Reviewing the Efficacy of Federal Reserve Bank Reserve Policies through a Time Series Analysis of the Effective Federal Funds Rate

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ABSTRACT

The Effective Federal Funds Rate (EFFR) is a crucial interest rate that reflects the cost of banks borrowing funds from each other overnight. This rate is a significant indicator of the financial system's health and stability in the United States. The rate values fluctuate due to various factors, such as changes in monetary policy, supply and demand for reserves, market expectations, events in financial markets, seasonal factors, and changes in regulations. Although it's challenging to pinpoint the exact factors that cause the variation in this rate, the concepts of time series are employed to identify peak points of such changes. The resulting figures are obtained using R software, and the reviews corresponding to each EFFR value are parallel to the business market incidence in the USA. At the end of this paper, all the EFFR values from the year 2016 to 2021 are included, along with their corresponding reviews.

Keywords*: Effective Federal Funds Rate, Financial Systems, Business Market, Stabilizing, New York, Indicator

INTRODUCTION

The EFFR, or Effective Federal Funds Rate, is a crucial interest rate that shows the expense of borrowing money overnight between banks [1]. It is a critical measure of the general stability and well-being of the US financial system and holds great importance for both monetary policy and financial markets. The EFFR is closely watched by policymakers, economists, and investors because it can influence the accessibility and cost of credit for businesses and consumers, as well as impact the overall economic conditions of the country [2]. In this article, we will examine the significance of the EFFR rate, its function in US monetary policy, and its effects on the economy.

The EFFR represents the interest rate at which overnight lending and borrowing occur between depository institutions like banks. It's a key indicator of the US financial system's health and liquidity [3]. A rise in the EFFR can offer numerous benefits, such as:

Raising the EFFR can play a role in inflation control by increasing the cost of borrowing for banks, thus making it more expensive for consumers to borrow as well. This could result in reduced spending and a slowdown of the economy [4]. Additionally, a higher EFFR may motivate individuals to save more money by offering higher interest rates on savings accounts, potentially leading to an increase in the overall savings rate and long-term benefits [5].

Supporting the value of the currency

Raising the EFFR could boost the appeal of holding U.S. dollars in investment portfolios, potentially enhancing the currency's value and aiding the U.S. economy to become more globally competitive [6].

Stabilizing the financial system

Raising the EFFR can have a stabilizing effect on the financial system by increasing the cost of borrowing for banks, thereby reducing their risk-taking behavior and making them less vulnerable to financial shocks [7]. This can be beneficial in preventing future financial crises similar to the one experienced in 2008.

Despite the fact that an increase in the EFFR may lead to higher borrowing costs for consumers and businesses, it can have various benefits for the US economy and the financial system as a whole. On the other hand, if the EFFR value decreases, banks can borrow money at a lower interest rate, which has both advantages and disadvantages [8]. Among the possible drawbacks of a decrease in the EFFR value are:

Reduced earnings for savers: If the EFFR value goes down, it can cause a decline in the interest rates offered on investments such as savings accounts. As a consequence, people who depend on interest earnings for their daily expenses may experience lower profits [9].

Inflationary pressures: If the EFFR value drops, it may result in higher inflationary pressures. Cheaper borrowing rates for banks could encourage them to lend more money to consumers and businesses, which could result in increased spending and drive up prices.

Asset bubbles: The formation of asset bubbles can also be attributed to a reduction in the EFFR value. Low-interest rates could prompt investors to borrow money to invest in assets like stocks or real estate, leading to overpricing and a possible market crash when the correction takes place.

Reduced income for banks: If the EFFR value decreases, it may result in decreased earnings for banks, particularly for those that rely on interest income to make profits. Consequently, lending money and backing economic growth can become more challenging for banks [10]. Nonetheless, the effects of a drop in the EFFR value can be positive or negative, depending on several factors, such as economic circumstances and the decisions of policymakers.

SIGNIFICANT

If the EFFR value decreases, it may result in decreased earnings for banks, particularly for those that rely on interest income to make profits. Consequently, lending money and backing economic growth can become more challenging for banks. Nonetheless, the effects of a drop in the EFFR value can be positive or negative, depending on several factors, such as economic circumstances and the decisions of policymakers.

Changes in monetary policy: The EFFR is utilized by the Federal Reserve to enforce monetary policy, and alterations in the target federal funds rate or other policy measures can trigger adjustments in the EFFR. Thus, the EFFR is a crucial instrument for the Federal Reserve in implementing monetary policy.

Supply and demand for reserves: The EFFR relies on the overnight lending rates between depository institutions for reserve balances. Changes in the availability and need for reserves can impact the lending rates that institutions apply to each other.

