

The Evolving Impact of the Post-Pandemic Federal Funds Rate Hikes on the Dollar Index

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Abstract: On March 17th, 2022, the Federal Reserve issued its first federal funds rate hike to address elevated inflation rates and consumer prices amidst the post-pandemic period. By July 2023, the Fed had raised the rate eleven times, increasing it from 0.25% to 5.50%. These monetary policies not only played a role in stabilizing prices and containing inflation but also contributed to strengthening the U.S. dollar index. This research analyzes the quantifiable impact of these rate hikes on the dollar index by implementing time series models and creating visualizations of daily, weekly, and monthly index trends. Specifically, leveraging data from 2010 to 2023 and utilizing ARIMA modeling, the goal is to provide an understanding of the relationship between the Fed's monetary policy choices and the standing of the U.S. dollar in global financial markets. A key finding is that there is a positive increase in the dollar index change after the rate hikes compared to no action by the Fed. The daily data is less convincing than the monthly data in reaching this conclusion.

Keywords: USD, Index, Rate Hikes

1. Introduction

Given the severity of the COVID-19 pandemic, economies across the globe struggled to maintain prosperity caused by the lack of international trade and consumer spending. The United States, in particular, faced surging inflation rates, stagnating growth, and high levels of unemployment rate. This led the Federal Reserve to implement monetary policies to control the economy by increasing the federal funds rate, otherwise known as the interest rate. With more domestic and international customers saving money in U.S. banks and investing in long-term high-interest products, the Fed's policy effectively created a robust defense for the U.S. economy amidst the chaos of the post-pandemic financial crisis.

1.1. Background

The dollar index is used to set the value of the U.S. dollar in the international market and serves as the indicator of international financial stability and the relative strength of the U.S. economy. This index is closely tied to the interest rate, and a change in the latter can influence international trade and investment decisions.

1.2. Literature Review

The federal funds rate has long been viewed as a valid indicator of the effectiveness of monetary studies. Previous studies have consistently emphasized its role in regulating inflation and influencing the broader economy. However, there can be concerns regarding the effectiveness of the federal funds rate in making an impact on key economic indicators. In a 2014 study, the research questioned whether traditional tools of monetary policies, like the Fed funds rate, still remain influential after the 1990s. They warned policymakers to give careful recommendations based on their concluded inconsistency [1]. Beyond the national scope, the monetary policy can also negatively affect foreign economies due to the power of the U.S. economy. One study showed that despite being smaller and more delayed, GDP in developed countries dropped by about 0.5% three years after a 1% interest rate rise [2]. In emerging market countries, capital outflow to the U.S. caused by the hikes is not likely to return to the original economy in the short run, thus requiring monetary authorities in those countries to take action to prevent a shrinking economy [3]. Another study, with the goal of evaluating the post-pandemic interest rate hikes' impact on stock market values, discovered solid proof that exports and overseas investors significantly influence company worth when there is a U.S. interest rate shock [4].

Domestically, the Federal Reserve makes decisions about whether to manipulate the interest rate to slow inflation, which could be effective in the short run but problematic in the long run [5]. Thus, the interest rate is a reliable indicator of economic health as it is a closely monitored value and is less likely to be skewed by immediate economic conditions, compared to metrics like the money growth rate [6].

An important component of this economic research is the use of time series analysis, specifically ARIMA models, which have been extensively used for economic forecasting. Since the 1970s, this type of time-series model has been used by economists to tackle a range of problems. On a micro-scale, researchers used ARIMA to forecast live cattle future prices [7]. In another study, a researcher stressed the robustness of these models. Smith suggested that some macroeconomic indicators may become unstable with time fluctuations while using noise-reducing methods could offer more accurate predictions of the business cycle [8].

1.3. Research Purpose

The dollar index reflects the current value of the U.S. dollar and indicates trends in the economy's growth or decay rate. Therefore, examining the relationship between the interest rate and the dollar index provides a robust framework for evaluating the effectiveness of changes in the rate. In this context, the paper seeks to contribute to this understanding by employing a rigorous empirical analysis, utilizing ARIMA models, to quantify the short-term and gradual effects of federal funds rate hikes on the dollar index.

In Section 2, the research design is outlined, which includes the data sources, the methods used for unit root testing, and the ARIMA model settings. Section 3 presents the data findings and interpretations, including the determination of the order of the ARIMA model and the predictions and interpretations of the results. Section 4 offers a discussion of the findings and identifies research insights. Lastly, Section 5 summarizes the essential findings and their implications for future research and policy decisions.

