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The Influence of the Federal Reserve System Interest Rate Hike on Tesla: Empirical Research Based on ARIMA Model

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Abstract: On 23 March 2022, the Federal Reserve System announced interest rate hikes and increased 25 basis points. After that, a series of negative monetary policies were carried out. Tesla CEO stated that the price of cars must be reduced when interest rates rose sharply. This means that Tesla's stock price will continue to decrease. The 25 -basis points raised the rate of interest rates and the highest interest rate reached 5 % to respond to inflation. The rate hikes of The Federal Reserve System have a great impact on the world. This article selected all stock data from Tesla from the listing to August this year (including daily data, weekly data, and monthly data) and uses ARIMA model to model and analyses the data. It will compare with the actual value of the Federal Reserve System. According to the study, the trend of the decline in stock prices after the RECERAL Reserve System raised interest rates is the same as the trend of research prediction in this article. Its interest rate hikes will cause Tesla's stock price to fall.

Keywords: Federal Reserve System, raise interest rates, Tesla, ARIMA model, stocks

1. Introduction

Explanation of The Federal Reserve System. It is the Central Bank of the United States. It provides the United States with a flexible and stable currency and financial system [1]. This shows that it has a very high position in the United States and many small banks rely on it to invent, and its policies also affect other American banks. The Federal Reserve System adjusts interest rates based on changes in different periods to develop monetary policy [2]. This represents the increase in interest rates of the Federal Reserve System, other companies and banks will get better savings interest. Then deposit more money to achieve the policy of recycling currency. Therefore, other bank will definitely increase deposits to The Federal Reserve System, reduce loans. Therefore, they will get more interest on deposit. The current money in the bank has become less, so the money loan from the bank will become less. If the company or individuals will not invest from the bank's loans, they will not invest, so that the money entering the stock market will become less. If company enter the stock market less, the stock market will fall.

Studies have found that The Federal Reserve System raising interest rate hikes have led to a series of economic consequences. Firstly, The change in interest rates is inevitable and inflation. [3]. The Federal Reserve System rate hikes will inhibit inflation. When banks increase interest rates, individuals or companies will choose to increase their savings, so their consumption will become less. The meaning of inflation is that when the demand is greater than the supply, the purchase power of

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money will decrease, so it needs to spend more money to buy the same items [4]. When most people's consumption becomes less, that is, their demand is reduced, and the speed of price increases slows down. The inflation rate will be reduced. Secondly, Long -term low interest rate will lead to the depreciation of the US dollar, which will also reduce the circulation of goods. [5]. On the contrary, the Federal Reserve increases interest rates to recover the US dollar in the market, thereby reaching the US dollar appreciation to increase purchasing power. This shows an increase in deposit interest rates of US, so the circulation of the US dollar will become less. The purchasing power of the US dollar has risen, and this is the appreciation of the US dollar. Thirdly, The Federal Reserve System rate hikes will lead to an increase in borrowing costs, and the financing cost of stocks will also rise. It will promote investors from stock markets to lower risk assets [6]. In the short term, the rate hike of The Federal Reserve System will lead to contraction of the stock market, and the adjustment and adaptability of the medium and long -term stock market will determine the final performance of the stock market.

In summary, according to the current literature, the company is replaced with Tesla. On the one hand, The Federal Reserve System rate hikes will lead to decrease in inflation, increased savings and consumption, and appreciation of the US dollar. This means that consumers can buy Tesla cars with the same price through less dollars. On the other hand, The Federal Reserve System rate hikes will cause Tesla's stock price to fall, which leads to a decline in the market value of Tesla.

The rest of the structure of this article are as follows: The second section will introduce data sources, unit root inspection, and ARIMA model settings. Section 3 will show the empirical results and analysis (ordering, prediction results and interpretation). The conclusions of this article will be discussed next. Revelation and final conclusions of this article.

2. Research Design

2.1. Data Source

The data comes from INVESTING [7], and Tesla has selected Tesla's stock price data from listing to the present. Daily data, weekly data, and monthly data are used as analytical materials. Starting the model from the first time of the first increase of the Federal Reserve System.

2.2. Weak Stationarity Test

According to Table 1, these data generally reflect whether the difference in daily, weekly, and monthly data difference can stabilize modeling.

For daily data, the first -order difference from the data has reached smoothly, but it is still necessary to do the second -order difference. Because the PACF cannot be settled when the first -order difference, it cannot be modeling, so the second order difference is made Essence It also reached stability.

For weekly data, it has reached stability when the first-order difference, so the next step can be performed.