Market expectations: The Expected Federal Funds Rate (EFFR) can be impacted by market outlook regarding future interest rate changes. Anticipated changes in economic conditions or monetary policy can affect the supply and demand of reserves, leading to an impact on the EFFR.

Events in financial markets: Fluctuations in the demand for reserves may occur due to changes in financial markets, including credit market disturbances, which can result in variations in the EFFR.

Seasonal factors: Reserve requirements may experience seasonal fluctuations caused by events like tax payments or shifts in the flow of funds that coincide with holidays.

Changes in regulations: The EFFR can be influenced by modifications to reserve requirements and adjustments to interest on excess reserves regulations, which can impact the supply and demand of reserves.

It's worth mentioning that although the EFFR is a crucial benchmark for interest rates, the Federal Reserve doesn't have direct control over it. Instead, the Fed uses its monetary policy operations to affect the EFFR, which is determined by the interbank lending market's supply and demand dynamics for overnight loans.

METHODOLOGY

EFFR value calculation process Top of Form Bottom of Form

The EFFR is a reference interest rate that establishes the borrowing cost between banks in the US. It's computed as a weighted average of the rates at which depository institutions lend reserve balances to other depository institutions overnight. The Federal Reserve Bank of New York calculates the EFFR daily, utilizing data from a group of institutions [11-14]. The computation approach entails taking a volume-weighted average of the collected rates.

1. The Federal Reserve Bank of New York gathers information about the number of reserves held by depository institutions at the Federal Reserve Banks.
2. The New York Federal Reserve Bank also gathers information regarding the rates of interest that depository institutions impose on one another for short-term borrowing.
3. The interest rates are averaged by the Federal Reserve Bank of New York using a volume-weighted method, where the amount of reserves held by each institution determines the weights assigned [15].
4. The EFFR for a particular business day is determined by calculating the average rate based on the volume of funds exchanged that day.

Data collective method

The New York Federal Reserve Bank gathers information about the EFFR by surveying a group of depository institutions. This group comprises of eligible entities such as banks, credit unions, and savings associations that can take part in the Federal Reserve System.

To collect information on overnight loans between depository institutions, the Federal Reserve Bank of New York uses various methods. One of these methods is conducting surveys on a daily basis, where a sample of institutions are surveyed to gather data on the volume and interest rates of these loans. Additionally, the Bank also uses automated data collection systems to gather information from settlement systems used by depository institutions, such as the Fed Wire Funds Service and the Clearing House Interbank Payments System (CHIPS).

Furthermore, depository institutions are required to submit quarterly reports to their regulatory agencies that include information on the volume and interest rates of overnight loans. The Federal Reserve Bank of New York also collects this data from regulatory agencies. Finally, some institutions directly report their overnight loan activity to the Federal Reserve Bank of New York.

The data gathered is utilized to compute the interest rate average, weighted by volume, for short-term loans between banks, known as the Effective Federal Funds Rate (EFFR) for a particular day. The Federal Reserve Bank of New York publishes the EFFR on a daily basis during business days.

Analyzing method

In this study, we utilized the EFFR data for the period 2016-2021 that was obtained from the Federal Bank Reserves. Our focus was on the published rate values, as they can offer valuable insights into the monetary policy decisions of the Federal Reserve. While examining the EFFR values, it's crucial to take into account other economic indicators and trends to make sound financial decisions, as the EFFR is just one of many factors that can impact the economy. To analyze the EFFR values during the specified period, we employed R-software and time series techniques.

1) Time Series Techniques: Time series analysis comprises a collection of methods to analyze data that changes over time. The goal is to observe patterns, trends, and behavior of the data over time, in order to draw conclusions, make predictions and make well-informed decisions [16]. There are various commonly used techniques in time series analysis, such as:

To analyze time series data, various techniques can be used in combination, depending on the nature of the data and the problem being addressed. Time series decomposition can be employed to break down a time series into its components, such as trends, seasonal patterns, and random fluctuations [17]. Autocorrelation analysis is useful for identifying any patterns or dependencies by measuring the correlation between a time series and its lagged values. Moving averages can help to smooth out fluctuations by averaging a fixed number of data points. Exponential smoothing is often used for forecasting and gives more weight to recent data points. ARIMA models combine autoregressive and moving average models with differencing to account for non-stationary time series data. Prophet is a time series forecasting framework that uses additive and multiplicative models to model trends, seasonality, and holidays [18]. LSTM models, which are a type of recurrent neural network, are well-suited to time series forecasting tasks.

2) R Software: R is widely used for analyzing time series data, thanks to its numerous built-in functions and packages. It provides several tools to analyze, forecast, and visualize time series data. To begin with time series analysis in R, you can follow these fundamental steps [18-23].

