



# Impact of CPI on Stock Index

TEAM 36

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# Motivation

## Economic Indicator

CPI measures inflation, which can reduce the real value of stock returns, making it a crucial metric for investors.

As CPI reflects living costs, higher inflation can reduce consumer spending, negatively affecting company revenues and stock values.

## Financial Market

Changes in CPI guide central bank interest rate decisions, affecting borrowing costs and company profits, thereby impacting stock prices.

Different market sectors react differently to CPI changes due to their varying sensitivity to inflation and consumer spending.

## Investment Strategy

CPI data can sway investor sentiment and market expectations, leading to stock market volatility.

Understanding CPI's effects helps investors in portfolio diversification and adjusting investment strategies according to inflation trends.

# Literature Review

## **What Every Bond Investor Should Know by Charles P. Jones & Jack W. Wilson (1998)**

- Findings: The study found that inflation significantly impacts bond returns and compares these effects with the performance of the S&P 500 Index. It suggests that inflation is a primary determinant of long-term bond yields and has historically diminished bond returns. The study also examines the correlation changes between stocks and bonds over time.
- Methodology: This research incorporates an analysis of corporate and government bond performance over time, considering the impact of inflation. The methodology involves comparing real returns of bonds with those achieved by the S&P 500, using historical data to assess the effects of inflation on investment returns.

# Literature Review

## **The Consumer Price Index by Mark A. Wynne & Fiona D. Sigalla (1994)**

- Findings: While this study primarily focuses on the construction and potential shortcomings of CPI as a measure of inflation, it provides a contextual backdrop for understanding how CPI might influence investor perception and market dynamics, indirectly affecting stock indices like the S&P 500.
- Methodology: The approach includes a detailed literature review and evaluation of CPI's discrepancies from a true cost-of-living index, considering quality improvements, introduction of new goods, and consumer substitution. This analysis aids in understanding the overall bias in CPI and its potential overstatement of inflation.

# Literature Review

## **A Review of Core Inflation and an Evaluation of its Measures by Robert W. Rich & C. Steindel**

- Findings: This paper reviews various measures of core inflation and their effectiveness in predicting future aggregate inflation trends. While not directly analyzing the S&P 500, the study's insights into inflation measurement can be crucial for investors and analysts in understanding inflation's underlying trends, which could influence stock market performance.
- Methodology: The study evaluates several core inflation measures (e.g., CPI excluding food and energy) against criteria such as ease of design, accuracy in tracking trend inflation, and predictive content for future inflation. This involves an empirical analysis of historical inflation data and the assessment of different core inflation series' performance.



# Methodology

**Treatment Variable:** Monthly Consumer Price Index (CPI) data will serve as the primary independent variable, reflecting inflationary pressures.

**Outcome Variable:** Stock prices, aggregated through indices such as the S&P 500, will represent the overall market response.

However, we need to recognize that the OVB problem definitely exists. For example, by omitting the unemployment rate, the model suffers from OVB, potentially leading to incorrect conclusions about the true treatment effect of CPI on stock prices. The omitted variable, unemployment rate, correlates with both the independent variable (CPI) and the dependent variable (stock prices), thus biasing the estimated relationship between CPI and stock prices.

# Methodology

Proposing Commodity Index as an Instrument Variable to solve OVB:

## Revelence

The relevance condition seems logical. In this case, the relevance would be justified if changes in commodity prices have a significant impact on the CPI. This is likely because commodities like oil, metals, and agricultural products are components of the consumer basket that affects the overall price level. If commodity prices rise, it is likely that the CPI, which measures the average change over time in the prices paid by urban customers for a market basket of goods, will also increase.

## Exclusion

The exclusion criterion requires that the instrument affects the dependent variable (stock prices) only through its effects on the endogenous explanatory variable (CPI), and not through any other channel. This is what ensures the validity of the instrument in identifying the causal effect. In this case, the commodity index should influence stock prices solely through its impact on the CPI, without any direct relationship.

