Capstone Project: Oral and PowerPoint Presentation

Jeffrey Wolff

Colorado State University Global

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Dr. Lisa Bryan

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Examining Fed Monetary Policy on the Economy and its Impact to the Consumer

- The Fed influences monetary policy by changing the Fed Funds Interest Rate (FFR).
- Changes in FFR influence the rate all lenders use for interest rates.
- As interest rates change the amount of lending changes, bond prices change, and investment in the economy goes up or down as the money supply increases or decreases.
- The Fed makes more aggressive changes in FFR during times of extreme economic conditions
    - Money Supply easing or tightening by purchasing or selling treasuries.
    - Called Quantitative Easing/Tightening.
- Recently the Fed has also engaged in buying other asset types.
- US government has engaged in direct stimulus to businesses and individuals.
- The effects of Fed policy on the economy have been well documented, but less obvious are direct effects to the individual consumer.
- A relationship established between Fed action and how the economy will impact the consumer would be a great tool for consumer to plan for economic changes.

Research Question, Theory, and Hypotheses

Question: 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?

Theory: Changes in FFR correlate to changes in inflation, unemployment, consumer prices, stock performance and housing prices and can be used to predict when and by how much those items will change.

General Null and Alternative Hypothesis Set:

H_0: There is no effect on economic conditions caused by changes in monetary policy through the Fed changing interest rates.

H_a: There is an effect on economic conditions caused by changes in monetary policy through the Fed changing interest rates.

5 Sub-Set Hypotheses for each Economic Condition Variable:

- **$H1_o$:** There is no effect on unemployment rate caused by changes in monetary policy through the Fed changing interest rates.
- **$H1_a$:** There is an effect on unemployment rate caused by changes in monetary policy through the Fed changing interest rates.

- **$H2_o$:** There is no effect on inflation rate caused by changes in monetary policy through the Fed changing interest rates.
- **$H2_a$:** There is an effect on inflation rate caused by changes in monetary policy through the Fed changing interest rates.

- **$H3_o$:** There is no effect on stock market performance (adjusted for inflation) caused by changes in monetary policy through the Fed changing interest rates.
- **$H3_a$:** There is an effect on stock market performance (adjusted for inflation) caused by changes in monetary policy through the Fed changing interest rates.

- **$H4_o$:** There is no effect on average home prices (adjusted for inflation) caused by changes in monetary policy through the Fed changing interest rates.
- **$H4_a$:** There is an effect on average home prices (adjusted for inflation) caused by changes in monetary policy through the Fed changing interest rates.

- **$H5_o$:** There is no effect on the consumer price index caused by changes in monetary policy through the Fed changing interest rates.
- **$H5_a$:** 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 Fed Policy, interest rates and how Fed Policy affects monetary policy and the financial sector.
- Additional research has reviewed the effects of Quantitative Easing (QE) and stimulus legislation on the economy.
  - After the 2008 Credit Crisis and after COVID
  - Lasting impact the short-term emergency policies had on the economy for years after the initial actions.
- There has been many studies on the relationship of interest rates on bond prices.
  - One study characterized QE and stimulus as indirect controls on long-term interest rates.
- Some research deemed any manipulation by the Fed as an exacerbation of economic problems.
  - Tend to prolong and deepen downturns.
  - Any actions destabilize the natural economic cycle.
  - These arguments speak to the effectiveness of Fed monetary policy, but do not answer the question how consumers should react to those actions.
- There have been several studies researching the correlation between interest rates, inflation, stock performance, and prices.
- There has been a theory that short-term rates led to changes in Fed forecast for rate changes because the Fed responds to expected inflation.
  - Impact long-term rates.
  - Long-term rates are connected to short term rates on the yield curve through bond prices.
  - This creates a feed-back loop of sorts.
- A similar circular correlation was studied in the relationship between FFR and the CPI.
- Additional studies of economic inputs and outputs show correlation but typically causation was in the opposite direction of the data proposed to be studied in this research.
- Taken together, studies of circular correlations between interest rates and both inflation and price changes may mean changes FFR could predict changes in inflation and pricing even without causation.