To import time series data in R, you can use various sources, such as CSV files, Excel files, or databases. To read the data, you can employ the "read.csv" or "read_excel" functions. After importing the data, use the "ts" function to transform it into a time series object. Specify the time index, such as daily, weekly, or monthly, while applying this function. To visualize the data, employ the "plot" function to generate a time series plot, which will aid in identifying trends, patterns, or anomalies [24-25]. You can utilize descriptive statistics and time series decomposition techniques like decompose() and STL() to comprehend the data's structure and patterns. To forecast the data, use time series models such as ARIMA, exponential smoothing, or Prophet. To evaluate the accuracy of the model, you can calculate metrics like mean absolute error (MAE) and root mean squared error (RMSE).

Here are some useful packages for time series analysis in R:

- The "forecast" package offers various techniques, such as ARIMA and exponential smoothing, for predicting time series data.
- The "series" library offers features for analyzing time series data, such as conducting tests for autocorrelation and unit roots.
- "xts": Provides tools for working with time series data more efficiently and flexibly.
- "ggplot2" offers a range of resources to generate visually appealing charts and visuals.

In general, R offers a robust and adaptable setting for analyzing time series

RESULTS

The federal funds rate, which currently ranges from 4.25% to 4.50%, is a key tool used by the Federal Reserve to guide monetary policy in the United States. This rate impacts various financial aspects such as the annual percentage yields (APYs) earned on savings accounts and the interest rates paid on credit card balances. Essentially, the federal funds rate dictates the cost of money in the U.S. economy.

Banks, savings and loans, and credit unions charge each other for overnight loans at the federal funds rate. The Federal Reserve influences this rate to control inflation, which is done by increasing or decreasing the rate to shrink or increase the supply of money available for purchases. When the federal funds rate is low, it implies an expansionary monetary policy by the government. This results in a low-interest rate environment for businesses and consumers, which stimulates aggregate demand and employment but also leads to relatively high inflation. Similarly, central banks of other countries follow similar patterns.
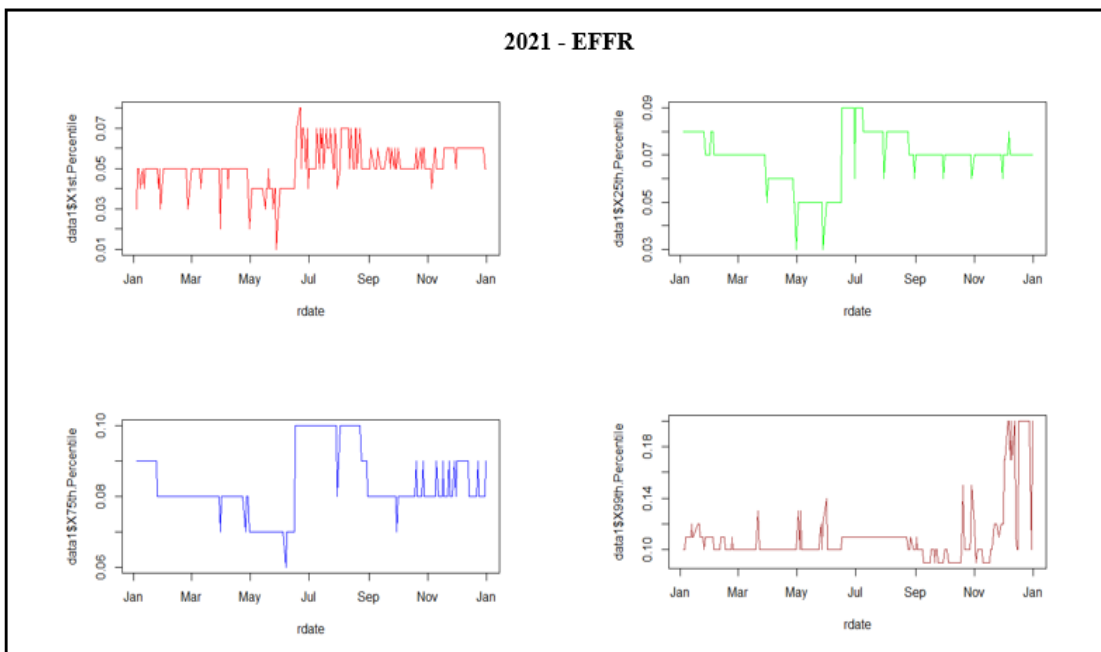
Fig. 1. The value of EFFR varied throughout 2021 for each percentile

The graph in Fig. 1. illustrates how the EFFR rate changed across different percentiles in 2021. The EFFR rate mostly fluctuated between 0.01 to 0.09 for the first and twenty-fifth percentiles. However, for the seventy-fifth and ninety-ninth percentiles, the rate ranged from 0.06 to 0.18, with the highest values seen for the ninety-ninth percentile. This indicates that the EFFR rate was highest for the top percentile.

