**Portfolio Milestone:  Final Research Paper**

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**Abstract**

The Fed sets monetary policy using changes in interest rates and changes in money supply. Changes in the Fed funds interest rate (FFR) affect the interest rates of the rest of the market, bond prices, and lending activity, impacting the financial sector. In times of great economic stress, the Fed makes aggressive moves that have very significant impacts on the economy and the consumer beyond the immediate goals of stabilization and solving any liquidity crisis. Much has been studied about interest rates and the banking industry, but little has been researched on monetary policy directly impacts the consumer. A study of how changes in FFR correlates to changes in unemployment, inflation, stock market performance, home prices, and the Consumer Price Index (CPI) can provide evidence that Fed monetary policy has a direct impact on changes in these economic conditions. Knowing when and how much each of these five economic conditions will change would be a great tool for the consumer to have in making financial decisions. Using Pearson correlations, significant correlative relationships are determined between FFR and each variable. By looking at different timeframes of change, the timing of when interest rate changes will impact each of these factors can be examined and predicted. Using linear regression, it may be possible to predict the magnitude of change for unemployment, inflation, stock market performance, home prices, and CPI. Ultimately, the study found significant correlations between FFR and unemployment, inflation, and the CPI. There was no significant correlation between FFR and either home prices or stock market performance. Further analysis found that a 6-month change in FFR correlated to changes in inflation and the CPI 6 months later and a 3-month change in FFR correlated to a change in unemployment 3 months later. Despite the correlations for these 3 variables, there were no linear regression models found with any meaningful predictions for the magnitude of change and further study would be needed to develop and predictive model.

*Keywords*: interest rates, unemployment, inflation, CPI, monetary policy, consumer.

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Historically, governments set monetary policy to keep prices stable and control the value of the country’s currency. In more recent times, governments use monetary policy to affect other parts of the economy such as unemployment rates and wage levels. The Federal Reserve (the Fed) sets monetary policy in the United States by establishing the federal funds interest rates (FFR), which all US banks and other lending institutions use to establish subsequent interest rates that they use in transactions (Ireland, 2019). In more recent times, in addition to adjusting the FFR, the Fed has engaged in more aggressive monetary policy by adjusting the monetary supply more directly by purchasing or selling US treasury bonds to add or remove to its balance sheet which adds or removes dollars from circulation in the US economy.

In reaction to the financial crisis and recession of 2007 to 2009, the purchase of treasuries and other financial assets was massively increased (Goodfriend, 2014). The Fed also made loans to entities other than banks for the first time, had much larger bank reserves on its balance sheet and held much larger amounts of foreign assets (Reis, 2009). At the same time, it took the Fed funds rate essentially to zero (Reis, 2009). This policy became known as quantitative easing. Lowering rates immediately to zero and purchasing large amounts of treasuries were designed to get money into the economy faster. The first direct stimulus (in the form of a tax refund) was passed by Congress in 2008 to give the average taxpayer $600 in refunds to assist with the impact of the recession. While these policies tended to prevent the financial system from freezing up and collapsing, it did create massive distortions in the economy for the average consumer (Goodfriend, 2014).

In reaction to the COVID crisis and economic turmoil created by the economy almost entirely being shut down in March of 2020, again the Fed used many of the same tools it had used in 2008 (Al-Hadi & Al-Abri, 2022). Congress also acted directly by granting stimulus programs that disbursed billions of dollars to individuals and businesses affected by the COVID crisis, via the Paycheck Protection Program (PPP) and other programs (Cachanosky et al., 2021). Again, this prevented a short-term collapse of the financial system, but the long-term effects and disruptions to the economy are still being felt over two years later, with the largest inflation since the 1970s affecting prices and production in the economy.

It can be debated whether increased government intervention and control of the free-market forces are good or bad, required or unnecessary, and much has been written about that subject. Additionally, much study has been done on the effects of these policies on the banking industry (Filardo et al., 2022). Financial planners, bankers, and economists understand the macro level effects of monetary policy on the US economy. It is relatively easy to predict how interest rates tend to affect the overall economy or how increasing the money supply will likely lead to inflation. However, most of the predictions made by the industry experts are generalizations that lack the specifics of magnitude and timing such that the information is not easily actionable. What is less considered, is when the government adjusts interest rates, buys or sells treasuries, and/or injects massive amounts of money directly into the economy is how these policies affect the average citizen and what that person can do about it. Often, people must react to the economy after the government acts and do not have the tools or information to help predict what their course of action should be or how to prepare their personal finances to better weather economic turmoil.

