

Multi-factorial Assessment of Economic Data

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1 Introduction

In today's fast-paced economic environment, policymakers, businesses, and stakeholders encounter increasingly intricate issues that demand detailed, data-driven solutions. Understanding the interplay of various economic factors is vital for crafting effective policies, fostering sustainable growth, and ensuring widespread prosperity.

To tackle these challenges and maximize the benefits of informed decision-making, we support conducting a thorough economic analysis that incorporates a wide range of economic indicators. Our analysis seeks to uncover key trends, relationships, and insights within the economy, equipping stakeholders with valuable information to shape policies, allocate resources, and navigate uncertainties confidently.

Our main goal is to explore the complex dynamics of the economy by systematically examining essential variables across labor markets, monetary policy, housing trends, inflation dynamics, employment patterns, and demographic shifts.

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2 Literature Survey

The extensive literature on minimum wage policies encompasses numerous studies exploring their impacts on diverse economic aspects. In the fast-paced economic environment of today, decision-makers, businesses, and stakeholders confront increasingly complex issues demanding detailed, data-driven solutions. Understanding the intricate interplay of various economic factors is essential for devising effective policies, fostering sustainable growth, and ensuring widespread prosperity. [4.] [Ansari et al. \(2022\)](#) delve into the relationship between economic growth, regional minimum wage, inflation, and unemployment rate in Brebes County, revealing limited impacts on unemployment. [1.] [Neumark and Yen \(2022\)](#) examine the effects of recent minimum wage increases in the state of California and nationwide, offering mixed evidence of the effects on employment. Despite challenges in determining causation and limited absoluteness, leveraging their methodologies and insights can enrich our project's scope by considering additional variables and regions for a more comprehensive analysis. [Kandilov and Kandilov \(2020\)](#) contributes insights into the impact of minimum wage policies on farm employment in the US, particularly seasonal agricultural jobs, highlighting potential impacts on capital investment and farm consolidation.

Amidst the COVID-19 pandemic, [Kang \(2021\)](#) analyze its impact on the US economy, offering insights into immediate effects on GDP, stock market trading volume, and unemployment rates. [2.] [Leonard \(2023\)](#) proposes solutions to enhance citizens' financial stability amidst the minimum wage situation in North Carolina, addressing the need for regional specificity in policy discussions. [2.] [Jardim et al. \(2022\)](#) investigate the consequences of minimum wage hikes in Seattle, uncovering a nuanced relationship between hourly wage increases and employment levels, providing insightful observations into the nuanced effects of minimum wage policies. [Boesel et al. \(2021\)](#) emphasize the importance of precise rent change measurement, introducing the Single-Family Rent Index (SFRI) to address measurement gaps in the single-family rental market, revealing significant differences in rent growth rates across property types. [2.]

¹The Heilmeiers' questions have been answered within square brackets mentioning the question being answered, in the Literature Survey and Expected Innovations and Plan of Activities sections.

Furthermore, [Otterby et al. \(2024\)](#) examine the influence of the minimum wage on labor markets across different regions in the US, utilizing county-level data to identify a positive correlation between the minimum wage and labor force participation. [Doh and Van der Meer \(2023\)](#) explore the potential consequences of raising the US federal minimum wage, comparing it to international experiences with significant minimum wage adjustments. Their findings suggest that gradual increases may have smaller negative impacts on employment compared to rapid increases, especially in competitive sectors. [Paun et al. \(2021\)](#) examine how minimum wage laws impact employment dynamics across 22 EU countries, finding a negative effect on total employment and specific categories, despite limitations in considering other factors influencing employment and the need for further investigation into regional differences within countries. [2.]

[Neumark and Shirley \(2022\)](#) examine conflicting conclusions in the literature on minimum wage effects in the US, finding predominantly negative estimates, particularly for specific demographic groups. Despite limitations in accounting for other factors and regional variations, their study provides valuable insights into the employment impact of minimum wages. Lastly, [Martínez and Martínez \(2021\)](#) provide a comprehensive examination of the effects of minimum wage policies on labor markets, spanning more than a century of research articles, revealing a consistent but modest negative impact of minimum wage on employment and highlighting various factors influencing these outcomes. [2.]

