Inflation and Real Personal Income Growth in the United States

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Introduction

Inflation and real personal income are fundamental indicators of economic well-being. While nominal income measures how much individuals earn in dollar terms, real personal income captures purchasing power by adjusting for changes in prices. When inflation rises faster than income, households may experience a decline in their standard of living even if nominal earnings increase. For this reason, inflation is often described as an implicit “tax” on income.

Using monthly data from 1959 to 2020, this study applies a data science framework—descriptive, exploratory, predictive, and inferential analysis—to evaluate how CPI-based inflation influences real personal income growth over time.

Problem Formulation

Descriptive Question
What are the distributional characteristics of CPI year-over-year growth and RPI year-over-year growth from 1959 to 2020?

Exploratory Question
Is there a systematic relationship between CPI growth and RPI growth over the long run?

Predictive Question
Can CPI year-over-year growth be used to predict real personal income growth using a regression model?

Inferential Question
At the 95 percent confidence level, is the estimated effect of CPI growth on RPI growth significantly negative when assessed using bootstrap methods?

Data Collection

The data used in this analysis come from official U.S. government sources, specifically the Federal Reserve Bank of St. Louis (FRED-MD) and the Bureau of Economic Analysis (BEA). These sources provide long-run, high-quality macroeconomic data that are commonly used in academic research.

The dataset consists of monthly observations from 1959 through 2020, yielding approximately 791 observations after basic cleaning.

Key variables include:

- CPI_yoy:
  The year-over-year percentage change in the Consumer Price Index, used as a measure of inflation.
- RPI_yoy:
  The year-over-year percentage change in real personal income, which adjusts income for inflation.

These variables are well suited for examining how changes in prices affect real income growth over time.

Data Preparation

Data preparation involved merging CPI and RPI series using the monthly date as a common index. The analysis focuses exclusively on year-over-year growth rates to capture structural economic relationships rather than long-term trends in index levels.

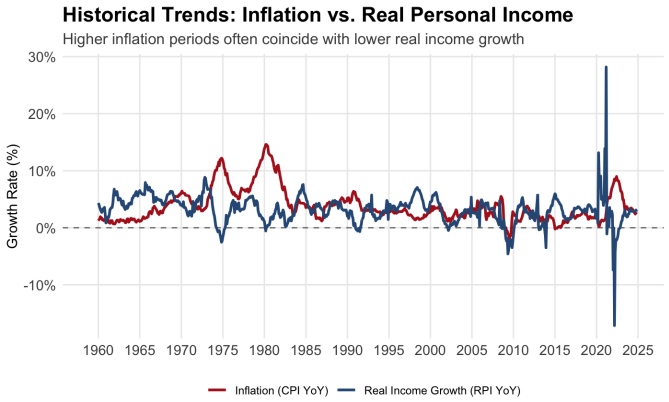
A small number of missing observations were removed. The final dataset was organized in tidy format, with each row representing a single month and each column representing a single variable. This structure supports efficient visualization, regression analysis, and bootstrap resampling.

Data Analysis

1. Descriptive Analysis

Descriptive analysis shows that CPI year-over-year growth typically falls within low to moderate ranges, with notable spikes during high-inflation periods such as the 1970s and the post-COVID inflation surge. Real personal income growth is more tightly clustered, indicating that income growth is generally less volatile than inflation.

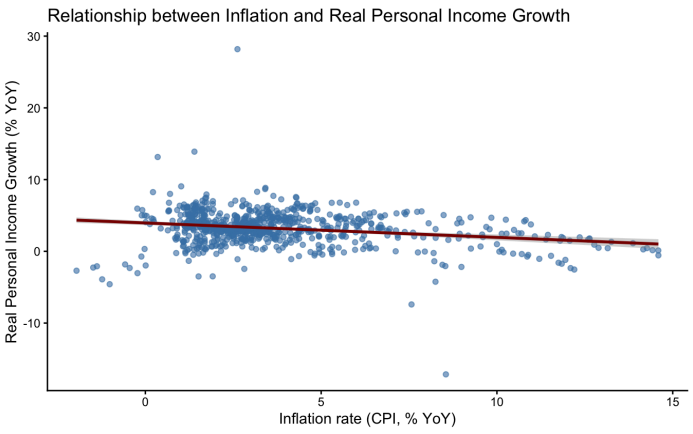
Time-series plots reveal clear divergence during high-inflation regimes, where surges in CPI coincide with sharp slowdowns or contractions in real personal income growth. This pattern supports the intuition that inflation erodes purchasing power when income growth does not keep pace.