The average person in the United States cannot use the information provided on the news or by their financial advisors in way that gives them concrete advice how and when to react to the economy and the government policies used to shape it. A study of how, when, and to what magnitude and direction changes in monetary policy have had on the economy, as illustrated by how it affected consumer prices, inflation rates, unemployment rates, or home prices can be used to better understand how future actions might affect the economy in a measurable and predictive way. Establishing a significant correlation between changes in the FFR and changes to unemployment, inflation, stock market performance, home prices, and consumer prices will indicate which, if any, of these economic indicators are affected by monetary policy. Establishing a quantifiable relationship between FFR and the economic indicators could then be used to predict future economic impacts of any changes in FFR.

**Objectives**

The purpose of this research is to find correlations between changes in government monetary policies via changes in FFR; and the resulting changes in consumer prices, interest rates, housing prices and other economic factors that impact everyday costs of living. Using historical data, the research will attempt to find a pattern in the actions taken by the Fed that correspond to changes in prices, inflation, interest rates and other costs of living. Not only will the research try to find a correlation between the inputs to monetary policy to the outcomes in the economy, but also quantify that relationship. Additionally, it is important to discover any time correlation between the implementation of a policy change such as FFR change and any change in prices or inflation. The analysis of the relationships between the inputs and outputs could be used to establish a model that will predict when and by how much economic indicators will change on average based on what monetary policies changes are to be implemented. This research could help develop a tool used by end-users or a part of a service provided by financial professionals to their customers to help with financial decisions.

**Overview of Study**

By using historical government data for FFR, inflation rate, unemployment rate, Consumer Price Index (CPI), home prices adjusted for inflation, and the S&P 500 adjusted for inflation, monthly changes can be calculated so that changes to FFR can be compared to changes in the other economic measures in 1-, 3-, and 6-month intervals. Each economic condition can be measured if and at what time interval does change in FFR significantly correlate to the other economic conditions. It can be shown that changes in FFR have significant correlations with changes in CPI, inflation, and unemployment. Those relationships can further be refined to look at which timeframes for each pair have the strongest correlation. Then using that strongest pairing, a relationship can be developed that tries to quantify change in FFR to a corresponding change in that economic condition and ultimately use that in a predictive model.

**Research Questions and Hypotheses**

How do changes in FFR affect inflation, prices, stock performance, and unemployment for the average consumer and can those Fed Funds rate changes be used to predict when and by how much prices, inflation, stock performance and unemployment will be affected? A general statement of the hypothesis for this research question is as follows:

**H0:** There is no effect on economic conditions (as illustrated by unemployment rate, inflation rate, stock market performance, change in inflation adjusted home prices, or changes in consumer prices) caused by changes in monetary policy through the Fed changing interest rates.

**Ha:** There is an effect on economic conditions (as illustrated by unemployment rate, inflation rate, stock market performance, change in inflation adjusted home prices, or changes in consumer prices) caused by changes in monetary policy through the Fed changing interest rates.

This research question is not complex but has several outcomes all potentially affected by the same input variable. Because there are several outcome variables in this research question, the general hypothesis should be broken down, using HoH, into several sub-set hypotheses (Heger, 2021). This will also minimize questions of co-variance. Each one is essentially the same set of null and alternative hypotheses as the general hypothesis, but limited to just one of the economic outcome conditions:

**H1o:** There is no effect on unemployment rate caused by changes in monetary policy through the Fed changing interest rates.

**H1a:** There is an effect on unemployment rate caused by changes in monetary policy through the Fed changing interest rates.

**H2o:** There is no effect on inflation rate caused by changes in monetary policy through the Fed changing interest rates.

**H2a:** There is an effect on inflation rate caused by changes in monetary policy through the Fed changing interest rates.

**H3o:** There is no effect on stock market performance (adjusted for inflation) caused by changes in monetary policy through the Fed changing interest rates.

**H3a:** There is an effect on stock market performance (adjusted for inflation) caused by changes in monetary policy through the Fed changing interest rates.

**H4o:** There is no effect on average home prices (adjusted for inflation) caused by changes in monetary policy through the Fed changing interest rates.

**H4a:** There is an effect on average home prices (adjusted for inflation) caused by changes in monetary policy through the Fed changing interest rates.

**H5o:** There is no effect on the consumer price index caused by changes in monetary policy through the Fed changing interest rates.

**H5a:** There is an effect on the consumer price index caused by changes in monetary policy through the Fed changing interest rates.