For monthly data, it has also reached the stability when the first-order difference, so the next step can be performed.

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Table 1: Weak stationarity test.

	t	p
Daily		
Ln price	-1.856	0.6773
1st order difference	-40.581	0.0000
2nd order difference	-70.988	0.0000
Weekly		
Ln price	-1.870	0.6701
1st order difference	-16.806	0.0000
Monthly		
Ln price	-2.024	0.5882
1st order difference	-9.122	0.0000

2.3. ARIMA Model

$$T_t = \emptyset_0 + \sum_{i=1}^{p} \emptyset_i y_{t-i} + \alpha_i - \sum_{i=1}^{q} \emptyset_i \alpha_{t-i} \quad (1)$$

The introduction of the ARIMA model (p, d, q), its basic formula is shown above. $\{\alpha_t\}$ is a white noise sequence. p, q are non -negative intestines. d represents class. The AR and MA models are special situations in ARIMA. $\emptyset_0 + \sum_{i=1}^{p} \emptyset_i y_{t-i}$ can be expressed as AR (p), while the rest represent MR (q).

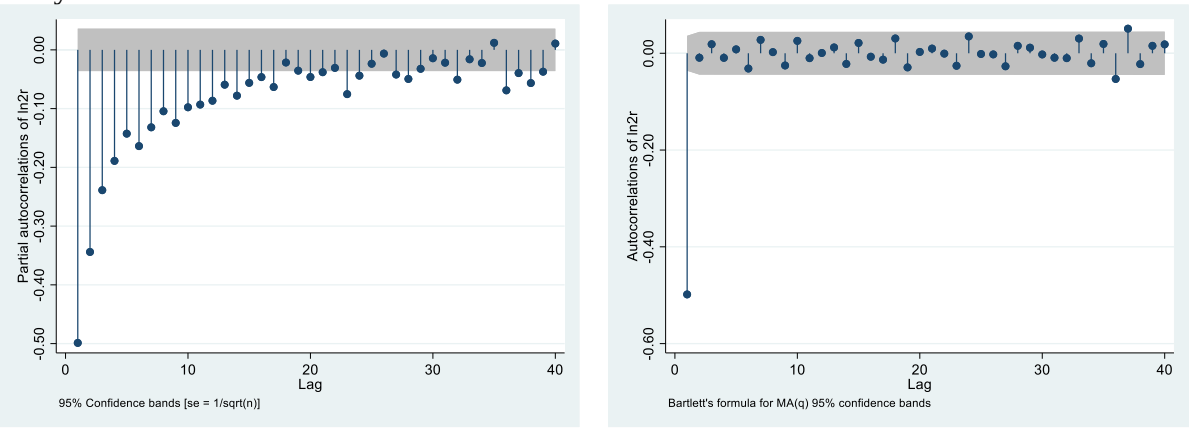
3. Empirical Results and Analysis

3.1. Order

It can be seen from Figure 1 when the unit roots appear unstoppable, the differential method needs to be solved. For daily data, the reason for making the second difference is that the first difference is not effectively modeling, and the order is too large. For weekly and monthly data, it only needs to make a differential to achieve stability. For this model, it has three parameters (p, d, q). d means the number of differential times. For daily data, its d represents 2, and the others are determined by PACF. ACF to determine the value of q.