2. Research Design

2.1. Data Sources

The research gathers U.S. dollar index values from 2010 to 2023, sourced from "cn.Investing.com." The full dataset contains the closing values of daily, weekly, and monthly dollar indexes. Meanwhile,

the federal funds rate information was acquired from the Federal Reserve’s official records. The initial date of the raise in 2022 was on March 17th, with a rate increase of 25bps. This date, along with the corresponding week and month, is used as the base value for the change and set as t0 in the analysis portion.

2.2. ADF test

To ensure the stationarity of the time series data, the Dickey-Fuller test was conducted in STATA. This test is conducted for this time series analysis to avoid inaccurate results arising from non-stationary data. As observed in the following Table 1, the near-zero p-values suggest that the first-order and second-order differences are sufficient in rejecting the null hypothesis and can be used for further analysis.

Table 1: Weak stationarity test

| | t | p |
|----------------------|---------|--------|
| Daily | | |
| Raw | -1.533 | 0.5170 |
| 1st order difference | -56.121 | 0.0000 |
| 2nd order difference | -98.172 | 0.0000 |
| Weekly | | |
| Raw | -1.604 | 0.4818 |
| 1st order difference | -26.587 | 0.0000 |
| 2nd order difference | -44.426 | 0.0000 |
| Monthly | | |
| Raw | -1.406 | 0.5794 |
| 1st order difference | -13.178 | 0.0000 |

2.3. ARIMA Model

For each time frame—daily, weekly, and monthly—ARIMA (Autoregressive Integrated Moving Average) models are used for analysis. The models are chosen based on the lag orders of the corresponding PACF and ACF models.

Model Specification:

The ARIMA model was specified using the following components:

p: Order of the autoregressive term (lag size).

d: Degree of differencing required to make the series stationary.

q: Order of the moving average term.

To ensure the validity of the chosen ARIMA models and their results, residual tests are implemented to verify the significance of the models, which then can be used for graphing.

2.4. Visualization and Interpretation

Once the previous steps are completed and tested, three separate graphs of the actual values and the fitted values of the dollar indexes are plotted to visualize the impact the treatment, or the federal funds rate raise, made. Besides the graphs, the percentage changes and rates of changes in the dollar indexes are compared for the daily, weekly, and monthly values.

3. Empirical Results and Analysis

3.1. Determination of ARIMA Model Order (p, d, q)

Based on the ADF tests and the examination of PACF and ACF plots (see Figure 1), optimal ARIMA model orders were identified for daily, weekly, and monthly time frames. For the daily data, an ARIMA(10,2,1) model was selected; ARIMA(10,2,1) for the weekly data; ARIMA(6,1,6) for the monthly data.

