, and conclusions must be challenged before being utilized in another country.

However, the related studies explicitly focusing on interest rates and Second board market lacks. Is there any other positive influence? Do these effects on the stock market exist in China's second board market? How do these effects vary with changing national conditions and different interest rate rises? The essay will fill in the gaps and find out the relationship between raised interest rates by the US Federal Reserve and the ChiNext market. There are negative and positive effects caused by raised interest rates. First, capital flight can decrease closing prices. Another possible factor exerting a positive impact on closing price could be policy lag and effort. Second, RMB depreciation could affect exports and imports. An endeavor is to estimate the effect with quantitative analysis by applying an autoregressive integrated moving average model (ARIMA) to analyze the data from 2010 to March 2022. Then, the author will utilize the model to predict the closing prices after 17th March 2022, which is the first date after the interest rate is raised and compare the forecast with real data.

2. Research Design

2.1 Sources of data

The empirical analysis conducted in the research relies on data coming from Investing, an authoritative website that provides real-time data in stock markets worldwide. The research selects closing prices in the ChiNext market from 2010 to 2024. The daily and weekly closing prices from 2010 to 2022 March are modeled and result in 4 groups of data including price and p-value, employing Stata analysis software. The closing prices of stocks are used as the basis to construct a logarithmic stock index series. This approach is commonly used in financial analysis as it provides a more accurate representation of percentage changes over time. From this series, 1st order difference is calculated to determine logarithmic returns. Subsequently, the logarithmic return series are employed to construct the ARIMA model and predict the prices after 16th March 2022, when the US Federal Reserve raised interest rates, to evaluate the impact on the ChiNext market quantitatively.

2.2 ADF Unit Root Test

Subsequent to the processing of modeled data, unit root test is a necessary step, using the Augmented Dickey-Fuller Test (ADF), thereby determining whether the time series is stationary. A stationary series means that the observed data fluctuates at a fixed level. Based on the null hypothesis that time series are not white noise, the ADF test statistic value will be relatively significant if the real data largely deviates from the linear trend. In contrast, the value will be infinitesimally small if the actual data profoundly corresponds to the linear trend. As shown in Table 1, only p-values of the logarithmic return series after the first order difference are less than 0.1. Therefore, the null hypothesis is rejected, suggesting that the model with first-order difference is stationary and viable, while the model based on the logarithmic stock index series does not work.

Table 1 Weak stationarity test

	t	p
Daily price		
Ln value	7.8885069	0.6066
1st order difference	7.87709	0.0000
Weekly price		
Ln value	7.919225	0.6234
1st order difference	7.957458	0.0000

2.3 ARIMA Model

Consisting of the Autoregressive model (AR), Integrated (I), and Moving Average model (MA), the Autoregressive Integrated Moving Average Model (ARIMA) model is a method that helps forecast future values based on the past time series. It is comparatively accurate in predicting short-term trends of economic operation. According to Table 1, the model from the logarithmic return series with 1st order difference satisfied the requirement of the ARIMA model. In arima (p,d,q), p is an autoregressive term, representing the order of the AR model. d is the degree of difference. q is the moving average term, representing the order of the MA model.

AR stands for autoregressive, which is dependent only on past historical value. The mathematical form can be expressed as follows:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \cdots + \beta_p y_{t-p} + \varepsilon_t \quad (1)$$

MA stands for Moving Average, describing current data concerning past noise. Its definition is based on the hypothesis of white noise series. The mathematical form can be expressed as follows:

$$y_t = \mu + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \cdots + \theta_q \varepsilon_{t-q} \quad (2)$$

d is the order of difference. Difference is the process where time series are altered to a stationary state, which makes it easier to construct a model. In the research, the AR model specifically employs daily and weekly logarithmic returns with 1st order difference before the US Fed increased the interest rate in 2022 to predict the future. Meanwhile, the MA model utilizes the error of previous q periods.

3. Empirical results and analysis

3.1 Order Determination and Residual Test

The research first uses PACF and ACF to determine the daily and weekly orders of the AR model and MA model, according to Figure 1.