**Literature Review**

Much has been researched about the Fed, the Federal Open Market Committee (FMOC) that sets the Federal Funds rate upon which all other US interest rates are based, and the tools the Fed uses to influence monetary policy. Ireland (2019) discussed how the Fed resorted to quantitative easing and Congress used fiscal stimulus to help the economy after FFR was already at zero during the credit crisis of 2008. It was argued quantitative easing and stimulus effectively were a form of control on long term rates, which affected bond prices and ultimately inflation rates (Ireland, 2019). It can be implied from this that even money supply, which is not part of the dataset studied here, ultimately translates to interest rate changes.

If one approaches the issue from the standpoint that any manipulation of the greater economy tends to exacerbate any problems in the economy and deepen and prolong downturns, then any action by the Fed could be considered bad. Lacker (2014) addressed the question of whether the Fed overcompensates when it expands its role further into credit policy functions and actually create additional disruptions in the natural cycles of the economy. According to Goodfriend (2014), the Fed has overstepped its authority as it continues to expand its role in the financial ecosystem beyond interest rate control and keeping inflation stable. Research has shown that traditional reactions by the Fed, in light of a downturn, tend to increase and prolong it because the mechanisms the Fed use either take too long and/or overshoot the targeted effect such as to make things worse (Filardo et al., 2022). This overcorrection leads to bigger swings in the cycles and therefore more disruption and instability in the economy. These arguments contemplate the effectiveness of Fed monetary policy and how to improve it, but do not answer the question of how the consumer should react to the Fed’s actions, over which it has no control.

Because the main tool the Fed uses to control monetary policy is changes to the FFR, research regarding the relationship of between FFR to other economic indicators should be examined. There have been several studies that research either the correlative or causal relationships between interest rates, inflation, stock performance, prices, and other economic factors. After the Fed took rates to zero during the credit crisis of 2008, it had to resort to quantitative easing when it greatly expanded its balance sheet in conjunction with government stimulus spending in hopes to ease liquidity in the market and increase demand in the economy with an influx of money. In this manner, Canova et al. (2011) start to develop the idea that quantitative easing was tantamount to an attempted control of long-term interest rates by affecting bond prices, which ultimately impacted inflation rates and consumer pricing. The circular relationship between interest rates and inflation and prices was also developed by Cochrane & Piazzesi (2002) with the theory that short-term interest rates led to forecasted Fed funds target rate changes because the Fed responds to expected inflation, which impacts long term rates. Because long-term rates and short-term rates are linked on the yield curve through bond prices, a feedback loop of sorts is created (Cochrane & Piazzesi, 2002). A similar circular cycle was studied in depth by Bierens (2000) when the relationship between the FFR and the CPI was examined. It was originally thought FFR might cause changes in the CPI inflation rate (Bierens, 2000). It was found that the FFR is a reaction by the FOMC to CPI and producer price index (PPI) changes. The correlation between FFR and CPI was still strong even though the FFR did not cause changes in the CPI and was more likely the other way around (Bierens, 2000). When taken together, these studies indicate there is a correlation between interest rates changes by the Fed and both inflation and price changes and the circular nature of the relationship could mean that changes in FFR could predict changes in inflation and prices based on correlation alone without direct causation.

Other studies relating to different economic inputs and outputs have shown correlation but usually causation has been in the opposite direction of the data proposed to be studied in this research project. There has been a study of inflation and price expectations on interest rates (Gibson, 1972). There has been a study regarding stock performance as an indicator of interest rates and inflation (Titman & Warga, 1989). When coupled with the circular relationship implied by the results Cochrane and Piazzesi (2002) and Bierens (2000) found, it is reasonable to test the relationship of interest rate changes on inflation, stock prices unemployment and other economic factors that impact the consumer. Extending the existing research that indicates the correlation between FFR and unemployment, interest rates, CPI, home prices and other factors that affect individual consumers, a predictive model quantifying the correlation between FFR and the various individual economic factors important to the consumer and its ability to make more informed financial decisions could be developed.