1st percentile: In general, the first percentile of Fig. 1. suggests that EFFR values hover around 0.05. However, there is some fluctuation during the months of February, March, and April. After May, the rate consistently decreases, likely due to the impact of the COVID pandemic on the economy. However, the EFFR value experienced a sudden increase in July due to the release of the Pfizer COVID vaccine, which generated significant profits for the company. From July to September, the rate remained stable. However, in the middle of September, the rate experienced a sudden drop, which may have been influenced by the entrance of cryptocurrency into the banking industry, causing concern in Washington.

25th percentile: Fig. 1. depicts a step graph in green color representing the EFFR's 25th percentile for 2021.

The graph shows a downward trend until June, which prompted the Federal to announce its plan to sell corporate bond holdings as a remedy. Consequently, the EFFR value abruptly increased in July but slightly decreased after that. However, a positive observation is the constant EFFR value from September to January.

75th percentile: The EFFR values for the seventy-fifth percentile show a decline in the graph until June. Despite the addition of 559,000 jobs in the USA, the rate value increased, but the road to recovery was challenging. However, in August, the rate value suddenly decreased due to the escalation of violence resulting from Mexico suing gun companies in the USA. In October, the EFFR value quickly decreased again due to the spike in energy prices caused by the producers' attitudes toward the pandemic and climate.

99th percentile: The corresponding values of the 99th percentile vary between 0.10 to 0.14 till November. This happened due to the Omicron COVID movements.
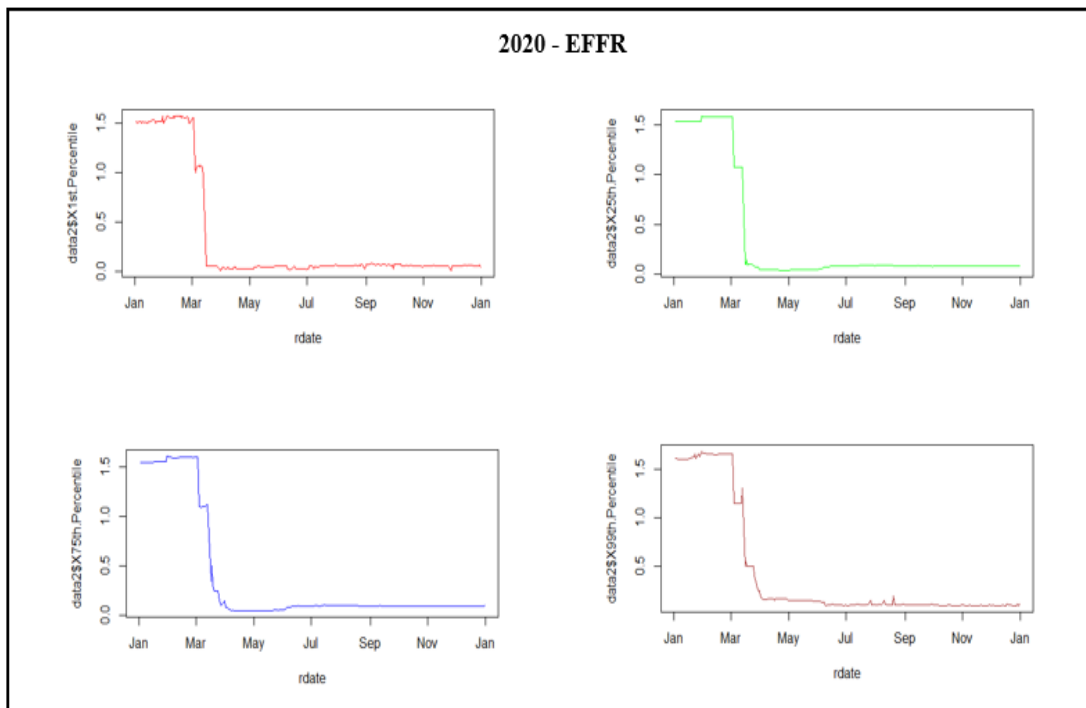
Fig. 2. The value of EFFR varied throughout 2020 for each percentile

Fig. 2. illustrates the fluctuation of EFFR rates for different percentiles in 2020. The majority of the EFFR rates range from 0.0 to 1.5 across all percentiles. However, in 2020, the rate values were generally higher compared to 2021. The lowest rate values for all percentiles were recorded from April to January, with an approximate value of zero, indicating no EFFR rate. Additionally, each percentile showed similar fluctuations. Thus, the above summary provides an overall understanding of Fig. 2. data for each percentile.

