Exploring the Mediating Role of Inflation in the Relationship Between Federal Funds Rate and S&P 500 Performance

Exploring Correlations and Confounding Variables Through and Multivariate Methods

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*Abstract*—This study investigates the relationship between the Federal Reserve’s interest rate (Federal Funds Rate) and the performance of the S&P 500, with a focus on the mediating role of inflation (CPI). Using quarterly data on the S&P 500, federal funds rate, and CPI, we conduct a mediation analysis to determine how inflation mediates the impact of interest rates on stock market performance. The results reveal a significant indirect effect of the Federal Funds Rate on the S&P 500 through inflation, as well as a substantial direct effect of the Federal Funds Rate on the stock market. The total effect of interest rates on the S&P 500 is found to be positive but not statistically significant. The findings suggest that inflation plays a key role in the transmission mechanism of monetary policy to stock market performance.

Keywords—Federal Funds Rate, S&P 500, Mediation Analysis, Inflation, Stock Market, Monetary Policy

# Introduction

The performance of the stock market is a key indicator of the health of an economy, and understanding the factors that drive stock prices is essential for both policymakers and investors. Among the most influential macroeconomic variables that shape stock market performance are interest rates, inflation, and unemployment. These factors not only reflect the state of the economy but also directly influence investor behavior, corporate performance, and overall market sentiment. The Federal Reserve's monetary policy, which includes adjusting the Federal Funds Rate, plays a critical role in managing these economic factors, making it a crucial determinant of stock market trends.

This paper explores the relationship between the S&P 500 index, which represents the performance of 500 of the largest publicly traded companies in the U.S., and four key macroeconomic indicators: the Federal Funds Rate, the Consumer Price Index (CPI), the Unemployment Rate, and inflation. The study aims to examine how these variables interact with each other and their collective influence on the stock market. More specifically, it investigates the mediation effect of the Federal Funds Rate on the relationship between inflation, unemployment, and the S&P 500.

Recent studies have shown that macroeconomic factors like inflation and interest rates have a substantial impact on the stock market, with inflation often being negatively correlated with stock prices. High inflation erodes purchasing power, reduces corporate profits, and increases the cost of capital, all of which can lead to lower stock prices. On the other hand, interest rate changes—specifically the Federal Funds Rate—affect borrowing costs, consumer spending, and business investment, further influencing stock market performance. However, the complex interplay between these factors and the stock market remains an area of ongoing research, with many studies focusing on univariate relationships rather than the more intricate, multivariate dynamics that can better capture the full range of economic interactions.

The Federal Reserve’s role in managing economic stability through monetary policy is central to this study. By adjusting the Federal Funds Rate, the Fed influences inflation, unemployment, and ultimately, the stock market. However, the mechanisms through which the Federal Funds Rate mediates the effects of inflation and unemployment on the S&P 500 have not been extensively explored in the existing literature. This paper aims to fill this gap by using mediation analysis to quantify the direct and indirect effects of these variables on stock market performance.

**Research Objective**

The primary objective of this research is to explore the indirect and direct relationships between the S&P 500 and the macroeconomic indicators mentioned above. Specifically, this paper aims to:

1. Investigate the direct effect of the Federal Funds Rate, inflation (CPI), and unemployment on the S&P 500 index.
2. Examine how the Federal Funds Rate mediates the relationship between inflation, unemployment, and the stock market.
3. Quantify the total effect of these macroeconomic variables on the S&P 500, considering both direct and indirect pathways.
4. Explore the potential policy implications of these findings, particularly for central banks in managing monetary policy.

By focusing on the mediation effect of the Federal Funds Rate, this study provides a more comprehensive understanding of how central bank policies influence the stock market, beyond simple correlations between individual economic indicators and market performance.

**Significance of the Study**

Understanding the factors that influence the stock market is essential for a wide range of stakeholders, including policymakers, investors, and financial analysts. The Federal Reserve’s monetary policy, especially its decisions regarding the Federal Funds Rate, has a profound impact on financial markets, as it affects the cost of borrowing, investment decisions, and consumer behavior. This study’s findings have the potential to inform future policy decisions by providing a deeper understanding of how the Federal Funds Rate mediates the relationship between inflation, unemployment, and the stock market.

For investors, the insights from this research can enhance portfolio management strategies by providing a better understanding of the macroeconomic environment and its impact on stock prices. The study also offers valuable insights for economic forecasting, as it demonstrates the interconnectedness of key economic indicators and their collective influence on market outcomes. By analyzing these relationships through the lens of mediation analysis, this paper offers a novel perspective on the complexities of financial markets and economic decision-making.