Methodology

- Use Quantitative Data to test the hypothesis and measure the relationship between changes in monetary policy and changes in economic conditions.
- Data gathered from public sources
  - Federal Reserve
  - Bureau of Labor Statistics
  - Datahub website
  - National Association of Realtors
  - Robert Shiller home prices
  - Federal Housing Finance Agency
- Combined into one dataset using Excel with data records matched by month
- 1- 3- and 6- month change variables derived from raw data
- Correlation used to compare FFR with each outcome variables at all time combinations
- Regression used to analyze most significant combinations

Methods

- Compare change in FFR, representing monetary policy, to each of the 5 dependent economic variables: inflation, unemployment, CPI, stock market performance, and home prices.

- Using SAS Studio, the data was analyzed with the Pearson correlation test.

- All 3 time periods of FFR change was compared to all 3 time periods of change in each economic variable.

- All correlations with a P-value less than 5% (.05) are considered significant and evidence of correlation.

- If a pair of variables have a significant correlation, the timeframe pair with the strongest correlation coefficient will represent that pair.

- Those with P-values over (0.05) will be considered insignificant correlation and support the null hypothesis for that variable.

- The pairs that are significant and strongest are graphed to show how they are correlated and provide evidence of when and in what direction changes in FFR will impact the consumer.

- SAS Studio was used to create a predictive model, using simple linear regression, for each significant pair.

- If the results of the regression model have a high enough R^2 value, then they can be used to potentially predict amount of change in that economic factor.

Limitations

- There is no data that represents change in money supply (Quantitative Easing and Tightening).
  - Besides interest rate changes, changes in money supply and stimulus are tools used in extreme economic conditions.
  - It is very difficult to measure this kind of data.
- There is no data available for some variables after 2016.
  - Results for the COVID era would be helpful.
  - Another group of datapoints during a relatively extreme economic period generally would be helpful.
- National data may mask regional effects, particularly in unemployment, CPI, and housing prices –more granularity might be helpful.

Ethical Considerations

- Protecting personal privacy and integrity of the data is very important.
- This data is from public records and national averages so no privacy concerns.
- Integrity is maintained by using consistent time periods when combining data sources.
- All derived data uses the same methods of transformation to retain consistent measures.
- Housing and Stock Market data are adjusted for inflation and converted to percent change to have consistent comparisons with other variables.
- Adjusting for inflation eliminates covariance with the inflation variable.

Pearson Correlation Coefficients for each Variable pair

Table 1a
Pearson Correlation for FFR vs Unemployment.

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations	Fed_Interest_Rate_1	Fed_Interest_Rate_3	Fed_Interest_Rate_6
Unemploy_1 Unemploy_1	-0.21379 <.0001 749	-0.20783 <.0001 747	-0.20725 <.0001 744
	Fed_Interest_Rate_3	Fed_Interest_Rate_1	Fed_Interest_Rate_6
Unemploy_3 Unemploy_3	-0.24549 <.0001 745	-0.21562 <.0001 747	-0.21211 <.0001 742
	Fed_Interest_Rate_1	Fed_Interest_Rate_3	Fed_Interest_Rate_6
Unemploy_6 Unemploy_6	-0.17499 <.0001 744	-0.17140 <.0001 742	-0.12919 0.0004 739

Table 1b
Pearson Correlation for FFR vs inflation.

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations	Fed_Interest_Rate_6	Fed_Interest_Rate_3	Fed_Interest_Rate_1
Inflation_1 Inflation_1	0.22604 <.0001 744	0.21687 <.0001 747	0.12592 0.0006 749
Inflation_3 Inflation_3	0.28672 <.0001 742	0.28335 <.0001 745	0.22024 <.0001 747
Inflation_6 Inflation_6	0.34042 <.0001 739	0.26169 <.0001 742	0.21045 <.0001 744

Table 1c
Pearson Correlation for FFR vs S&P500.

