

Economic Data Analysis of U.S. Indicators Using FRED API

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Summary

This research explores how major U.S. macroeconomic indicators the Consumer Price Index (CPI), Federal Funds Rate, and Unemployment Rate affect Personal Consumption Expenditures (PCE).

The analysis covers data from January 2022 to 2025, obtained through the Federal Reserve Economic Data (FRED) API using R programming.

The study applies correlation and regression analysis to understand how consumer spending responds to changes in inflation, interest rates, and employment.

Results show that inflation has the strongest and most statistically significant influence on PCE, while interest rates and unemployment play secondary roles.

Introduction

The relationship between consumer spending, inflation, unemployment, and interest rates is one of the most important topics in macroeconomics.

This project aims to quantify these relationships using real data from the Federal Reserve.

Understanding how Personal Consumption Expenditure (PCE) changes in response to CPI, Federal Funds Rate, and Unemployment helps policymakers and businesses predict consumer behavior in changing economic conditions.

Data and Methodology

Four datasets were collected from the FRED database:

1. Personal Consumption Expenditures (PCE)
2. Consumer Price Index (CPI)
3. Unemployment Rate
4. Federal Funds Rate

The data was retrieved using the `fredr` package in R. The analysis period started from January 2022. All datasets were merged by date using `tidyverse`. Missing values were removed using `drop_na()`. Summary statistics, correlation coefficients, and multiple linear regression were used to analyze the data.

Descriptive Statistics

The main variables showed the following mean values over the study period:

- Mean PCE: 17,860.41
- Mean CPI: 297.36
- Mean Unemployment Rate: 3.7%
- Mean Federal Funds Rate: 4.6%

These averages reflect a period of strong inflation and steady economic activity in the post-pandemic recovery years.

Correlation Analysis

Correlation analysis measured how strongly PCE moved with each macroeconomic factor. The results were as follows:

Variable Pair	Correlation (r)	Relationship
PCE and CPI	0.987	Very strong positive
PCE and Unemployment	0.598	Moderate positive
PCE and Federal Funds Rate	0.756	Strong positive

The strong positive relationship between CPI and PCE indicates that as prices rise, consumer spending also increases in nominal terms.

This result aligns with expectations during inflationary periods where goods and services cost more, leading to higher total expenditures.

Regression Analysis

A multiple linear regression model was estimated to understand the combined influence of inflation, unemployment, and interest rates on consumer spending:

$$\text{PCE} = -13,080 + 500(\text{Unemployment}) + 99.7(\text{CPI}) - 43.9(\text{Fed Rate})$$

The model achieved an R^2 value of 0.9925, meaning it explained 99% of the variation in consumer spending.

This is a strong indication that the chosen variables effectively represent consumer behavior during this period.

Variable	Coefficient	p-value	Interpretation
Intercept	-13,080	<0.001	Base level when all predictors are zero
Unemployment	+500	0.04	Mild positive impact; possibly short-term recovery effect
CPI	+99.7	<0.001	Strong positive and statistically significant effect
Fed Rate	-43.9	0.21	Negative but statistically insignificant

The results show that CPI has the strongest and most statistically significant impact on PCE.

The unemployment rate also affects PCE, but to a lesser extent. The federal funds rate, while expected to slow spending, was not a significant predictor during this period.

Visualization Summary

Scatter plots with trend lines were created for PCE against each variable.

1. PCE vs. CPI showed a clear upward trend, confirming their strong positive correlation.
2. PCE vs. Unemployment displayed a weaker pattern but still indicated a mild positive trend.
3. PCE vs. Federal Funds Rate showed that spending remained high even as interest rates rose, consistent with the inflationary environment of 2022–2025.

Discussion

The study period was characterized by post-pandemic economic recovery, supply chain disruptions, and inflationary pressure.

During this time, consumer spending rose significantly despite higher interest rates, driven mainly by rising prices and household savings accumulated during 2020–2021.

The regression model's high R^2 value confirms that inflation and related factors largely explain PCE behavior in this era.

The weak significance of the Federal Funds Rate suggests that short-term rate increases did not immediately suppress consumer spending.

Conclusion

This analysis demonstrates that inflation, represented by CPI, had the most powerful and statistically significant influence on consumer spending in the United States between 2022 and 2025.

The unemployment rate had a smaller but noticeable impact, while the federal funds rate played a limited role.

Overall, this project highlights how macroeconomic conditions interact in real-world data and provide valuable insight into post-pandemic consumer behavior.

This study also showcases technical skills in R programming, data cleaning, statistical analysis, visualization, and economic interpretation all essential for modern data-driven research.

Tools and Skills Used

- R Programming
- FRED API (fredr)
- Data Wrangling and Cleaning (tidyverse)
- Correlation and Regression Modeling
- Visualization (ggplot2)
- Economic Analysis and Interpretation

Note: Chatgpt was used for corrections and to skim unnecessary details. Data was taken from Fred with the key to provide authentic records, thanks for checking my project. If you have any questions regarding this project or you need the key. You can reach out to me @ Aazeemi@mercy.edu. Please put the subject: R-Economics Fred Analysis. Thank you!