After May 2020, the EFFR values dropped to zero amidst some significant incidents. However, the manufacturing industry showed signs of recovery from COVID-19 pandemic-related disruptions as orders for long-lasting factory goods increased for the fourth consecutive month in August and September. On the other hand, the number of applications for unemployment benefits remained high in September, indicating that the labor market recovery was stalling.

In October, although new applications for unemployment benefits fell slightly, they remained between 800,000 and 900,000, suggesting that the labor-market recovery was losing momentum. Additionally, job gains slowed as more layoffs turned permanent, indicating that the US economy faces a long and challenging road to fully recover from the pandemic.

The global economic outlook is improving as US consumer imports return to pre-pandemic levels,indicating a faster-than-expected recovery from COVID-related trade disruptions. Additionally, socialsecurity benefits for Americans have increased by 1.3%, while US industrial production has declined by0.6% since September, leaving it 7.1% below pre-pandemic levels. Despite a decrease in foreign investmentduring the pandemic, China has remained relatively stable, with foreign direct investment remaining steadyin the first half of the year. Finally, durable goods orders have increased for the fifth month in a row.

Conversely, there is a positive global economic outlook as US consumer imports have returned to pre-pandemic levels, indicating that trade has rebounded faster than anticipated despite COVID-related disturbances. In addition, social security benefits have increased by 1.3% for Americans. However, it was reported that US industrial production fell from 0.6% in September and is currently 7.1% lower than its February level before the pandemic, according to the Federal Reserve's assessment of output in factories, mines, and utilities.

In October, there was a significant decrease in foreign investment due to the pandemic, except in China, where foreign direct investment remained stable, indicating that the Chinese economy was less affected by the pandemic. Additionally, durable goods orders increased for the fifth month in a row.

A report by the New York Federal Reserve revealed that although Americans borrowed more for homes and cars, they were hesitant to use credit cards. Home sales in the US reached a 14-year high in October, with a 4.3% increase in sales of pre-owned homes from September, and median home prices hit a new high. Global trade also showed a rapid recovery in November, with the largest rise in two decades due to increased demand for consumer goods and the reopening of air and sea transport channels. Furthermore, US industrial production rose by 0.4% in November, although it remained below pre-pandemic levels.
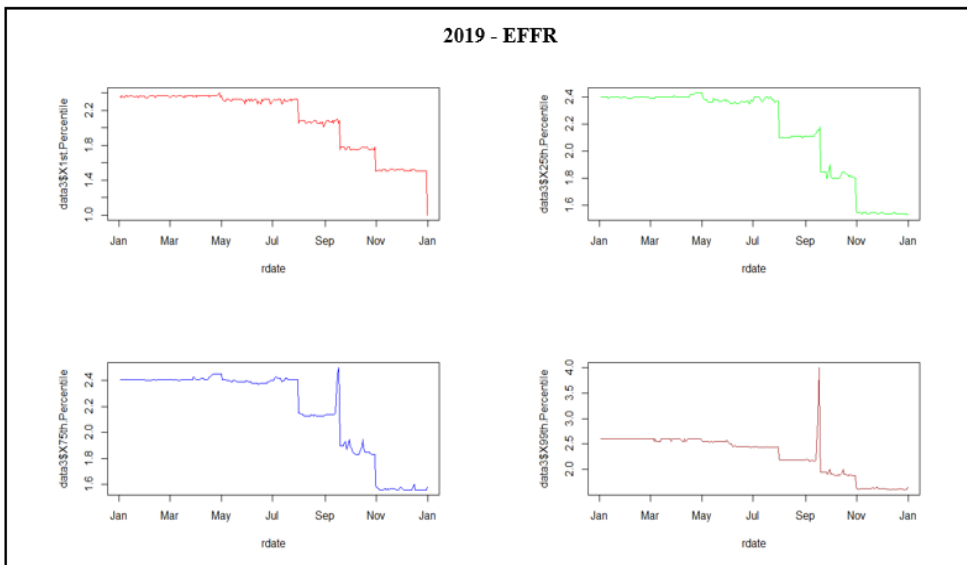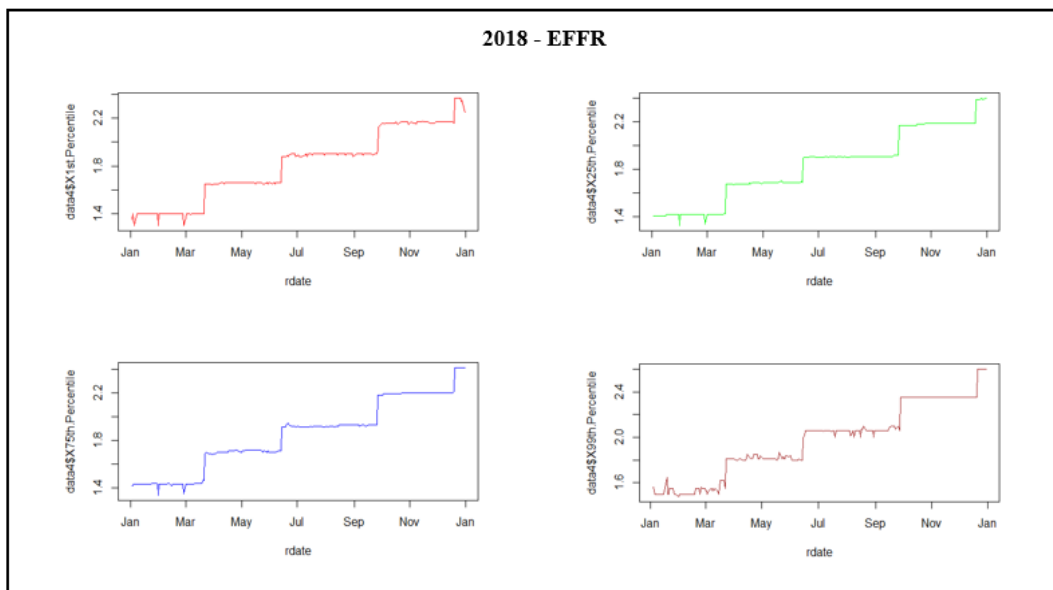