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations	Fed_Interest_Rate_6	Fed_Interest_Rate_1	Fed_Interest_Rate_3
SP500_1 SP500_1	0.01934 0.5984 744	0.01533 0.6754 749	0.00603 0.8693 747
	Fed_Interest_Rate_6	Fed_Interest_Rate_3	Fed_Interest_Rate_1
SP500_3 SP500_3	0.03146 0.3922 742	0.01312 0.7208 745	0.00605 0.8689 747
SP500_6 SP500_6	0.06330 0.0855 739	0.02846 0.4388 742	0.01895 0.6057 744

Table 1d
Pearson Correlation for FFR vs Home Price.

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations	Fed_Interest_Rate_3	Fed_Interest_Rate_6	Fed_Interest_Rate_1
homechange1 homechange1	-0.02438 0.5059 747	-0.01955 0.5945 744	0.01689 0.6445 749
	Fed_Interest_Rate_3	Fed_Interest_Rate_1	Fed_Interest_Rate_6
homechange3 homechange3	-0.03994 0.2762 745	-0.02073 0.5717 747	-0.01323 0.7190 742
	Fed_Interest_Rate_1	Fed_Interest_Rate_6	Fed_Interest_Rate_3
homechange6 homechange6	-0.01345 0.7142 744	0.01191 0.7466 739	-0.01111 0.7626 742

Table 1e
Pearson Correlation for FFR vs CPI.

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations	Fed_Interest_Rate_6	Fed_Interest_Rate_3	Fed_Interest_Rate_1
CPI_1 CPI_1	0.09044 0.0136 744	0.08945 0.0145 747	0.04314 0.2384 749
CPI_3 CPI_3	0.10300 0.0050 742	0.10242 0.0051 745	0.08085 0.0271 747
CPI_6 CPI_6	0.12068 0.0010 739	0.09496 0.0096 742	0.07509 0.0406 744

Changes in FFR compared to effects in CPI, Inflation, and Unemployment over Time

Fig. 1a
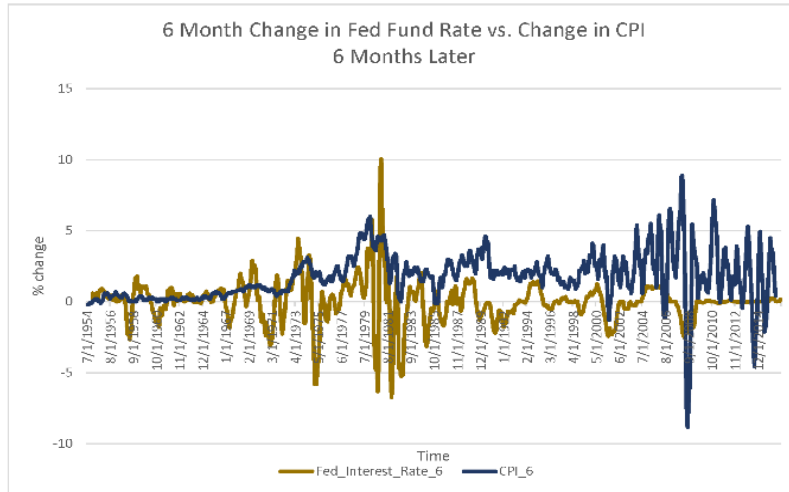*Changes in Fed Funds Rate and CPI over Time.*

