

# Final Project

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Research question: Our project explores the economic impacts of interest rate changes made by the Federal Reserve on unemployment and spending patterns across the United States. We analyzed how these changes, during the low-interest-rate period of 2011–2015 and the relatively high-interest-rate period of 2016–2019, influenced state-level unemployment trends and urban consumer spending patterns measured by the Consumer Price Index (CPI). We chose to compare these two periods because of the Federal Reserve’s decision to increase the interest rate in late 2015. Moreover, we also explored the tone of Federal Reserve speeches and announcements to understand how these policies were conveyed to the public. Key areas:  
- How does unemployment vary across states during these periods? - What are the trends in Consumer Price Index (CPI) in urban areas? - How does the tone and specific wording in Fed communications reflect policy strategies?

Approach/methods: To address these questions, we collected unemployment and CPI data from the Bureau of Labor Statistics, and official Federal Reserve communications for textual analysis. Unemployment rates were aggregated from county to state levels for more accessible regional analysis. CPI data, reflecting urban spending patterns, allowed us to examine inflation trends over time. For Fed communication analysis, we also did research on official press release documents for detailed wording comparison and analysis.

For unemployment data, we analyzed yearly averages and used geopandas to create choropleth maps that visualized regional disparities, and a difference map to highlight significant differences between the two periods. For CPI data, we used Altair to create line plots demonstrating temporal trends and scatter plots comparing changes across urban areas between the two periods. For textual analysis, we applied NLP techniques and used polarity scores to compare Fed speeches versus announcements to evaluate sentiment and tone. And a Shiny app that integrates all our visualizations into an interactive platform.

Weakness/difficulties: A key difficulty we encountered was working with unemployment data, which was only available on a county-by-county basis and differentiated by year on the official

website. This required more recalculation to make them appropriate for our analysis. We merged county-level data and recalculated it on a state-by-state basis, taking yearly averages and then recalculating mean values for each time interval.

Another challenge was aggregating data at the state level helped simplify our visualization and analysis but may have ignored more localized trends and variations within states. For CPI data, which was only available to download for urban areas, we faced limitations in exploring non-urban trends.

## **Step 0: Data combining for state**

## **Step 1: Plot data based on Unemployment Rate**

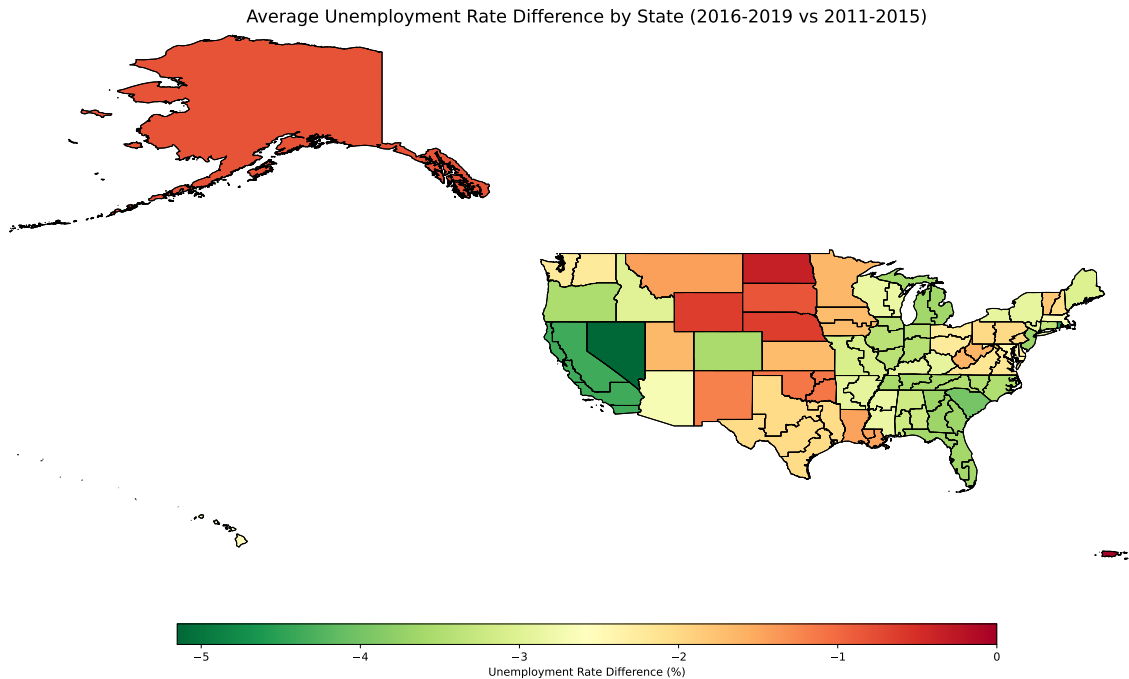
Plot descriptions for unemployment rate: In general, it declined significantly between 2011 and 2019, with a sharp increase during the pandemic in 2020. The West and Southeast showed the greatest reductions in unemployment, particularly in states like Nevada and California.

In contrast, the Midwest and East saw relatively little reductions or even no differences. Including 2020 data revealed less obvious improvements in unemployment.