PACF ACF

Daily



Weekly

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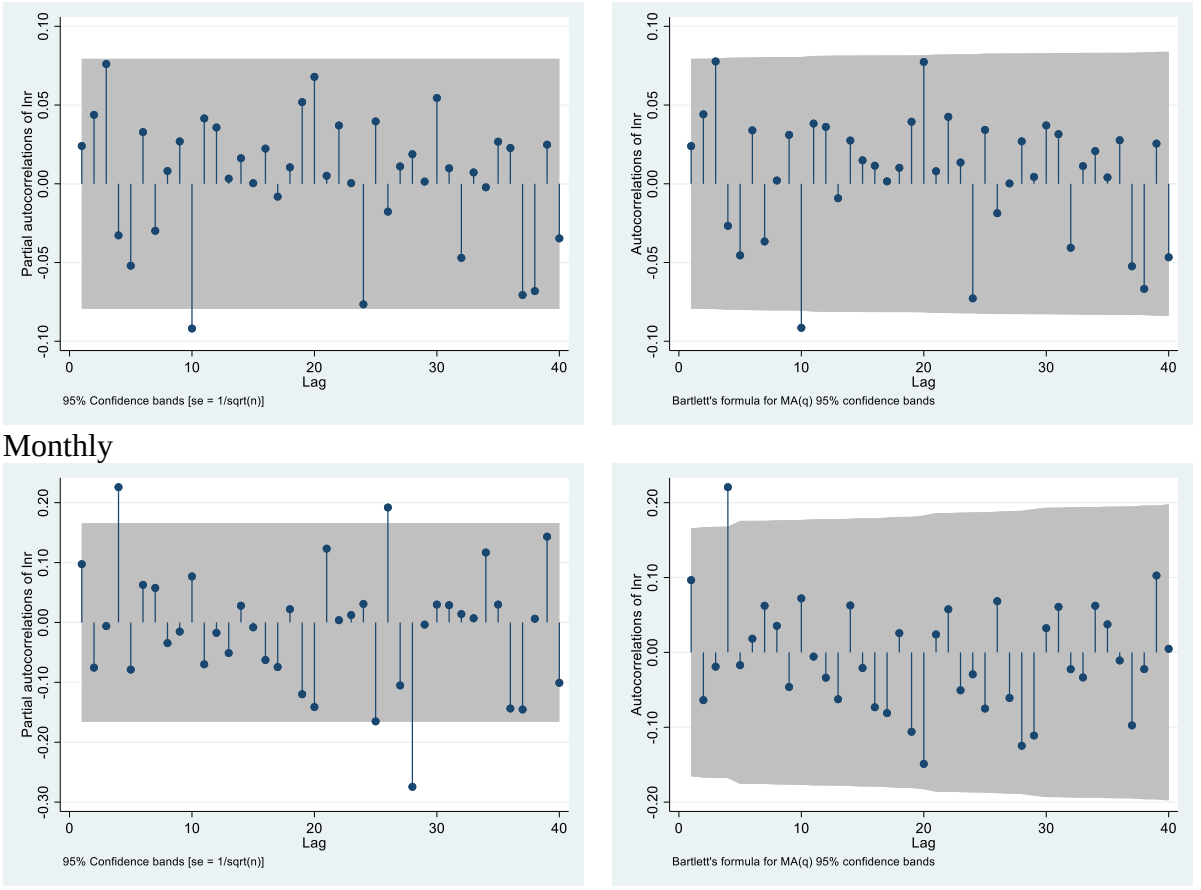

Figure 1: ARMA (p, q) identification.
Photo credit: Original

According to the number sequence diagram, the daily data PACF is taken 10, because the order of the MLE is too high, the order of the order will cause no convergence. ACF is significant at 1, so take 1. For daily (10, 2, 1). For weekly data, the 10th order of PACF is significant, and the 10th order of ACF is also significant. So you can take (10, 1, 10). For the monthly data, the first significant point of the initial is 4. (4, 1, 4).

Table 2: Residual test.

Model	Portmanteau (Q) statistic	Prob > chi2
Daily-ARIMA(10,2,1)	42.1094	0.3798
Weekly-ARIMA(10,1,10)	22.8648	0.9865
Monthly-ARIMA(4,1,4)	31.9539	0.8139

According to Table 2, the model of $Y = x\beta + \varepsilon X\beta$ can explain Y well, ε is white noise. The original assumption here is that there is no correlation between the sequences. If the value of Prob> Chi2 is greater than 0.1, it means accepting the original assumption, that is, the sequence here is not related. Daily data and week data are expected to accept the original assumptions. So these three models can be used.

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3.2. Empirical Results and Analysis

According to Figure 1, the Actual Value of Tesla's stock is constantly rising, but the FITTED VALUE of Tesla shares continues to decline according to the model inspection results. The percentage of their changes is 20 %. The cause of this result is also expected by this study. There are two reasons for the differences between the Actual Value and Fitted Value: the policy hysteresis and interest rate hike are not enough.

Firstly, the financial market has a policy lag, and the change of currency changes can only change after a long lag and a long time [8]. This study can prove that after the rate of interest rate hike The Federal Reserve System, the reason why Tesla's stock price changes and expected changes are due to the lagging policy. According to Figure 2, the actual price of Tesla's stock price is in a state of continuous rise within 10 days, which is partly because the cycle of currency changes is not enough. It takes time to take the corresponding currency action, and it takes time until the policy play is effective.