## Independence

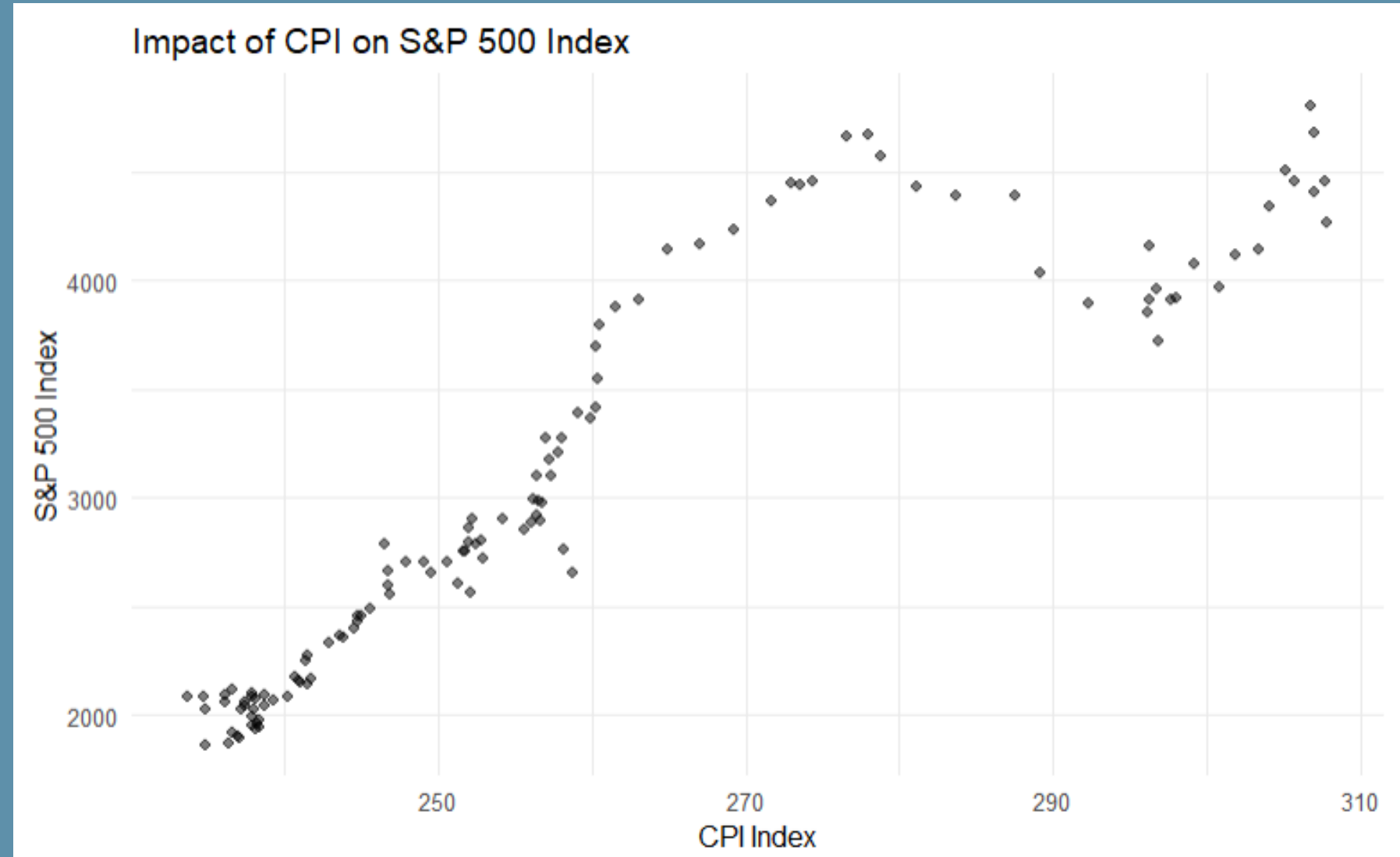
The independence criterion requires that the instrument variable is not correlated with the error term in the regression equation for the dependent variable. This condition is necessary to avoid endogeneity problems in the IV estimation. In this case, to satisfy the independence criterion under the consideration that unemployment rate is the key omitted variable, we must ensure that fluctuations in the commodity index are unrelated to changes in the unemployment rate. This is important because the unemployment rate can impact both stock prices and CPI.



# Research Data

We gather our monthly Consumer Price Index (CPI) and S&P 500 data from both the U.S. Bureau of Labor Statistics and Yahoo Finance. Additionally, the Commodity Index data is sourced from the International Monetary Fund.