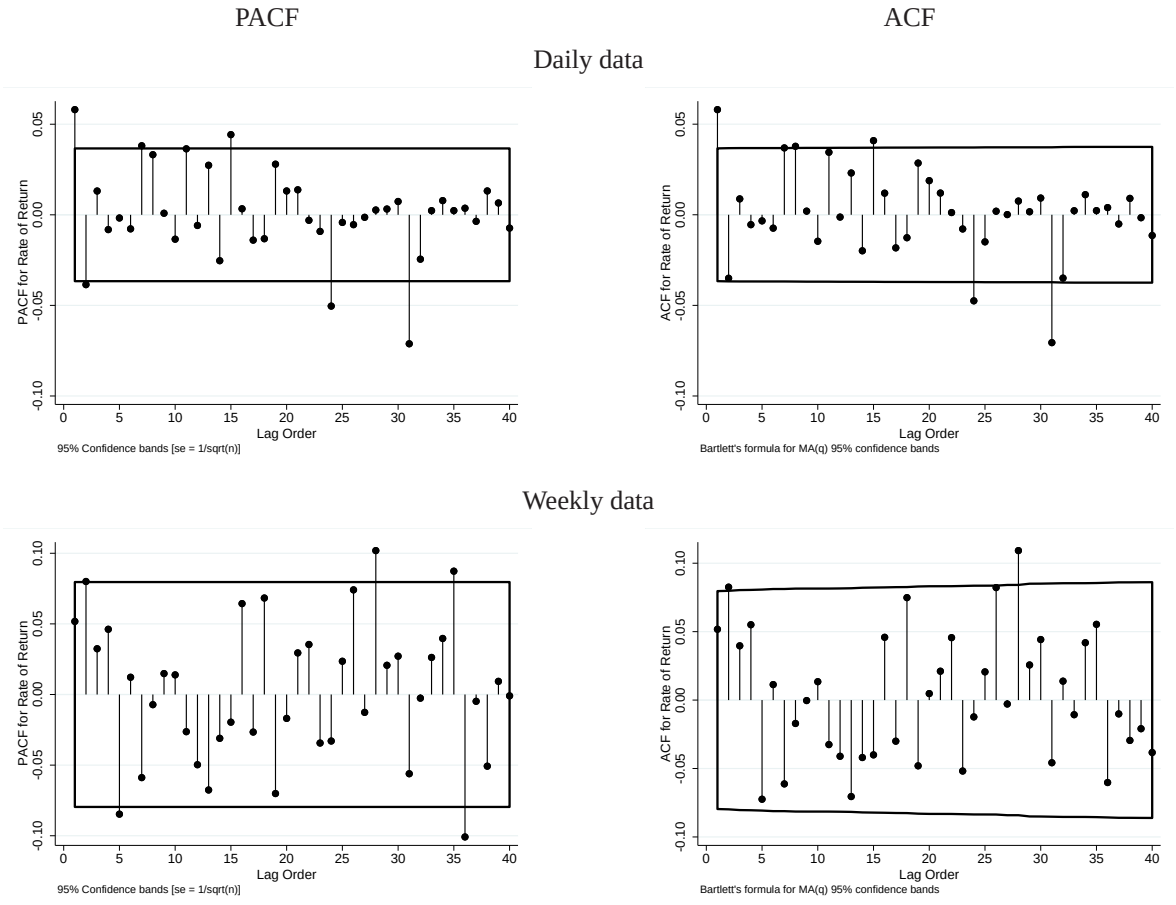

Figure 1 ARMA (p, q) identification

Note: The X-axis represents lag order. The Y-axis is daily and weekly PACF and ACF of the logarithmic return with 1st

order difference.

Photo credit: Original

The areas bounded by x=1 and x=40 are under a 5% significance level for AR (p) and MA (q). If ACF images are trailed and PACF images are truncated, the AR model is suitable for the given time series. In this case, the lag at which the PACF cuts off provides the optimal value for the hyperparameter p in the AR model. Similarly, if PACF images are trailed, and ACF images are truncated, MA model is more appropriate. The lag at which the ACF truncates provides the ideal value of hyperparameter q in the MA model.

PACF shows a correlation between two observations and cannot interpret the shorter lags between observations. In ACF, q is the lag. Smaller parameter q usually has stronger positive correlations as data that is closer in time appears to be more similar [8]. According to Figure 1, the orders of daily AR and MA are 7 and 8, which are larger than the orders of weekly models.

Table 2 Residual test

Model	Portmanteau (Q) statistic	Prob > chi2
Daily price - ARIMA (7,1,8)	28.4341	0.9143
Weekly price - ARIMA (5,1,2)	36.2725	0.6388

According to Table 2, the ARIMA models, including daily and weekly prices, pass the residual tests, as both the values of Prob > chi2 surpass 0.1, suggesting that the series are white noise and stationary.

3.2 Forecast results and interpretation

Tables 3 and 4 represent daily and weekly actual and predict values in the ChiNext market, starting from 16th March 2022. PV stands for predict value. Difference (%) is the percentage deviation of the difference from the fitted value.