**Research Design**

**Methodology**

The methodology of this research uses quantitative data to test the hypotheses and measure the relationship between changes in monetary policy via FFR data and changes to economic conditions via the 5 output variables. The data used in this research is public data gathered from government or websites that aggregate other public sourced data. The monthly FFR , unemployment rate, and inflation rate were gathered from The Federal Reserve and BLS data records (Federal Reserve of St. Louis & US Bureau of Labor Statistics, 2016). The monthly CPI was gathered from the Bureau of Labor Statistics website (US Department of Labor, 2022). The S&P 500 values (both nominal and adjusted for inflation) were gathered from the Datahub website (Kariv & Pollock, 2022). The monthly home prices adjusted for inflation were gathered from the real estate analysis site [www.dqydj.com](http://www.dqydj.com), which compiled the data from a combination of National Association of Realtors, Robert Shiller home sales prices and Federal Housing Finance Agency sources (PK, 2022). The four sources were combined into one dataset, with all the records matched by month. Using the raw monthly data, one month, three month, and 6 month change rates were derived in Excel to create derived variables for each dimension. The derived output variables were then shifted in time such that changes in the outcomes 3 months and 6 months in the future would tie back to the current monthly, 3-month and 6-month changes in FFR. Correlation was used to analyze which outcomes were significantly influenced by FFR and what time intervals were most significant. Lastly, regression was used to analyze the most significant relationships to see if a model could be developed that might be used to predict economic conditions in the future based on changes in FFR.

**Methods**

To test the five sets of hypotheses, the following method will be used: First all the economic factors as represented by the outcome (dependent) variables will be individually compared to effects of monetary policy as represented in changes in Fed funds interest rates, the independent variable. Using SAS studio, the data set, which contains monthly data from 1954 thru 2016, will be analyzed by the software using the Pearson correlation test (Wang & Mi, 2019). It will perform a correlation analysis comparing the one-month change in interest rates, three-month change in interest rates and six-month change in interest rates against one-, three- and six-month changes in unemployment rates. The same analysis will be done for changes in interest rates against inflation rate, the stock market performance as measured by the S&P 500 adjusted for inflation into 2018 dollars, home prices adjusted for inflation, and the consumer price index (CPI).

For any of the variables that show a significant correlation, as measured by a p value less than 0.05, further analysis will be used to determine which combination of time periods for both change in interest rates and change in economic indicators is most impactful. Again, using SAS, a simple linear regression model could establish a relationship between Fed funds interest rate changes and each significant variable showing change of economic conditions (Wang & Mi, 2019). If any of the models have a strong enough linear relationship, they can be used to develop a predictive model using the data set for training and testing, such that economic conditions, including magnitude, timing and direction could be predicted for consumers.

**Limitations**

The biggest limitation of this study is the lack of data for changes to money supply. As history shows, some of the biggest changes in the economy are after a crisis where quantitative easing and other policies greatly affected the money supply. The literature gave some support that those effects could be translated or represented indirectly by changes in interest rates, but a direct test of that relationship would be more conclusive. Measuring changes in money supply can be difficult because defining the money supply itself is difficult with many different calculations and assumptions used by various groups. Consequently, there is not a clean and simple data set that could have been combined with the rest of the data. Creating that part of the data set was not feasible for this study.

Other limitations in the data include the lack of data for all variables past 2016. It might have been better to have additional data that covered the COVID pandemic timeframe to provide more datapoints during periods of economic change with larger magnitudes. Lastly, the data was national in scope with broad categories. Perhaps breaking the data down by region or subsets of the CPI would provide greater detail and variation. However, the data was not presented in such a way to get that granularity and collection of the data using primary collection methods was not feasible.

**Ethical Considerations**

An important consideration in research is the protection of personal privacy and keeping the integrity of the dataset. Fortunately, the data being used in this research is not personal in nature. The data is from widely available public records. The main consideration with this data is one of maintaining integrity of the raw data when deriving variables from the original dimensions and avoiding bias or distortions in the data. Integrity in data research can be defined as maintaining truth, honesty, and being objective as well as admitting when the alternative hypothesis is wrong and not fitting the data to the hypothesis (Shaw & Satalkar, 2018). All the variables representing amounts of change from one time-period to another were calculated directly from the raw data and any shift in timing was also done consistently to maintain the same adjustments throughout the dimension and the entire dataset.

**Findings**

Using SAS, the cleaned and shifted data set was analyzed. First, the data was explored using correlation tests, comparing change in FFR at 1-month, 3-month, and 6-month timeframes to changes in each of the economic indicator variables at 1-month, 3-month, and 6-months into the future from the end month of the FFR timeframe. Every time interval combination of FFR was compared to every time interval of outcome variable. The results showed that change in FFR was significantly correlated to unemployment, inflation, and the CPI for at least 1 combination of timeframes. FFR was not significantly correlated to changes in the SP 500 adjusted for inflation or home prices adjusted for inflation. See Table 1a through Table 1e. Significant correlation is defined as when the p value is less than .05. Based on these results, the null hypotheses for **H1 (Unemployment)**, **H2 (Inflation)**,and **H5 (CPI)** were not supported but **H3 (Stock Performance)** and **H4 (Home Prices)** were supported by the results of the Pearson correlation test. Changes in FFR do not have an effect on changes in stock performance or home prices, but further study is needed to support the alternative hypotheses for its effects on unemployment, inflation, and CPI.