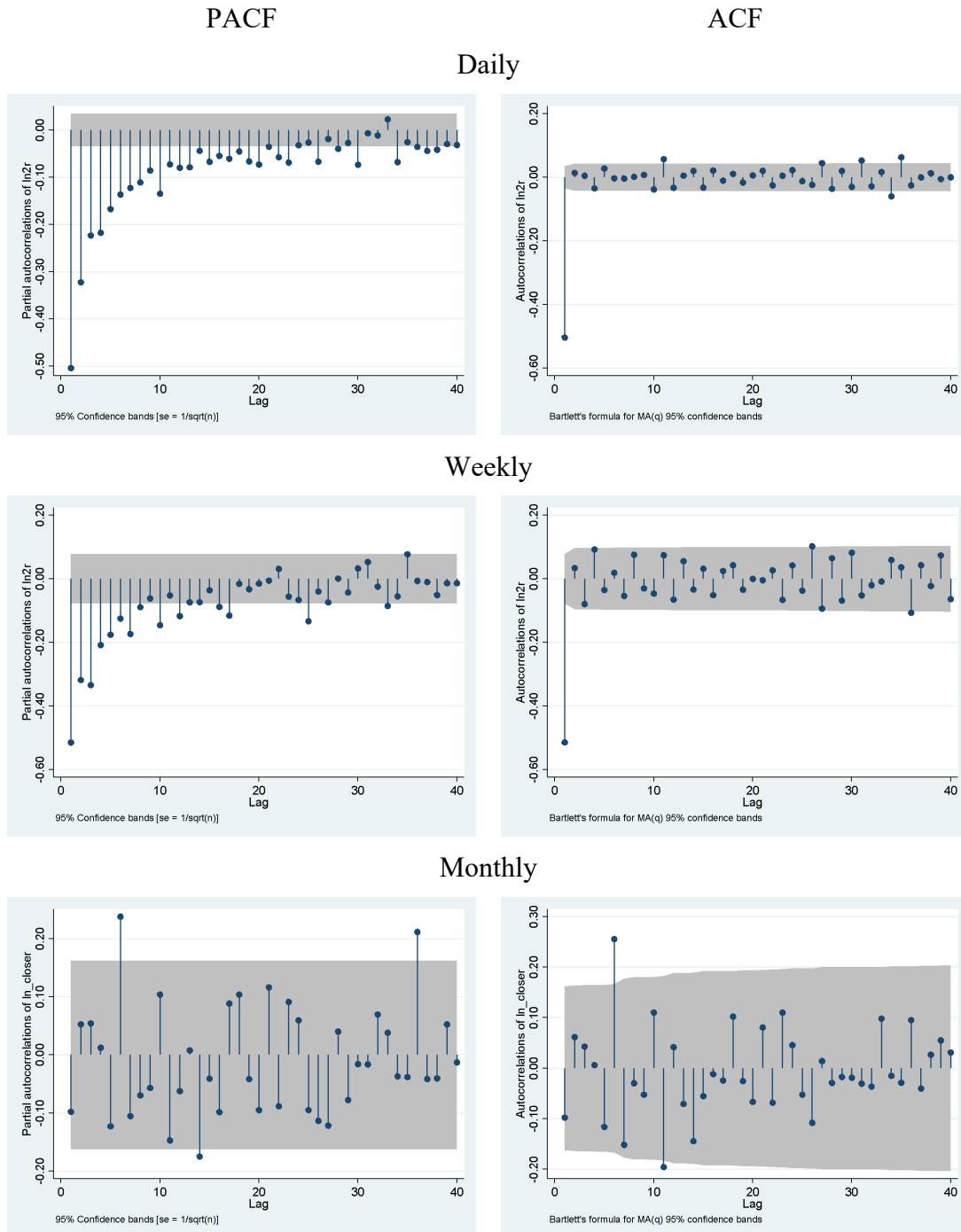


Figure 1: ARMA (p, q) identification (Photo credit: Original)

3.2. Model Residuals

Residual tests were conducted to assess the reliability of the ARIMA models. The Portmanteau (Q) statistic indicated that the residuals for each time frame—daily, weekly, and monthly—were white noise (see Table 2), and therefore, the models were well-specified ($\text{Prob} > \chi^2 > 0.05$).

Table 2: Residual test

| Model | Portmanteau (Q) statistic | Prob > chi2 |
|-----------------------|---------------------------|-------------|
| Daily-ARIMA (10,2,1) | 46.5251 | 0.2216 |
| Weekly-ARIMA (10,2,1) | 38.9552 | 0.5172 |
| Monthly-ARIMA (6,1,6) | 23.9615 | 0.9790 |

3.3. Prediction Visualizations

Upon implementation of the ARIMA models, three plots were created to showcase the predicted effects of the interest rate hikes. The dates are labeled on the x-axis, and the dollar closing index is labeled on the y-axis. The blue line represents the actual fluctuation of the index, with the orange line being the fitted prediction.

Figure 2 is the daily dollar index plot, observing change starting on March 17th, 2022. The relatively consistent blue line indicates that there is no immediate effect of the rate increases. Moreover, the difference between the actual and fitted lines is minimal, which could be the result of policy time lags or insufficient degrees of interest rate hikes. In Milton Friedman’s book speculating the length of the lag, he states that “the predominant direct effects of monetary and other changes will occur within three to six months” [9], which cannot be seen within solely two weeks of the daily index.