Fig. 1b
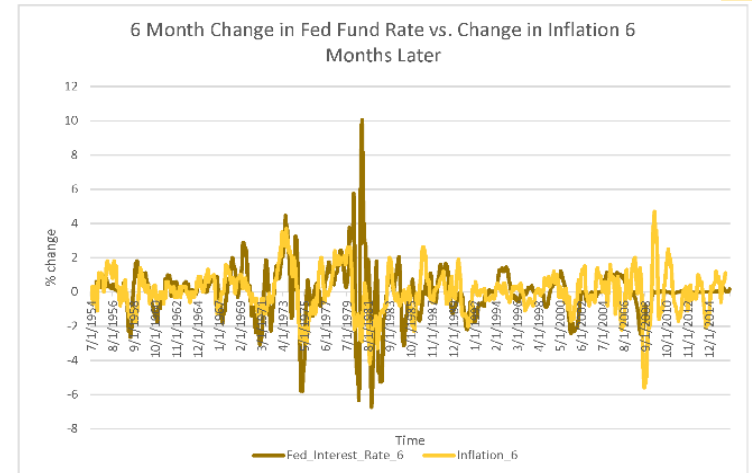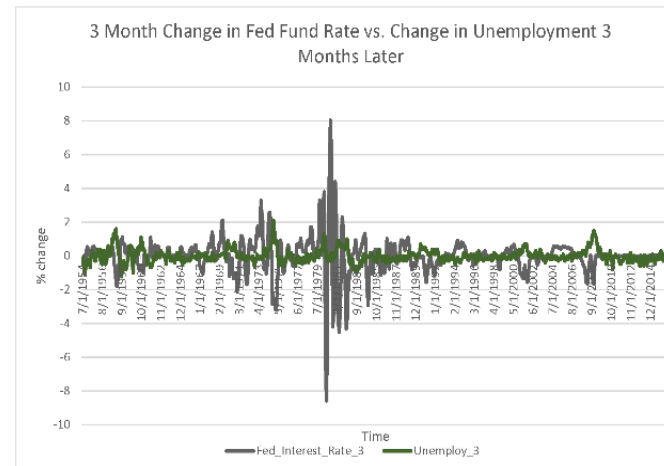*Changes in Fed Funds Rate and Inflation over Time.*

Fig. 1c
Changes in Fed Funds Rate and Unemployment over Time.

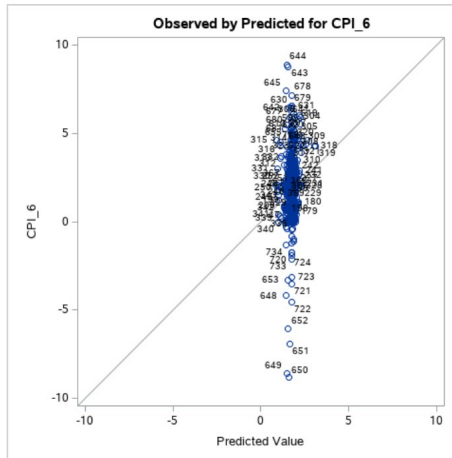# Predictive Linear Regression Models

FFR &CPI

Figure 2a.
Results of Predictive Model of FFR v CPI

Observed by Predicted for CPI_6

Root MSE	1.64123
Dependent Mean	1.86930
R-Square	0.0125
Adj R-Sq	0.0106
AIC	1025.32482
AICC	1025.37198
SBC	518.80538
ASE (Train)	2.68314
ASE (Test)	3.68531

Parameter Estimates						
Parameter	DF	Estimate	Standardized Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.868140	0	0.072464	25.78	<.0001
Fed_Interest_Rate_6	1	0.117849	0.111803	0.046337	2.54	0.0113

FFR &Inflation

Figure 2b.
Results of Predictive Model of FFR v Inflation

Observed by Predicted for Inflation_6

Root MSE	1.13561
Dependent Mean	0.04678
R-Square	0.0981
Adj R-Sq	0.0963
AIC	647.47022
AICC	647.51737
SBC	140.95077
ASE (Train)	1.28458
ASE (Test)	1.58954
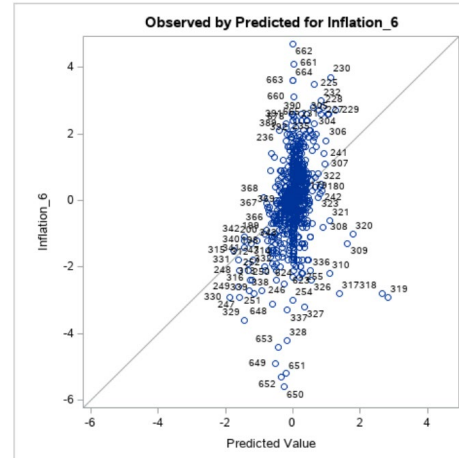
Parameter Estimates						
Parameter	DF	Estimate	Standardized Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.044435	0	0.050139	0.89	0.3759
Fed_Interest_Rate_6	1	0.239050	0.313231	0.032062	7.46	<.0001