**Table 1a**

*Pearson Correlation Coefficients for Combinations of Changes in Fed Funds Rate vs. Changes in Unemployment Rate.*

Table

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**Table 1b**

*Pearson Correlation Coefficients for Combinations of Changes in Fed Funds Rate vs. Changes in Inflation Rate.*

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**Table 1c**

*Pearson Correlation Coefficients for Combinations of Changes in Fed Funds Rate vs. Changes in S&P 500 Adjusted for Inflation.*

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**Table 1d**

*Pearson Correlation Coefficients for Combinations of Changes in Fed Funds Rate vs. Changes in Home Price Adjusted for Inflation.*

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**Table 1e**

*Pearson Correlation Coefficients for Combinations of Changes in Fed Funds Rate vs. Changes in CPI.*

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Looking closer at the results of each combination. The strongest correlation pairs for the 3 variables that were significant were a 6 month change in FFR and the change in unemployment 6 months later, a 6 month change in FFR and the change in inflation 6 months later, and a 3 month change in FFR and the change in unemployment 3 months later. Figures 1a through 1c show the changes in FFR and the changes in each of the economic conditions shifted to line up the future outcomes they correspond to. Visually, inflation has the strongest alignment. It also had the largest correlation coefficient at 0.34042, meaning about one-third of the change correlates with changes in FFR.

**Fig. 1a**

*Changes in Fed Funds Rate and CPI over Time.*

Timeline

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**Fig. 1b**

*Changes in Fed Funds Rate and Inflation over Time.*

A picture containing chart

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*Changes in Fed Funds Rate and Unemployment over Time.*

Chart

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Linear regression of these 3 variables with FFR resulted in models that had very low r2 values. Using SAS to generate the models by splitting the data into 70% training and 30% testing. The residuals were quite high and there appeared to be little pattern to the linear model such that it could be used for prediction. See Table 2a through Table 2c.

**Table 2a**

*Predictive Linear Regression Model Parameters and R2 Values for CPI and FFR.*

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**Table 2b**

*Predictive Linear Regression Model Parameters and R2 Values for Inflation and FFR.*

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**Table 2c**

*Predictive Linear Regression Model Parameters and R2 Values for Unemployment and FFR.*

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**Conclusion**

The analysis of the data show correlation and the time relationship among the independent and three of the five dependent variables. The statistical analysis of the data supported the null hypotheses for home price and stock market performance, while it failed to support the null hypotheses and suggested the alternative hypothesis that there is an effect for unemployment, inflation and CPI. Additionally, it is likely that directional prediction as well as the timeframe the independent variable affects those three dependent variables can be inferred from the data. The correlation is directionally consistent and accurate. The correlation timing was always strongest at 6 months for CPI and inflation and strongest at 3 months for unemployment. It is likely the predictive value of the correlations for each of the three variables would be that give an increase in FFR over a 6-month period, it is likely that CPI and inflation will be higher 6 months later and given an increase in FFR over a 3-month period, unemployment will be higher 3 months later. The opposite effect would likely occur if FFR decreased. Further analysis using linear regression did not result in a predictive model that had results with residuals low enough and/or r2 values high enough to provide meaningful conclusions. The predictive value of such models is likely not useful to predict any quantification of any future changes in unemployment, inflation, or CPI. The results of this research do not support a predictive model that can be used as a tool to quantify predictive changes in the economy that would impact individual consumers. However, the data does narrow down which of the economic conditions might have directional predictions and when those conditions would have the most impact.

**Recommendations**

This research was a start in answering the question of whether there is a quantifiable relationship between actions by the Fed and how it impacts the consumer in the form of unemployment, inflation, home prices, the stock market and CPI. While this research eliminated some of those variables being affected by interest rate changes, others were shown to have some effect and further research could add additional details to the relationships between Fed policy actions and those variables. Further study could broaden the research to include effects of monetary supply on the economic variables in this research. Additional models might be used to find other ways to quantify the relationship between FFR and monetary supply such that a useful predictive model could then be developed. Additional data from the COVID era could also add additional incite in further developing this research.

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