Fig. 3. The value of EFFR varied throughout 2019 for each percentile

Fig. 3. illustrates the variation of EFFR rates across different percentiles during 2019. The rates fluctuate mainly between 1.0 and 2.4 for the first and twenty-fifth percentiles. However, the rate values range between 1.6 to 2.4 and 2.0 to 4.0 for the seventy-fifth and ninety-ninth percentiles, respectively. The highest rate values were observed for the ninety-ninth percentile. It is noteworthy that the EFFR values for 2019 were higher than those for 2020 and 2021.

Fig. 3. depicts a decreasing step pattern for each percentile, with the first step occurring in May. However, this was quickly recovered due to Warren Buffet's investment of 10 billion US dollars in backing Occidental's bid for Anadarko. The federal government is likely to leave interest rates unchanged despite

Donald Trump's calls for a cut. However, the trade war with China caused a 27-year low in China's economic growth in July, which directly impacted world markets. Additionally, a major technology dispute occurred between unlikely partners.

In September, there was negative news for E-cigarettes while gig workers received positive news. Freelancing was suggested as a solution to fill gaps in retirement funds for those over fifty. However, despite low unemployment, finding a job remained challenging for many individuals. The Gross Domestic Product (GDP) report showed that consumer spending had decreased in November, likely due to a smaller federal increment and slower inflation. The housing market also struggled in December despite low mortgage rates, as obtaining loans and affording homes proved difficult. Stock market forecasts in December were deemed useless, and wall street strategists recommended investing in cheap, diversified index funds for 2020.

Fig. 4. The value of EFFR varied throughout 2018 for each percentile
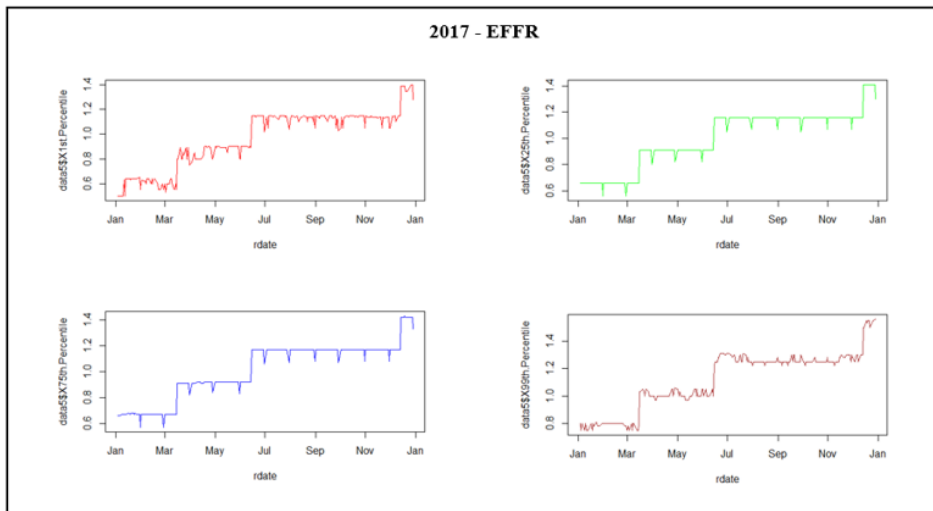
Fig. 4. displays how the EFFR rate fluctuated for different percentiles throughout 2018. The EFFR rate mostly ranged between 1.4 to 2.4 for each percentile, and there was a gradual increase in the rate as the percentile increased. The graph indicates that the EFFR values experienced significant increases in April, June, October, and December.