Secondly, the reason why Tesla's actual value is different from the Fitted Value is that the Federal Reserve System is not raised enough. Regarding the various nodes and amplitude changes of the US interest rate hike [9]. The United States began to raise interest rates for the first time on March 17, 2022, adding 25 basis points. However, according to the data, the rate of interest rate hikes is far from enough. During the subsequent period, almost every month will raise interest rates to increase an average of 33 basis points. Federal Funds Rate has risen from 0.25 to 4.00 percent. This means that the amplitude after the first interest rate hike cannot effectively deal with the inflation that occurred at the time, so the impact on Tesla in a short period of time was not enough.

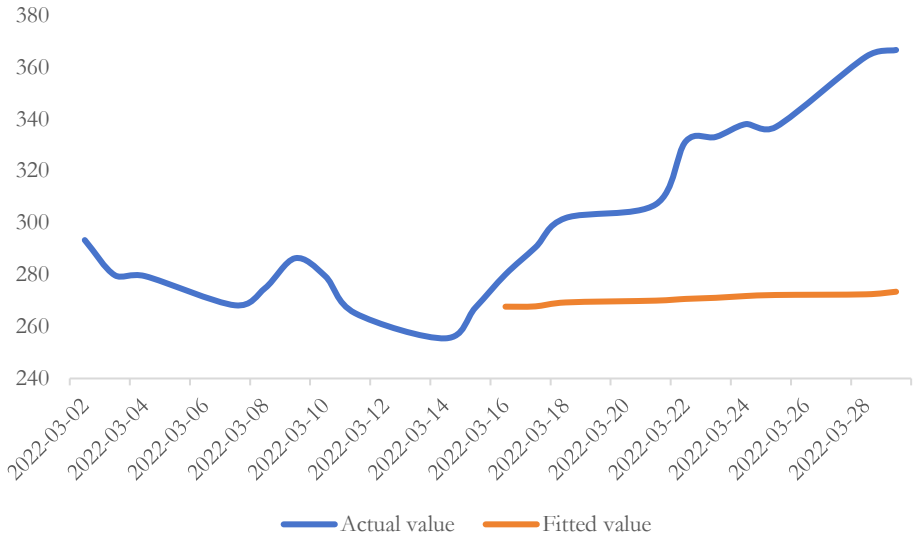

Figure 2: Actual value and fitted value, daily.
Photo credit: Original

According to Figure 3, the data chart of the next 10 weeks. Although there is an upward trend at the beginning, the overall results are not deviated, which is consistent with the prediction trend of the experimental model. Starting from the start of the first two weeks, the actual value of the first two weeks was increased from the first two weeks. After that, the actual value continued to decline with the Fitted Value, and the changes in the past 10 weeks were only 0.05 percent. This represents the

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change of monetary policy changes from the midterm. Tesla's stock price will continue to decline with the increase of interest rate hikes.

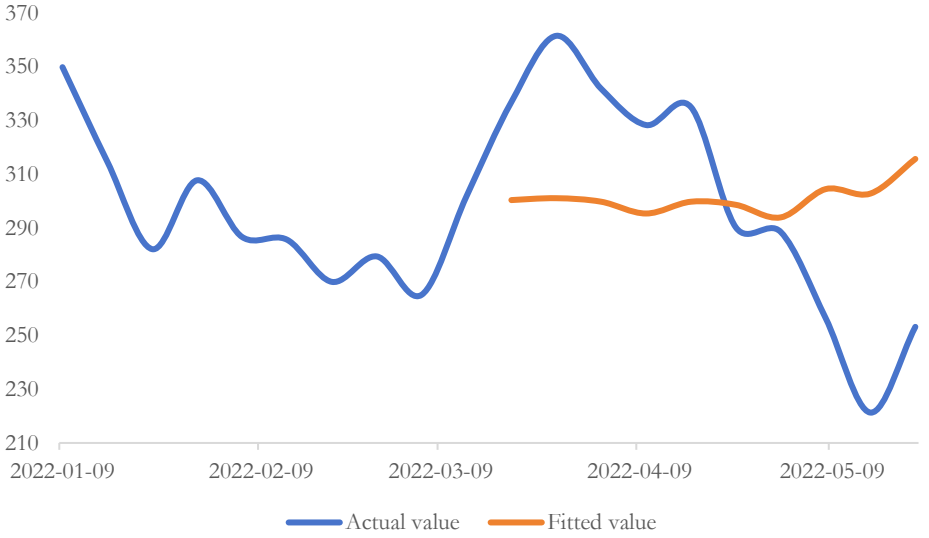

Figure 3: Actual value and fitted value, weekly.
Photo credit: Original

According to Figure 4, images of the next 4 months. With the continuous interest rate hikes of The Federal Reserve System, the actual value is more different from the middle data compared with Fitted Value. This also means that Tesla is difficult to deal with the rate hikes of The Federal Reserve System, and its stock market has begun to plummet, and the percentage of data changes has reached -34.59 percentage. This also means that Tesla cannot make effective strategies to resist.