Table 3 Daily-ARIMA (7,1,8)

	Closing price	PV	Difference	Difference (%)
3/4/2022	2748.64			
3/7/2022	2630.37			
3/8/2022	2582.99			
3/9/2022	2566.72			
3/10/2022	2635.19			
3/11/2022	2665.46			
3/14/2022	2570.45			
3/15/2022	2504.78			
3/16/2022	2635.08	2507.424	127.6563	5.09%
3/17/2022	2710.73	2512.584	198.1459	7.89%
3/18/2022	2713.79	2516.35	197.4396	7.85%
3/21/2022	2726.18	2518.28	207.9004	8.26%
3/22/2022	2688.23	2517.895	170.335	6.76%
3/23/2022	2715.95	2511.088	204.8624	8.16%
3/24/2022	2706.21	2504.758	201.4524	8.04%
3/25/2022	2637.94	2505.159	132.7812	5.30%

From Table 3, it is observed that closing prices in the ChiNext market are affected by interest rates raised by the US Fed in the very short run with the percentages of difference fluctuating from 5% to 9%. In the longer term

from 16th March to 17th April, it is prevalent that the difference is more remarkable with time variations. As shown in Table 4, the absolute value of the percentage of difference increased from 2.5% to 16.17%. Generally, the percentages of difference in the daily table are smaller than the absolute value of the percentages in the weekly table. Another difference between the two tables is that the daily differences stay positive while the weekly differences are negative, as seen in Figures 2 and 3. This difference means that in the short term, interest rates raised by the Fed have a positive impact on the ChiNext market. Raised interest rates suggest a rise in dollars and the ensuing depreciation of RMB. For export and import, this depreciation stimulates export, which leads to an increase in related stock prices, such as foreign trade, port, and shipping. Periodic stock, such as steel, coal, and oil, also benefits from the raised interest rate in the short run [9]. In contrast, in the long term, they have a negative impact, as shown by the apparent downward trend of closing prices in the ChiNext market.

Table 4 Weekly - ARIMA (5,1,2)

	Interest rate	PV	Difference	Difference (%)
2/13/2022	2826.81			
2/20/2022	2855.8			
2/27/2022	2748.64			
3/6/2022	2665.46			
3/13/2022	2713.79			
3/20/2022	2637.94	2705.644	-67.7041	-2.50%
3/27/2022	2666.97	2711.307	-44.3373	-1.64%
4/3/2022	2569.91	2720.157	-150.247	-5.52%
4/10/2022	2460.36	2735.444	-275.084	-10.06%
4/17/2022	2296.6	2739.455	-442.855	-16.17%

On a weekly basis, the data spans from 13th February to 17th April, providing a wider timeframe to analyze and understand the trend of the ChiNext market. The actual prices remained lower than predicted and experienced a diminishing trend. The reason for this could be policy lag in the aspects of implementation and influence. For instance, in the increasing interest rates the US Federal Reserve raised, the Central Bank in China comprehensively lowered the reserve requirement ratio. However, medium and long-term lending remains weak due to time lag. It takes time for policy to work well after being implemented. In this paper, the result could be the different performances of the ChiNext market. Furthermore, a lack of policy effort would strengthen the lag effect. It might be a challenge for policymakers to tackle the issue effectively due to time lags. When the Federal Reserve raised its federal fund rates, it took months to see the visible impact. To mitigate the lag effect, policymakers and central banks could employ variable strategies [10]. Forward guidance is a method that central banks utilize to inform the public about the expected future direction of monetary policy [11], is a viable approach.

Figure 2 Daily price and predicted value

Photo credit: Original

The analysis contributes insights into the inverse impact of short-term and long-term on the ChiNext market. As for the short term, one of the potential positive impacts is the depreciation of RMB. Increasing interest rates can reduce both consumer spending and investment, making saving a more appealing choice. The stimulation of saving decreases the money supply in circulation, curbs inflation, and leads to US dollar appreciation [12]. The RMB depreciation could benefit enterprises relying on exports as the costs decrease and expand the export scale. In contrast, RMB depreciation is bad news for enterprises that depend on imports because the real purchasing-power of the yuan decreases and the costs of imports increase.