3 Expected Innovations and Plan of Activities

In our Expected Innovations and Plan of Activities, we propose a novel approach that integrates a comprehensive review of existing literature on minimum wage policies with original economic analyses incorporating a wide range of indicators. By emphasizing data-driven solutions and detailed economic analysis, we aim to provide a rigorous understanding of the complex dynamics surrounding minimum wage policies. Our expected success lies in achieving a deeper understanding of the impacts of minimum wage policies on various economic dimensions, such as employment, inflation, and regional disparities. [3.] This, in turn, is anticipated to inform evidence-based policymaking, guide business strategies, and contribute to academic knowledge in the field. We plan to measure the impact of our research through statistical analyses of economic data, surveys to assess stakeholder attitudes, and evaluations of policy outcomes over time. [5.] While there are inherent risks, including limitations in data availability and challenges in establishing causal relationships, the potential payoffs are substantial, including informed decision-making and contributions to both policy and academic discourse. [6.] The cost of our endeavor will vary depending on factors such as the scope of research and data acquisition, while the timeline for completion will depend on the complexity of analyses and the availability of data, ranging from several months to years. [7., 8.] To gauge our advancement, we will undertake midterm evaluations through interim reports detailing the progress of data analysis and gathering feedback from stakeholders. As we near completion, final evaluations will encompass comprehensive reports summarizing research findings, offering policy suggestions, and assessing their influence on stakeholders and decision-making procedures. These final evaluations will serve as crucial milestones in evaluating the impact and effectiveness of our research efforts. [9.]

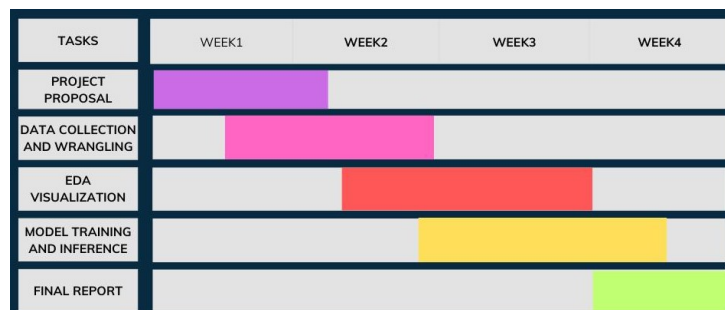


Figure 1: Gantt Chart

We have included our project plan in Figure.1, where every member of the team aims to contribute equally at every stage.

4 Proposed Methods

Our proposed method stands out by taking a comprehensive approach that goes beyond the usual focus on isolated economic indicators or single aspects of minimum wage policies. We combine an in-depth review of existing research with advanced economic analysis, integrating data from various areas such as employment, inflation, and regional differences. By using a wide range of economic indicators and sophisticated statistical and machine learning techniques, we provide a more detailed and interconnected understanding of how minimum wage policies affect the economy. This holistic approach leads to more accurate predictions, more effective policy recommendations, and a better overall understanding of economic complexities.

4.1 Data Collection and Preprocessing

We gathered economic data from various sources, including government databases, research papers, and economic reports. The dataset encompasses key economic indicators such as StateMinimumWage, FederalMinimumWage, EffectiveMinimumWage, EffectiveMinimumWage2020Dollars, CPIAverage, FedFundsRate, GDP, PopulationGrowth, and UnemploymentRate.

To ensure data quality, we applied data cleaning techniques to address missing values. Subsequently, we conducted exploratory data analysis (EDA) to explore relationships between variables and uncover patterns within the data. This analysis included visualizations like scatter plots, histograms, and correlation matrices, as shown in Figure 2.

For data modeling, we divided the dataset into an 80-20 split, designating 80% for training and 20% for testing.