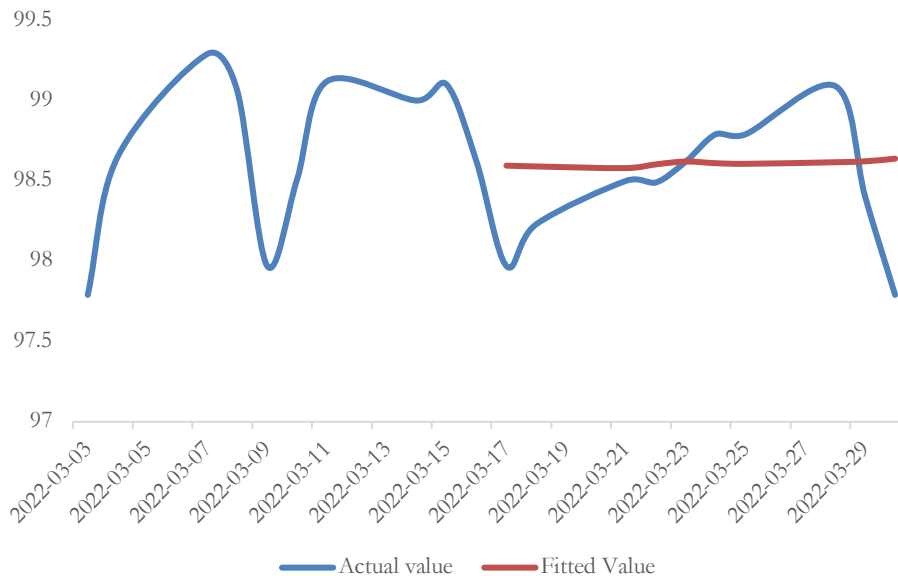


Figure 2: Actual value and fitted value, daily (Photo credit: Original)

Figure 3 is the weekly dollar index plot, observing change starting in the third week of March 2022. Here, the data range is increased and the effects of the policy change are more evident as the increase of the actual index value reached up to 6.21% compared to the fitted value.

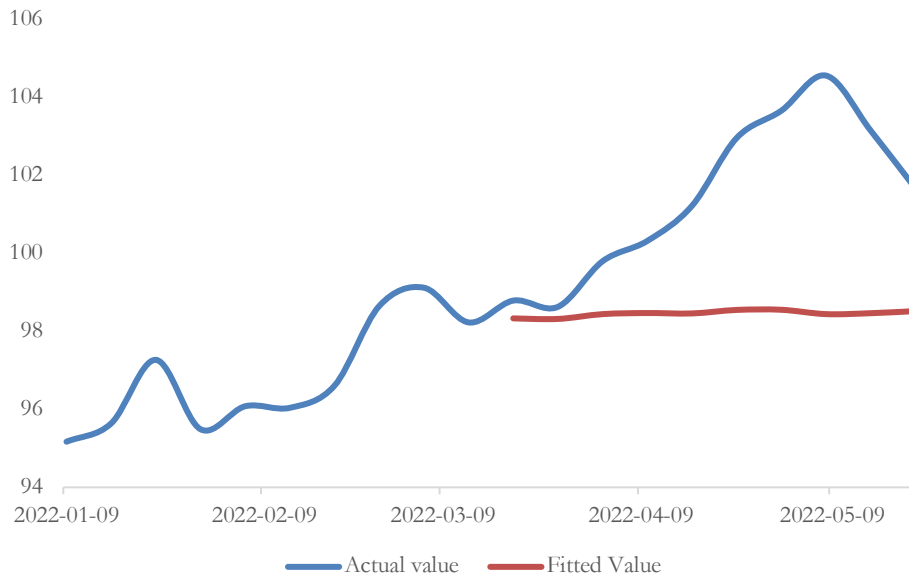


Figure 3: Actual value and fitted value, weekly (Photo credit: Original)

Figure 4 is the monthly dollar index plot, observing change starting in April 2022. Over a five-month period, the Fed policy has significantly played its role in boosting the economy, aligning well with Friedman’s view [9]. With the highest difference of 13.19% and an average increase of 7.29%, the interest rate hikes helped the dollar index grow effectively as opposed to no action at all.