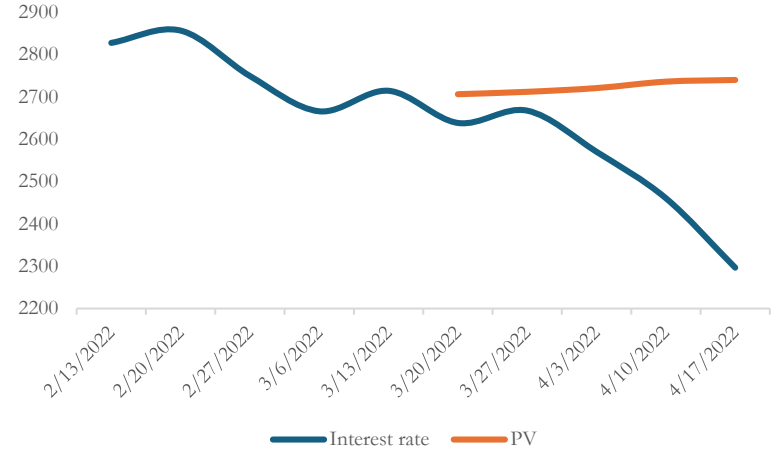

Figure 3 Weekly price and predicted value

Photo credit: Original

The negative influence on the ChiNext market is capital flight, which refers to the outflow of money, assets, or capital leaving a country for different reasons that can affect liquidity, inflation and the ability to purchase goods and services. The downward closing prices in the ChiNext market imply that the expectations of prospects are weak and dive capital out. If the outflow continues, China's ChiNext market and stock market may encounter continued instability [13].

4. Conclusion

The research has found that interest rates raised by the Federal Reserve have an impact on the ChiNext market, including positive and negative influences. The results differ in short term and long term. Interest rates positively affect the ChiNext market as the actual closing prices remain higher than the fitted value. In the long term, the difference between the actual and the fitted values is negative, suggesting a detrimental effect. One of the possible causes is the policy lag. The potential influences include

capital flight and RMB depreciation. Both could further influence the ChiNext market. With the increasing interest rate, responding in time could be a challenge. Therefore, governments and central banks should spare efforts to implement strategies. Forward guidance is an effective tool to inform the expected monetary policy, such as by adjusting interest rates. This study has contributed to existing literatures by providing a more specific perspective of the ChiNext market. It can help researchers look for support for the correlation between interest rates adjusted by the Federal Reserve and ChiNext and China's stock market performance. However, the research has drawbacks. It did not further develop how the impact on the ChiNext market could spread throughout the world. The application range is restricted to the ChiNext market.

References

[1] Qiao, G.X., Zhao, P.F., Li, W.P. Time varying price discovery of the New Third Board market in China: does the market-making system help?[J]. Applied Economics, 2019, 51(45), 4902–4919.

[2] Monacelli, T., Sala,L., Siena, D. Real interest rates and productivity in small open economies[J]. Journal of International Economics, 2023.142, 103746

[3] Ali, H. Impact of Interest Rate on Stock Market; Evidence from Pakistani Market[J]. Journal of Business and Management, 2014, 16, 64-69

[4] Toraman, C., Başarir, Çağatay. The Long Run Relationship Between Stock Market Capitalization Rate and Interest Rate: Co-integration Approach[J]. Procedia - Social and Behavioral Sciences, 2014, 143, 1070-1073

[5] Jammazi, R., Ferrer, R., Jareño, F., Hammoudeh, S.M. Main driving factors of the interest rate-stock market Granger causality[J]. International Review of Financial Analysis, 2017, 52, 260-280.

[6] Vuong, G.T.H., Nguyen, M.H., Huynh, A.N.Q. Volatility spillovers from the Chinese stock market to the U.S. stock market: The role of the COVID-19 pandemic[J]. The Journal of Economic Asymmetries, 2022, 26, e00276

[7] Brownlee, J. A Gentle Introduction to Autocorrelation and Partial Autocorrelation [EB/OL]. (2020-8-14) [2024-5-5]. https://machinelearningmastery.com/gentle-introduction-autocorrelation-partial-autocorrelation/

[8] Frost, J. Autocorrelation and Partial Autocorrelation in Time Series Data [EB/OL]. (no date) [2024-5-5]. https://statisticsbyjim.com/time-series/autocorrelation-partial-autocorrelation/

[9] Sina Finance. When the Fed rate hike landing, what is the impact on A shares and Hong Kong stocks? [EB/OL]. (2022-3-17) [2024-5-5]. https://finance.sina.com.cn/roll/2022-03-17/doc-imcwipih9060686.shtml?finpagefr=p_115

[10] Bamigbola, S. Response Lag: Definition, Real-world Examples, and Strategies [EB/OL]. (2024-3-21) [2024-5-5]. https://www.supermoney.com/encyclopedia/response-lag

[11] Board of Governors of the Federal Reserve System. What is forward guidance, and how is it used in the Federal Reserve's monetary policy? [EB/OL]. (2015-12-16) [2024-5-5]. https://www.federalreserve.gov/faqs/what-is-forward-guidance-how-is-it-used-in-the-federal-reserve-monetary-policy.htm

[12] Egilsson, J. H. How raising interest rates can cause inflation and currency depreciation[J]. Journal of Applied Economics, 2020, 23(1), 450–468.

[13] Musacchio, A. Capital Flight [EB/OL]. (2013-1-1) [2024-5-5]. https://www.sciencedirect.com/topics/economics-econometrics-and-finance/capital-flight