In 2018, the EFFR values suddenly dropped, leading to North Korea's surprising call for dialogue with South Korea, which could undermine Trump's administration. Demonstrations in numerous Iranian cities were triggered by miscalculations in a long-standing internal power struggle. In February, House Republicans released a secret memo accusing senior officials at the FBI and Justice Department of bias in the early stages of the Russia investigation. This, along with secret alliance issues in Israel, caused the EFFR values to fluctuate. Albertsons' acquisition of Rite Aid caused Walmart's stock to fall, as they became common rivals.

In March, Trump signed a spending bill, avoiding a government shutdown. Meanwhile, China split top jobs at the central bank, adding another reform. In June, the US market was primarily concerned about trade as EFFR values rose again. In September, the government spent more on interest than on the military due to rising debt, and tax cuts, spending increases, and higher interest rates could make it challenging to address future recessions and other needs.

Finally, in December, stocks closed on a bear market as Trump and Mnuchin fueled a Christmas Eve drop.

Fig. 5. The value of EFFR varied throughout 2017 for each percentile

Fig. 5. displays how the EFFR rate fluctuated for each percentile in 2017, with values mostly ranging from to 1.4. In 2018, the rate values were generally higher than in 2017, with the lowest values for each percentile occurring between January and April, around 0.6. The fluctuations were roughly equal for each percentile. This is a summary of the overall meaning of each percentile represented in Fig. 5.

In April, US construction spending increased but not as much as anticipated, as reported by the Commerce Department. The total construction spending in the country went up by 0.8% in February, reaching its highest level since April 2006. In addition, jobless claims in the US decreased significantly, indicating steady job growth as fewer Americans applied for new unemployment benefits. Moreover, the private sector saw a greater-than-expected increase in payrolls, as employers continued to hire more workers, according to their monthly report. This year, private-sector hiring remained robust.

On one hand, the UK's yearly public borrowing has reached its lowest point since 2008 due to strong economic growth leading to a record high in commercial tax receipts. On the other hand, the number of Americans applying for new unemployment benefits increased to 248,000 in May, which is still a low level indicating a healthy US labor market. Additionally, the Conference Board's analysis of employment trends shows a steady job growth potential, as their employment trend index increased from 132.8 in April to 133.7 in May.

The first quarter of 2017 saw no growth in US productivity, with a revised estimate indicating no improvement from the previous estimate. This is one of several indicators of slow economic growth over the past eight years. A decrease in US manufacturing output contributed to slow overall industrial production, which suggests limited growth for the factory sector and only moderate expansion for the economy as a whole. In addition, US consumer prices increased at a slower rate than they have in the past six months, which presents a challenge for the Federal Reserve as it seeks to balance low inflation with signs of improvement in the labor market. Lastly, US housing starts decreased for the third consecutive month in May, suggesting a slowdown in the home building despite limited supply.

In November, the US manufacturing sector grew at a slower pace for the second consecutive month, although it still remained strong. In contrast, China's service sector experienced a faster expansion during the same period. However, in December, New York manufacturers reported a decrease in growth due to longer delivery times and a decrease in the number of employees. This decline was reflected in an index measured by the Federal Reserve Bank of New York.

In December, Americans exceeded their holiday spending expectations, likely due to higher income, a