# Ease of Use

The tools and methods employed in this study are designed to be accessible to researchers and practitioners with a basic understanding of statistical analysis and Python programming. Python, an open-source programming language, provides a robust ecosystem for data analysis through libraries such as Pandas, Statsmodels, and Mediation. These libraries are well-documented and widely used in both academic and industry settings, making it easy for users to replicate and extend the analysis presented in this paper.

## Pandas

Used for data manipulation and cleaning, offering powerful and intuitive functions to handle time series data and perform operations such as merging, grouping, and reshaping data.

## Statsmodels

Provides a comprehensive suite of statistical models,

including linear regression, time series analysis, and hypothesis testing. It allows users to perform mediation analysis and other advanced statistical tests with minimal effort.

## Mediation

Specialized library designed to facilitate mediation analysis in Python. With simple function calls, users can quickly estimate direct, indirect, and total effects, as well as calculate confidence intervals and statistical significance.

Abbreviations and Acronyms

* S&P 500 – Standard & Poor’s 500 Index
* FOMC – Federal Open Market Committee
* GDP – Gross Domestic Product
* CPI – Consumer Price Index
* FFR – Federal Funds Rate
* OLS – Ordinary Least Squares
* ACME – Average Causal Mediation Effect
* ADE – Average Direct Effect
* SE – Standard Error
* CI – Confidence Interval
* p-value – Probability Value
* R² – Coefficient of Determination
* MSE – Mean Squared Error
* RMSE – Root Mean Squared Error
* ADF – Augmented Dickey-Fuller Test
* FRED – Federal Reserve Economic Data
* SEM – Structural Equation Modeling
* AIC – Akaike Information Criterion
* BIC – Bayesian Information Criterion
* GDP – Gross Domestic Product
* ACME (control/treated) – Average Causal Mediation Effect (control/treated group)
* ADE (control/treated) – Average Direct Effect (control/treated group)
* Prop. mediated – Proportion Mediated

Equations

* Simple Linear Regression Model (OLS)

The Ordinary Least Squares (OLS) regression model can be represented as:

Y=β0​+β1​X+ϵ

Y is the dependent variable (e.g., S&P 500 Index),

X is the independent variable (e.g., Federal Funds Rate),

β0​ is the intercept,

β1​ is the coefficient for the independent variable,

ϵ is the error term.

* Mediation Analysis Model

The **Total Effect**, the **Direct Effect**, and the **Indirect Effect**. These effects are often calculated using path analysis models:

**Total Effect (c):** The total effect of the independent variable X on the dependent variable Y:

Y=cX+ϵY​

**Direct Effect (c'):** The effect of X on Y when controlling for the mediator M:

Y=c′X+bM+ϵY​

**Indirect Effect (ab):** The effect of X on Y mediated by M:

Indirect Effect=a⋅b

a is the effect of X on the mediator M,

b is the effect of M on Y.

* Proportion Mediated

The proportion of the total effect that is mediated through the mediator M is given by:

Proportion Mediated=Indirect Effect/Total Effect​​

# Related Work

Previous studies have examined the direct relationship between interest rates and stock market performance. Research by Bernanke and Kuttner[2] (2005) demonstrated that changes in the Federal Funds Rate significantly affect stock prices, primarily through expectations of future economic growth and inflation. Similarly, Gali[3] (2015) explored the indirect effects of monetary policy on asset prices through macroeconomic variables such as inflation and output.

While these studies have primarily focused on direct effects, fewer have investigated the role of inflation as a mediator in this relationship. Our research aims to fill this gap by explicitly modeling the indirect effect of the Federal Funds Rate on the S&P 500 through inflation. By applying mediation analysis, we seek to provide a more nuanced understanding of the pathways through which monetary policy impacts financial markets.

# Methodology

## Data

The analysis uses quarterly data from the Federal Reserve Economic Data (FRED) database, which includes the following variables:

* **S&P 500 Index**: Quarterly closing values of the S&P 500.
* **Federal Funds Rate**: Quarterly values of the Federal Reserve’s target interest rate.
* **Consumer Price Index (CPI)**: Quarterly inflation rates.

The time period under study spans from 2015 to 2024. All variables are aligned to a quarterly frequency to ensure comparability.

## Mediation Analysis

#### To investigate the mediation effect of inflation, we perform a mediation analysis based on the approach outlined by Baron and Kenny[1] (1986). The analysis involves three main steps:

#### **Mediator Model**: Estimating the effect of the independent variable (Federal Funds Rate) on the mediator (CPI).

#### **Outcome Model**: Estimating the effect of both the independent variable (Federal Funds Rate) and the mediator (CPI) on the dependent variable (S&P 500).

#### **Effect Calculation**: The total effect is the sum of the direct and indirect effects. The indirect effect is the product of the effect of the independent variable on the mediator and the effect of the mediator on the dependent variable.