FFR &Unemployment

Figure 2c.
Results of Predictive Model of FFR v Unemployment

Observed by Predicted for Unemploy_3

Root MSE	0.37642
Dependent Mean	-0.00116
R-Square	0.0494
Adj R-Sq	0.0475
AIC	-491.18062
AICC	-491.13402
SBC	-1003.67681
ASE (Train)	0.14115
ASE (Test)	0.14252
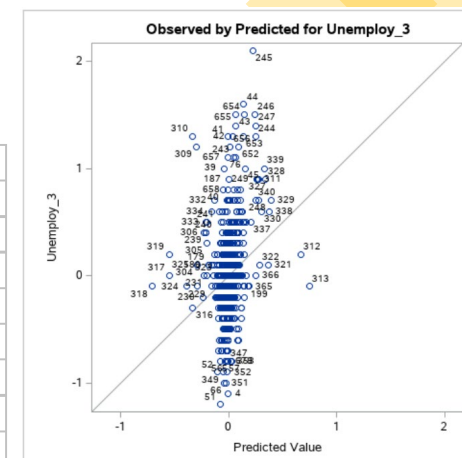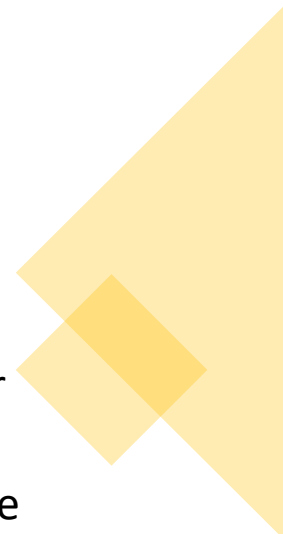
Parameter Estimates						
Parameter	DF	Estimate	Standardized Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.000468	0	0.016524	-0.03	0.9774
Fed_Interest_Rate_3	1	-0.075808	-0.222193	0.014630	-5.18	<.0001

None of these models create meaningful predictions as shown by the low R^2 values and uncorrelated plots

Summary of Findings

- Change in FFR correlation was found to be significant for unemployment, inflation and CPI for at least one timeframe pair.

- Change in FFR was not significantly correlated to changes in the S&P 500 or home prices when adjusted for inflation.

- The null hypothesis for H_1 (Unemployment), H_2 (Inflation), and H_5 (CPI) were not supported and favored the alternative hypotheses that change in FFR has an effect on these 3 variables.

- The null hypothesis for H_3 (Stock Performance) and H_4 (Home Prices) were supported. There is no evidence FFR correlates with these variables.

- The data supports that a 6 month change in FFR has the most correlation with changes in inflation and CPI 6 months later.

- The data supports that a 3 month change in FFR has the most correlation with changes in unemployment 3 months later. (See Figure 1c)

- The linear regression models for these 3 variables do not provide evidence of a quantifiable prediction for the amount of change in these variables. The R^2 value is far too low to be meaningful.

Conclusion

- There is no significant correlation between changes in monetary policy and changes in home prices or stock market performance.

- There is significant correlation between changes in monetary policy and changes in inflation, unemployment and the consumer prices.

- The timing and direction of impact of changes to inflation, unemployment and CPI can be predicted by changes in FFR.

- There is not a reliable model that can be used to predict the amount of unemployment, inflation or CPI based on change in FFR.

Recommendations

- Further study how monetary policy affects inflation, unemployment, and CPI using changes to money supply

- Study if money supply has correlation with home prices or stock market performance, when interest rates did not.

- Study the impact of data from the COVID era on existing research.

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