## Unemployment Rate General Trend (2011~2020)

### Unemployment Rate (2011~2015) & Unemployment Rate (2016~2020), Map by State

### Unemployment Rate (Difference), Map by State



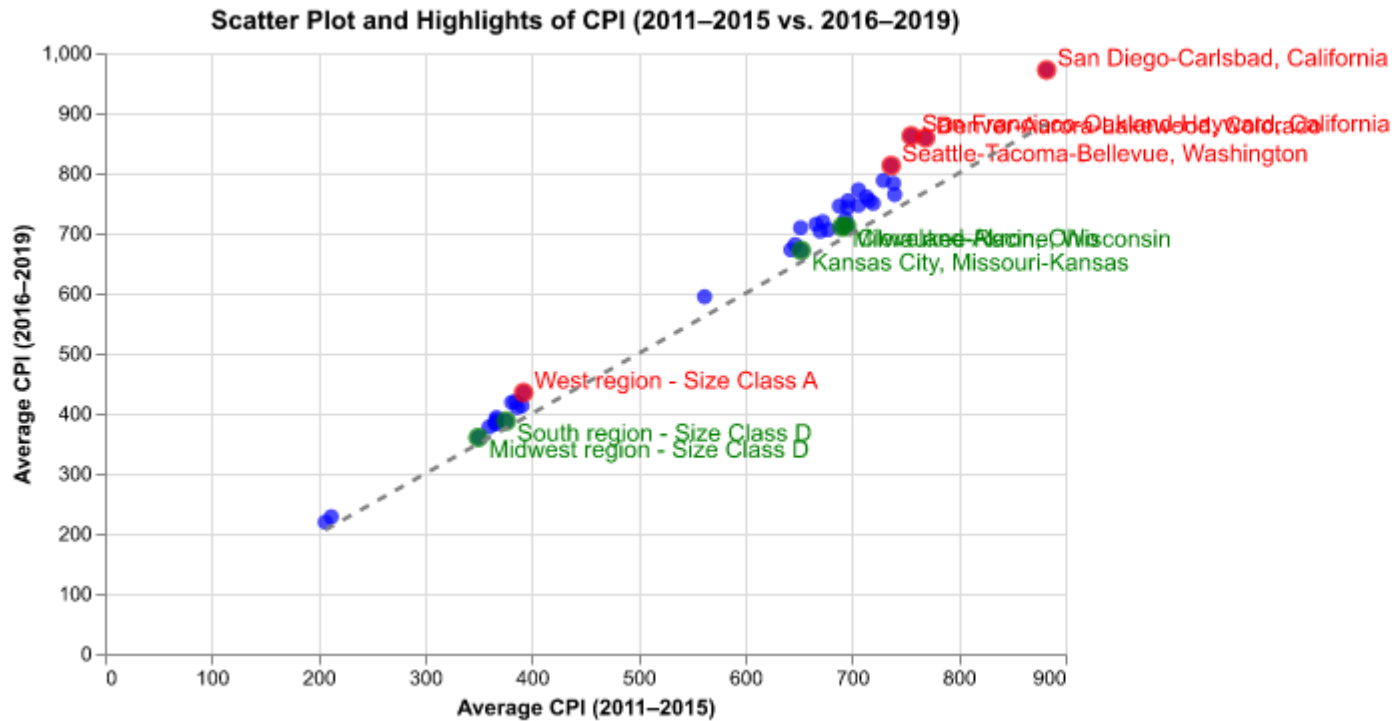
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## Step 2: Plot data based on CPI

Plot description for CPI: CPI revealed a consistent upward trend, reflecting gradual inflation. Urban areas like California experienced significant CPI increases marked in red, while regions like Ohio and Wisconsin saw minimal changes marked in green.

## CPI Rate General Trend (2011~2020)

## CPI Rate Scatter (Self-Regression)



## Shiny app

Shiny app: We developed a Shiny app that includes most plots and maps we created. The app has two dropdown menus: one for time intervals ('2011-2015', '2016-2020'), and another for visualization types ('NLP Analysis' and other 'Plots'). Once 'NLP Analysis' is selected, two polarity plots appear at the same time. Besides, after clicking on the 'Plots' option for visualization type, you can see three radio buttons (unemployment rate, CPI, and differences). And the unemployment rate is special in that you can use the slider to see each year's corresponding map dynamically.

Policy implications: Our findings reveal some key policy implications for addressing the various impacts of interest rate changes. Regional differences in unemployment trends present the need for targeted interventions, like job creation programs in regions like the Midwest, which showed little improvement over time. The CPI analysis underscores pressures of inflation in urban areas, suggesting policymakers consider tax adjustments or subsidies to support urban

households while promoting rural economic development. Lastly, the NLP analysis suggests that appropriate and flexible communication strategies can increase public trust and reduce uncertainty.

Future work: Future research could expand in various directions. For example, including more indicators such as wage growth and housing prices would provide a more comprehensive understanding of economic ripple effects. While we analyze urban data, exploring rural CPI trends can address regional differences and provide a broader perspective.

Extending the timeframe to include data before 2011 or after 2019 would also capture longer-term trends and the effects of recent economic events, such as the pandemic. These directions would strengthen the foundation we've already explored and open up new ways to understand the impact of interest rate changes.