2. Exploratory Analysis

Exploratory analysis examines the relationship between CPI YoY and RPI YoY using scatter plots and correlation measures. After transforming the data into year-over-year growth rates, a negative association becomes evident.

The scatter plot with a fitted regression line shows a downward slope, indicating that higher inflation is associated with lower real income growth. The correlation coefficient is approximately -0.23, suggesting a moderate negative relationship once non-stationarity is addressed. This confirms that naive correlations using raw index levels would be misleading.



3. Predictive Analysis

To evaluate predictive power, a simple linear regression model is estimated:

$RPI\_yoy = \beta 0 + \beta 1 \times CPI\_yoy + \varepsilon$

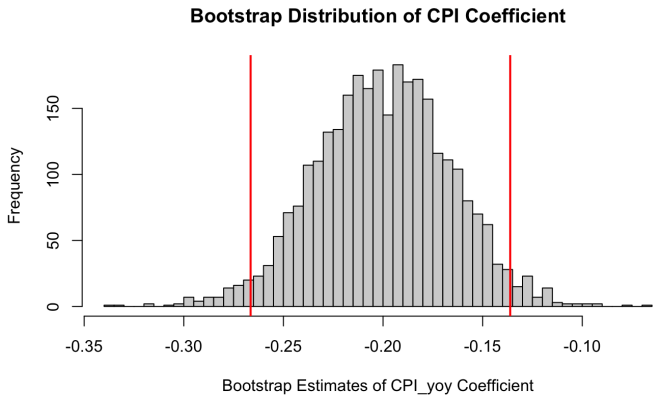
The estimated coefficient on CPI growth is approximately -0.20, indicating that a one percentage point increase in inflation is associated with a 0.20 percentage point decline in real personal income growth. In a theoretical zero-inflation environment, the model predicts a baseline real income growth rate of approximately 3.95 percent.

The model explains roughly 5.3 percent of the variation in real personal income growth ($R^2 \approx 0.053$). While this explanatory power is modest, the relationship is economically meaningful and statistically significant, highlighting inflation as an important—though not exclusive—driver of changes in purchasing power.

Characteristic	Beta (95% CI)	p-value
(Intercept)	3.953 (3.672 to 4.234)	<0.001
CPI_yoy	-0.201 (-0.261 to -0.141)	<0.001
Abbreviation: CI = Confidence Interval $R^2 = 0.053$		

4. Inferential Analysis

To assess statistical significance, a pairwise bootstrap procedure with 3,000 resamples was applied. For each resample, the linear regression model was re-estimated and the coefficient on CPI year-over-year growth was recorded. A 95 percent bootstrap confidence interval was constructed using the percentile method. The resulting confidence interval, [-0.266, -0.136], lies entirely below zero, indicating that the negative effect of inflation on real personal income growth is statistically significant and not driven by sampling variability.



Bootstrap distribution of the CPI year-over-year coefficient from the regression of real personal income growth on inflation. The red vertical lines indicate the 95 percent bootstrap confidence interval. The confidence interval lies entirely below zero, indicating a statistically significant negative relationship.

Problem Reformulation

Several extensions could improve this analysis. Additional macroeconomic variables, such as interest rates, wage growth, or productivity, could be incorporated to reduce omitted variable bias. Nonlinear models could be explored to capture asymmetric effects during high-inflation regimes. Finally, time-series or causal inference methods could help distinguish correlation from causation in the inflation–income relationship.

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