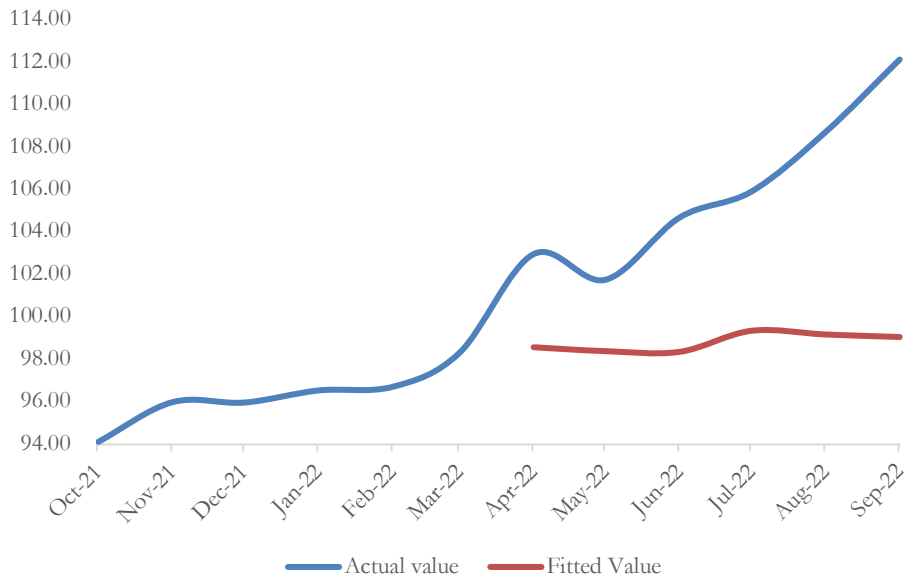


Figure 4: Actual value and fitted value, monthly (Photo credit: Original)

Meanwhile, the extent of the Fed’s interest rate hikes should be taken into account. The following Table 3 is a segment of the 2022-2023 timeline acquired from a “Forbes Advisor” article [10]. The timeline shows five initial rate hikes, with the first two being relatively modest increases of 25 and 50 bps, and the last three showing more substantial jumps of 75 bps. The pattern of increasing rate hikes corresponds well with the data in the monthly ARIMA model. Specifically, the rate of change

in the dollar index began to increase more rapidly after June 2022, which aligns with the time when the more dramatic rate hikes were implemented.

Table 3: Interest rate increase timeline

| FOMC Meeting Date | Rate Change (bps) | Federal Funds Rate (%) |
|-------------------|-------------------|------------------------|
| March 17, 2022 | +25 | 0.25 to 0.50 |
| May 5, 2022 | +50 | 0.75 to 1.00 |
| June 16, 2022 | +75 | 1.50 to 1.75 |
| July 27, 2022 | +75 | 2.25 to 2.50 |
| Sep 21, 2022 | +75 | 3.00 to 3.50 |

Note: one “bps”, or basis point, is 0.01% [10].

4. Discussion

Several noteworthy observations emerge from this analysis. Firstly, the daily model showed no significant difference between the actual and fitted values. This could be a sign of "policy lags," suggesting that the impact of monetary policy changes takes time to permeate through the economy, either due to slow government actions or long impact times. Alternatively, it could also imply that daily data are too volatile or noisy to capture the real effects of such macroeconomic policies.

Secondly, the weekly and monthly data give a better insight into the policy, showing the efficacy of the Federal Reserve's actions. Particularly in the monthly model, there is a 13.19% increase in the actual index compared to the fitted value, signifying a robust positive effect of the rate hikes.

These findings align with the view posited by Smith [7], emphasizing the utility of "real-time analysis using noise-reducing methodologies." Given that the ARIMA models have passed the residual tests, this lends credibility to the findings. While the daily data may not show a direct impact, looking at weekly and monthly data provides a clearer picture, confirming that the federal funds rate can indeed serve as an effective tool for strengthening the U.S. dollar index.

5. Conclusion

This research was inspired by the unique economic challenges in the post-pandemic period. Besides looking at the basic effects of the interest rate hikes, the paper focused on a more subtle economic indicator—the U.S. dollar index. In summary, there is an observable impact of federal funds rate hikes in 2022 on the dollar index. Some intriguing findings include the different implications of the selected data type and their respective correlations. The ARIMA models worked appropriately for all three data sets and are an appropriate and effective technique for this time series analysis.

Despite the negative impacts of the pandemic slowly fading as time passes, understanding the dynamics of such complex and extreme situations remains crucial for economics analysts and investors. While the paper sheds light on the significant relationship between interest rate hikes and the U.S. dollar index, it does have limitations. Firstly, the study focuses solely on the period after the interest raises in 2022, thereby lacking a comprehensive pre-pandemic comparative analysis. Secondly, the research does not incorporate external factors like geopolitical tensions or monetary policies from other nations that could also affect the dollar index. Future research could aim to fill these gaps by conducting a more detailed historical analysis and by considering a multi-variable approach. Additionally, understanding the lag time between policy change, like the one observed between the daily and monthly data in this paper, could offer critical insights for timely and effective decision-making for policymakers.

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