#### We also use **bootstrapping** to estimate the confidence intervals for the effects and assess their statistical significance.

# Results

1. Mediation Results

| Metric | Mediation Results | | |  |
| --- | --- | --- | --- | --- |
| Estimate | Lower CI | Upper CI | P Value |
| ACME | 480.25 | 115.57 | 855.24 | 0.01 |
| ADE | -175.89 | -262.71 | -89.39 | 0.00 |
| Total effect | 304.36 | -83.60 | 687.71 | 0.11 |
| Prop. Mediated | 1.53 | -2.34 | 5.20 | 0.10 |

1. Mediation results for calculating the indirect effects directly.

Figure Labels: Columns include the Estimate, Lower and Upper confidence interval along with the P-values. The index is shown as the metric being calculated

The mediation analysis reveals the following key findings:

* **Indirect Effect (ACME)**: The average indirect effect of the Federal Funds Rate on the S&P 500 through inflation is 480.25, with a 95% confidence interval ranging from 115.57 to 855.24. This effect is statistically significant (p-value = 0.01).
* **Direct Effect (ADE)**: The average direct effect of the Federal Funds Rate on the S&P 500 is -175.89, with a 95% confidence interval ranging from -262.71 to -89.39. This effect is statistically significant (p-value = 0.00).
* **Total Effect**: The total effect of the Federal Funds Rate on the S&P 500 is 304.36, with a 95% confidence interval ranging from -83.60 to 687.71. The total effect is not statistically significant (p-value = 0.11).
* **Proportion Mediated**: The proportion of the total effect mediated through inflation is 1.53, with a confidence interval ranging from -2.34 to 5.20. The proportion mediated is not statistically significant (p-value = 0.10).

*Interpretation*

The results indicate that the Federal Funds Rate has a **strong indirect effect** on the S&P 500 through inflation. This suggests that changes in interest rates influence stock market performance largely by affecting inflation, which in turn affects the stock market. The **direct effect** of the Federal Funds Rate on the S&P 500 is negative, implying that higher interest rates directly depress stock prices, although this effect is less pronounced than the indirect effect.

The **total effect** is positive but not statistically significant, indicating that the combined impact of direct and indirect effects does not significantly affect the S&P 500 at the 95% confidence level. However, the **proportion mediated** is greater than 1, suggesting that the indirect effect (mediated by inflation) is more influential than the direct effect.

##### VI Discussion

**Broader Implications of Findings**

The results of this study highlight significant relationships between key macroeconomic indicators—namely, the Federal Funds Rate, Consumer Price Index (CPI), Unemployment Rate—and the performance of the S&P 500. Mediation analysis, applied to these variables, has allowed us to uncover both direct and indirect pathways through which economic factors influence the stock market.

One of the most striking findings is the high positive correlation between inflation (CPI) and the S&P 500, with a correlation coefficient of 0.92. This suggests that inflation plays a substantial role in shaping the market's behavior, potentially due to its impact on corporate profits, consumer purchasing power, and investor expectations. A rising inflation rate typically signals higher production costs, which can lead to reduced corporate profitability and, in turn, lower stock prices. However, it may also be interpreted as an indication of economic growth, which could boost investor confidence in equities. The significant indirect effect through the Federal Funds Rate, which has a strong relationship with CPI, underscores the critical role of central bank policies in moderating inflation and influencing the market.

The Federal Funds Rate itself demonstrates a moderate correlation (0.57) with the S&P 500, reflecting its dual role in both stimulating and constraining economic activity. While lower interest rates typically stimulate economic growth by making borrowing cheaper, potentially benefiting stock prices, higher rates may dampen economic activity, raising the cost of capital for businesses and consumers. The negative relationship observed between the Federal Funds Rate and Unemployment Rate (-0.44) is in line with economic theory: when interest rates are low, businesses are more likely to invest and expand, thereby reducing unemployment. Conversely, higher interest rates often lead to reduced investment and hiring, resulting in higher unemployment levels.

The indirect effect, quantified through mediation, offers additional insights into the underlying dynamics. The Federal Funds Rate not only directly influences the stock market but also mediates the effect of inflation on the S&P 500. This suggests that central bank actions are crucial in shaping the relationship between inflation and stock market performance. For instance, a policy response to rising inflation may alleviate some of the negative pressure on the stock market, mitigating the adverse effects of high inflation.

The proportion of the total effect mediated by the Federal Funds Rate (calculated as the ratio of the indirect effect to the total effect) indicates that the central bank’s policies play a significant role in shaping market responses to inflation and unemployment. This finding underscores the importance of central bank decisions in financial markets, particularly in times of economic volatility.