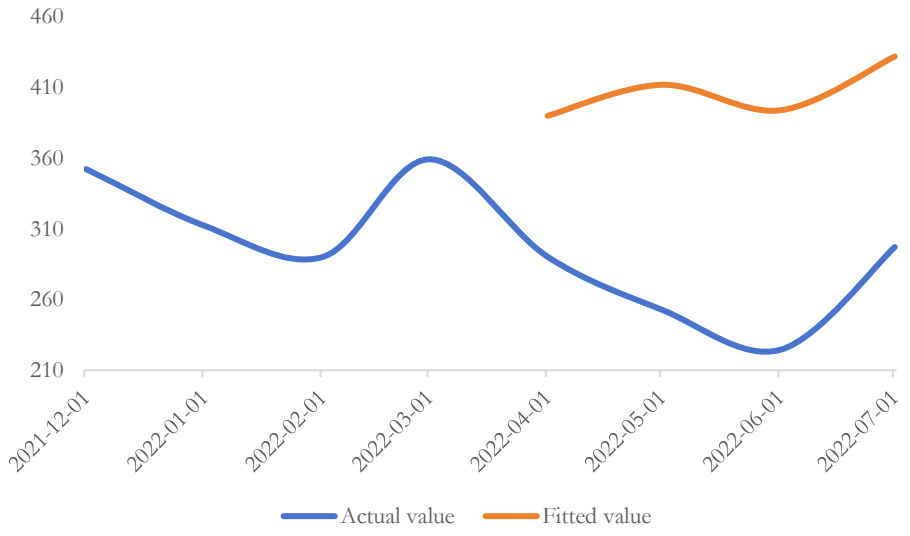

Figure 4: Actual value and fitted value, monthly.
Photo credit: Original

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4. Discussion

The main content of Mary's research is how interest rates affect the stock market change. She mentioned that the stock market also followed the reasons for changes and the type of consumers who recommended consumers to buy stocks [10]. Emerging market stock markets are very sensitive to economic news, and financial market participants tend to pay close attention to the announcement of changes in policy changes [11]. When the Federal Reserve System's interest rate hike means that stocks will continue to fall, investors in emerging markets will lose a lot. The interest rate and the stock price have a significant negative relationship [12]. That is to say, when the interest rate increases, the price of the stock will fall. The research on this article focuses on the rise of the Federal Reserve system, using the ARIMA model to predict the changes in the Tesla stock market and propose the reasons for prediction and actual changes. Compared with these two authors, the authors of this article are more oriented to find The Federal Reserve System raising interest rates from the data aspects of the data. The other two authors are more inclined to analyze how interest rate changes affect the stock market through actual examples. The same point is that for the prediction of The Federal Reserve System, it will cause interest rate hikes to cause shrinkage in the stock market, and the price of stocks will fall.

5. Conclusion

The research purpose of this article is to better understand the impact of The Federal Reserve System interest rate hike on Tesla's stock market. For more accurate experiments, the daily data, weekly data, and monthly data of the changes in the Tesla stock market are selected. Analyze the reasons for changes in stock prices from the perspective of short -term and long -term perspectives. ARIMA model is selected for modeling this time, and the stability of the model is verified by the unit root inspection. Secondly, the Residual Test is used to prove that the feasibility of this play is completely feasible. Looking at the final result, with the increase in interest rates of The Federal Reserve System, Tesla's stock price will inevitably fall. And over time, from a long -term perspective, the difference between the actual values and the fitted value is getting bigger. If the value of the stock is rising, the rate hike stop of The Federal Reserve System is an inevitable condition.

For the research on this article, based on research and analysis, when the interesting system of The Federal Reserve System increases, Tesla's stock decline is an inevitable trend. For short -term perspective, there may be financial -related policies or Tesla. Measures to slow down the frequency of decline, but in the long run, Tesla's stock market is inevitable, and as the rate hike increases, the price of Tesla's stock market is getting bigger and bigger.

Policy makers can speculate that other companies and the entire stock market will change according to the data of this article and related forecasts, and they can be alert to the future when designated policies. Investors can learn about the changes in the Tesla stock market according to the research of this article. As long as the increase in interest rate hikes, the trading price of the stock will continue to fall, and the amplitude will increase. Investors can better choose Stocks or companies with smaller fluctuations.

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