positive economic outlook, strong financial markets, and low inflation. On another note, US housing starts increased significantly last month, especially in the South and West regions, with single-family home building showing the most significant gains in over a year.
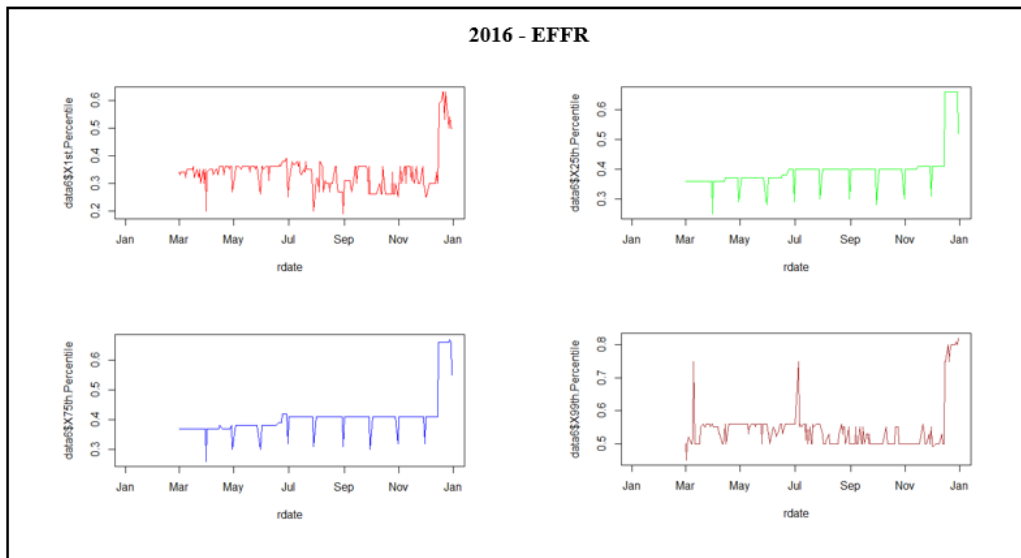
Fig. 6. The value of EFFR varied throughout 2016 for each percentile

Fig. 6. displays the fluctuation of EFFR rates across different percentiles in 2016. The EFFR rates primarily range from 0.2 to 0.6 for the first, twenty-fifth, and seventy-fifth percentiles, while the rates fluctuate between 0.5 to 0.8 for the ninety-ninth percentile. This indicates that the ninety-ninth percentile had the highest EFFR rate values among all the percentiles.

1st percentile: The number of new jobless claims in the US has slightly increased by 3,000 to a total of 269,000 in August. However, this figure is still indicative of consistent employment rates. Similarly, US consumer credit rose at a sluggish pace in June due to slower growth in student and auto loans. Furthermore, the US service sector index for September indicates the slowest growth since 2010, with a gauge of service sector activity declining to its lowest level in over six years. These trends suggest a deceleration of growth in significant sectors of the US economy before a policy meeting of the Federal Reserve officials.

25th percentile: In June, the EFFR reached its minimum due to a significant drop in US companies' hiring. This led to a decrease in unemployment as people left the labor force, which is a concerning situation for Federal Reserve officials who are considering increasing short-term interest rates during their upcoming policy meeting. Moreover, US companies are currently dealing with a troubling combination of poor productivity growth, rising wages, and sluggish demand, which could result in reduced hiring, decreased spending, and a weakened economy. Conversely, the EFFR had its highest value in December, which coincided with a two-year high in inflation across developed economies, according to the Organization for Economic Cooperation and Development.

75th percentile: The EFFR values remained stable up until July in the 75th percentile, but then experienced a sudden increase. This was attributed to the rise in the ISM manufacturing index, which reached its highest level since February 2015, indicating an upswing in manufacturing activity in the second half of the year. Additionally, consumer credit rose by 6.18 percent in July, as Americans took out more student and auto loans, leading to increased household debt.

99th percentile: The data experienced sudden increases in March, July, and December while remaining fairly stable at around 0.55. In March, new home sales in the US increased by 2% due to a shortage of older homes on the market and steady job growth. This indicates that despite difficulties overseas, the US

economy is still expanding. The EFFR values increased again in July, even though the number of Americans filing new jobless claims rose by 14,000 to 266,000. This still indicates growth in the labor market. However, Gross Domestic Product (GDP) only grew by 1.2% which was disappointing, as cautious business investment offset more robust consumer spending. This represented only a slight acceleration from the downwardly revised 0.8% pace.

CONCLUSIONS

The article discusses the variations in the EFFR (Effective Federal Funds Rate) across different percentiles in different years. In 2021, the rate was highest for the 99th percentile, likely due to the Omicron COVID variant. The US economy is facing challenges with slow job gains, but there are positive signs in trade and durable goods orders. In 2020, rates dropped to zero due to the pandemic. In 2019, rates were higher than in 2020/2021, and the chart shows a decreasing pattern with steps in May. In 2018, various events impacted the EFFR values, including North Korea's call for dialogue and trade concerns. In 2017 and 2018, the US economy showed signs of expansion despite challenges. In 2016, the US economy still showed signs of expansion despite challenges, with a slight increase in new jobless claims and sluggish growth in US consumer credit. The article also provides information about the 99th percentile's sudden increases in March, July, and December in 2016. Overall, the article provides an overview of the EFFR rate fluctuations over the years, indicating the US economy's ups and downs.

ACKNOWLEDGEMENT

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