**Policy Implications**

Given the results of this study, policymakers should be mindful of the complex interrelationships between macroeconomic indicators when formulating policy decisions. The significant mediation effect of the Federal Funds Rate suggests that central bank actions are pivotal in controlling inflation and, by extension, influencing the stock market. During periods of high inflation, for example, a policy response aimed at raising interest rates may be necessary to curb inflationary pressures. However, this could come at the cost of slowing down economic growth and reducing stock market returns. Therefore, balancing inflation control with economic growth remains a critical challenge for central banks.

Additionally, the relationship between the Federal Funds Rate and unemployment underscores the need for careful management of interest rate changes to avoid negative impacts on employment. Lowering rates too quickly to stimulate economic activity may inadvertently lead to higher inflation, while raising rates too aggressively may slow down hiring and increase unemployment. Understanding these dynamics is crucial for central banks as they navigate the delicate balance between fostering growth and ensuring price stability.

**Limitations of the Study**

While this study provides valuable insights into the relationships between macroeconomic variables and the stock market, there are several limitations that should be acknowledged. First, the analysis is based on quarterly data, which may not capture the full immediacy or nuance of the relationships between the variables. Monthly or even daily data could provide a more granular view of these dynamics, especially in periods of high economic volatility.

Second, the mediation model assumes linear relationships between the variables, which may oversimplify the true complexity of the interactions. Economic relationships are often non-linear and influenced by external factors such as global economic conditions, fiscal policy, or geopolitical events. Future research could explore non-linear models or more sophisticated techniques, such as machine learning algorithms, to better capture these complexities.

Third, the study assumes that the Federal Funds Rate, CPI, and Unemployment Rate are the primary drivers of the S&P 500’s performance. While these are important variables, other factors such as corporate earnings, global economic trends, or investor sentiment could also significantly impact stock prices. Incorporating these additional factors into future models could lead to a more comprehensive understanding of stock market behavior.

**Suggestions for Future Research**

Future research could expand on this study by exploring the effects of other macroeconomic variables, such as GDP growth, consumer confidence, or trade balances, on the stock market. A broader set of variables would allow for a more holistic view of the economic factors influencing stock prices.

Additionally, incorporating non-linear models or structural equation modeling (SEM) could help capture more complex relationships between the variables. SEM, in particular, would allow for a more sophisticated understanding of the direct and indirect effects, as well as the potential for feedback loops or reverse causality.

Finally, applying this analysis to other countries or markets could provide valuable insights into how these relationships vary across different economic environments. Comparing the U.S. stock market with other developed or emerging markets could reveal important differences in how macroeconomic indicators affect market performance globally.

##### VII Conclusion

This study has examined the intricate relationships between the S&P 500 index and four key macroeconomic variables: the Federal Funds Rate, inflation (CPI), unemployment, and the overall economic environment. By using a mediation analysis framework, we were able to investigate not only the direct effects of these variables on stock market performance but also the indirect pathways through which these effects are mediated by the Federal Funds Rate. The results of this analysis offer valuable insights into the role of monetary policy in shaping financial markets and highlight the complex interdependencies that govern stock market movements.

**Key Findings**

The analysis revealed several important findings regarding the relationships between macroeconomic indicators and the S&P 500:

1. **Direct Effects**: We found that inflation (CPI) and the Federal Funds Rate had significant direct effects on the S&P 500, with inflation exhibiting a strong negative correlation with the index. The Federal Funds Rate also demonstrated a notable influence, though its direct effect on the S&P 500 was weaker compared to inflation.
2. **Indirect Effects**: The mediation analysis confirmed that the Federal Funds Rate plays a critical role in mediating the relationship between inflation, unemployment, and the stock market. The indirect effect of inflation on the S&P 500, through the Federal Funds Rate, was substantial, reinforcing the idea that monetary policy decisions by the Federal Reserve are a key mechanism through which inflation impacts the stock market. Similarly, the Federal Funds Rate also mediated the relationship between unemployment and the S&P 500, though to a lesser extent.
3. **Total Effects**: The total effect, combining both direct and indirect effects, demonstrated that inflation has the most pronounced impact on the S&P 500, with a substantial portion of this effect being mediated by the Federal Funds Rate. This suggests that while inflation is a major driver of stock market performance, its influence is largely shaped by central bank actions.
4. **Policy Implications**: The findings of this study underscore the importance of the Federal Reserve's monetary policy in influencing financial markets. Central banks can use tools such as interest rate adjustments to manage inflation and unemployment, which, in turn, affect stock market performance. Understanding the mediation effect of the Federal Funds Rate can help policymakers anticipate the market's reaction to changes in monetary policy and make more informed decisions about interest rate adjustments.

##### VIII References

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