In total, we possess monthly CPI index data, including release dates, spanning from February 2014 to February 2024, amounting to 121 data points. However, for the sake of data consistency, we will exclude February 2014 and February 2024 since observations for these two months are unavailable for other variables of interest. Consequently, our dataset encompasses 119 months of comprehensive data for analysis.



# Research Data

The analysis reveals a potential **Omitted Variable Bias (OVB)**, suggesting the existence of a variable not accounted for in the model, possibly causing the observed downward trend around the S&P 500 index of 4700. Omitted variables, whether measurable (e.g., Consumer Confidence, Political Stability, Global Supply Chain Disruptions) or not, can introduce bias, impacting the interpretation of the relationship between the S&P 500 index and economic variables. For instance, omitting factors like unemployment rates may lead to a misleading interpretation.

To address the OVB issue, we propose using a **commodity index as an instrumental variable (IV)**. We selected "**Commodities for Index: All, excluding Gold (PEXGALL)**" to avoid issues related to the inverse relationship between gold prices and stock prices. Gold, traditionally a safe-haven asset, tends to have an inverse correlation with stocks. Excluding gold helps satisfy the IV condition that it should be uncorrelated with the outcome variable. This strategic use of an instrumental variable aims to mitigate potential biases and enhance the robustness of our analysis.

```

Call:
lm(formula = monthly_avg ~ cpi_idx, data = cleandata)

Residuals:
    Min       1Q   Median       3Q      Max
-675.64 -240.45  -90.11   90.22 1002.91

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -6420.297    411.362  -15.61  <2e-16 ***
cpi_idx      36.461      1.579    23.09  <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

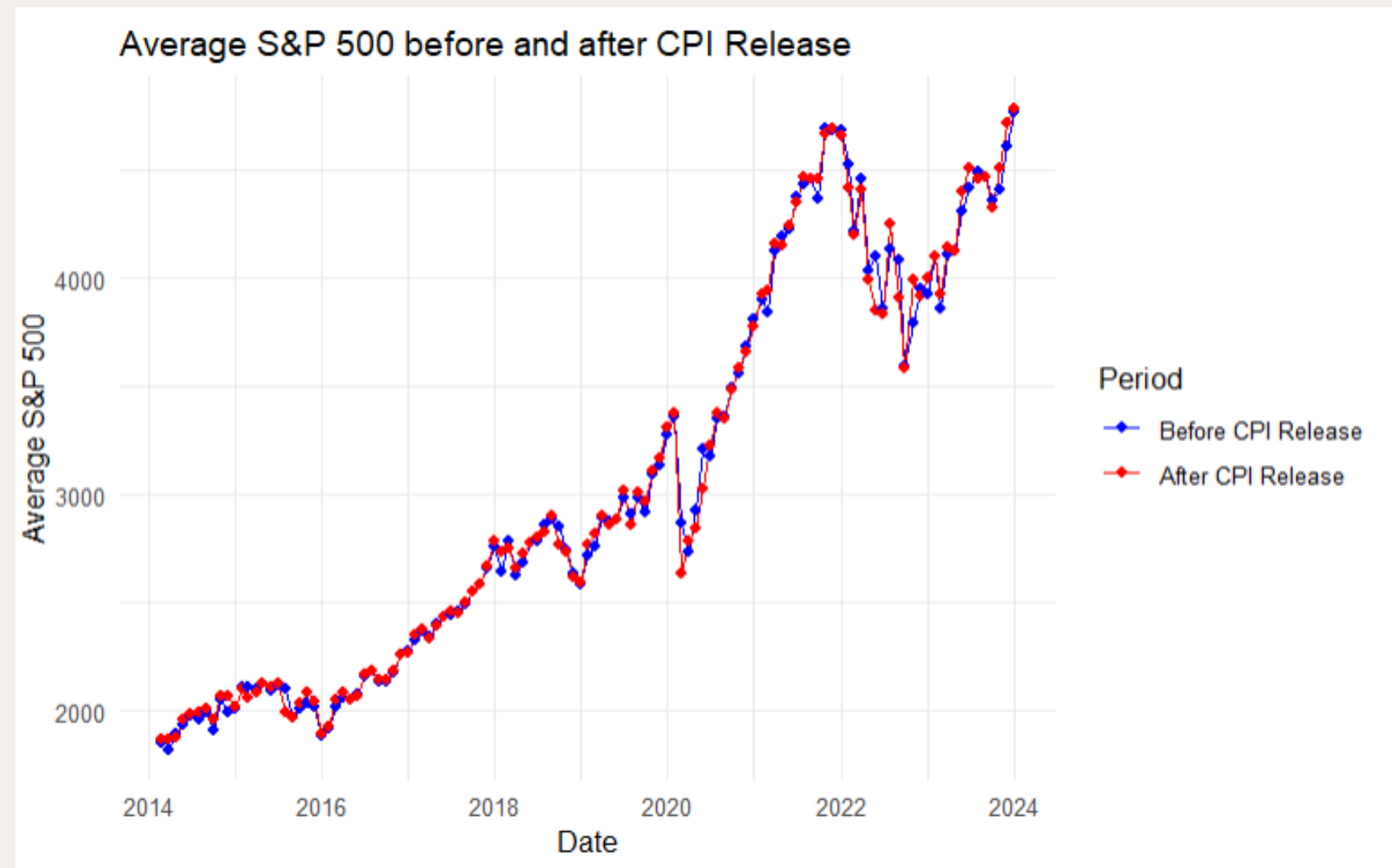
Residual standard error: 386.9 on 117 degrees of freedom
Multiple R-squared:  0.82,    Adjusted R-squared:  0.8185
F-statistic: 533 on 1 and 117 DF, p-value: < 2.2e-16

```

On running an OLS Regression,

- The coefficient of CPI in the model output represents the treatment effect of CPI on S&P 500 index.
- The Average Treatment Effect of CPI on S&P 500 index is statistically significant indicated by the small p-value. **1 unit increase of CPI index generally increases S&P 500 index by 36.461**

## Assessment of Treatment Effect



The difference between S&P 500 before and after the release of CPI is **minimal**. This is because the S&P 500 reflects the most recent available data from the stock market, which is complex. To assess the difference in means more accurately, we need to employ further statistical tools.

- **Average Treatment Effect on Treated:**

- CPI release, on average, drives the S&P 500 index to rise  **$3.41 \times 10^{-13}$**  as the S&P 500 index after CPI release has not experienced the release of CPI yet.

- **Average Treatment Effect on Control:**

- The observed S&P 500 index before CPI release, on average, increases by  **$3.41 \times 10^{-13}$**  following the release of CPI

```

Call:
ivreg(formula = monthly_avg ~ cpi_idx | com_idx, data = cleandata)

Residuals:
    Min       1Q   Median       3Q      Max
-725.02 -229.56  -68.23  105.53  980.28

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -6763.713    612.891  -11.04  <2e-16 ***
cpi_idx      37.785      2.358    16.02  <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 388.1 on 117 degrees of freedom
Multiple R-Squared: 0.8189,    Adjusted R-squared: 0.8174
Wald test: 256.8 on 1 and 117 DF,  p-value: < 2.2e-16

```

- The interpretation of the Instrumental Variables estimate is **akin to that of the OLS regression**.
- The IV estimate assumes that the **Commodity Index** serves as a valid instrument, ensuring consistency for the causal effect of CPI on S&P 500 index even if CPI index is endogenous.
- The IV estimate of the Average Treatment Effect is 37.785. This suggests that a one-unit increase in CPI index corresponds to a 37.785 increase in the S&P 500 index. The difference between the OLS and IV estimates of ATE indicates **a potential case of Omitted Variable Bias**. This implies that there are likely other factors beyond CPI that influence stock prices.
- In essence, while the OLS estimate considers only the direct relationship between CPI and the S&P 500 index, the IV estimate accounts for potential endogeneity issues, providing a more reliable assessment of the causal effect of CPI on stock prices. The presence of OVB underscores the complexity of the relationship between economic indicators and stock market performance, suggesting the need for a more comprehensive analysis of influencing factors.

# Conclusion and Discussion

- The exclusion of commodity index to stock price may be debatable. It is more challenging to justify because commodity prices can affect stock prices through multiple channels, such as impacting the earnings of commodity-sensitive companies, altering consumer spending, or influencing monetary policy. Therefore, the exclusion criterion is the most debatable and needs thorough examination. Typically, economic theory and prior empirical evidence are used to argue for the plausibility of exclusion.
- Additionally, we believed that commodity index is unrelated to unemployment rate. However, further statistical tests or empirical evidence is needed to indicate that variations in the commodity index are not correlated with changes in the unemployment rate.