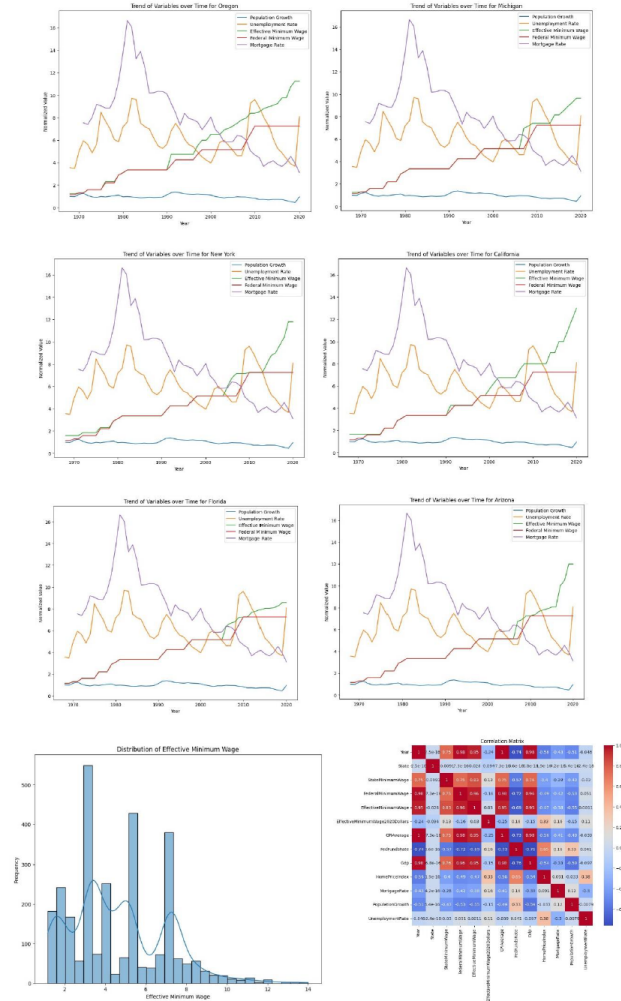


Figure 2: Visualizations based on the EDA performed

4.2 Analytical Framework

Our analytical framework was structured to systematically explore the intricate dynamics between minimum wage policies and various economic dimensions. Here's how we approached it:

- **Statistical Analysis:** We began by conducting rigorous statistical analyses, including regression analysis, hypothesis testing, and correlation analysis. These techniques allowed us to quantify the significance of different variables and understand their impacts on economic indicators.
- **Multicollinearity Handling:** Multicollinearity, where predictors are highly correlated, posed a challenge. To address this, we employed the Variance Inflation Factor (VIF) to identify and mitigate multicollinearity. After discovering high VIF values for `StateMinimumWage` and `FederalMinimumWage`, we made the informed decision to drop these variables from our analysis.
- **Model Training:** With the refined set of predictors, we retrained our models using machine learning algorithms such as Random Forest, Lasso Regression, and Ridge Regression. We ensured the robustness of our models through 20-fold cross-validation, specifically for the Lasso and Ridge models.
- **Model Evaluation:** By comparing mean squared error (MSE) values across different models, we identified Linear Regression as the most effective in predicting economic outcomes related to minimum wage policies.
- **Time Series Analysis:** Additionally, we integrated time series analysis based on the year variable to understand the temporal evolution of `EffectiveMinimumWage`. This temporal perspective provided valuable insights into long-term trends and fluctuations.

By following this analytical framework, we obtained a comprehensive understanding of how minimum wage policies influence economic dynamics. This approach enabled us to make informed predictions and draw meaningful conclusions regarding the broader economic implications of minimum wage adjustments.

4.3 Visualization and Interpretation

In Figure.3, Figure.4 and Figure.5, we observed the interplay between the `FedFundsRate`, `UnemploymentRate`, `GDP`, and `Consumer Price Index (CPI)`. Peaks and troughs in both the `FedFundsRate` and `UnemploymentRate` hinted at a potential inverse relationship, indicating that higher interest rates may precede decreases in unemployment, aligning with economic theory. Despite fluctuations, `GDP` showed overall growth, suggesting economic resilience, while the continuous rise in `CPI` implied persistent inflation over time.

We explored the relationship between the `HomePriceIndex`, `MortgageRate`, `PopulationGrowth`, and `Federal Minimum Wage`. Fluctuating trends in `HomePriceIndex` and `MortgageRate` revealed periods of high mortgage rates coinciding with elevated home prices, suggesting robust housing demand despite higher borrowing costs. Population growth showed variable trends with peaks aligning with increases in the `HomePriceIndex`, indicating a link between population growth and housing demand. Meanwhile, periodic increases in the `Federal Minimum Wage` demonstrated less direct correlation with immediate changes in home prices or mortgage rates, implying the influence of additional factors on the housing market.

Together, these insights underscore the complex dynamics within the economy. Effective management of monetary policy, particularly the `FedFundsRate`, holds significance for controlling unemployment and ensuring economic stability. While `GDP` growth reflects economic resilience, the persistent rise in `CPI` signals an ongoing inflation challenge. Policy considerations are crucial in navigating the housing market, given its sensitivity to factors like mortgage rates and population growth. Additionally, while periodic increases in the `Federal Minimum Wage` contribute to social equity, their direct macroeconomic impact appears to be less pronounced compared to other variables.

In conclusion, these visualizations provide valuable insights for crafting balanced economic policies that promote growth, stability, and equity.

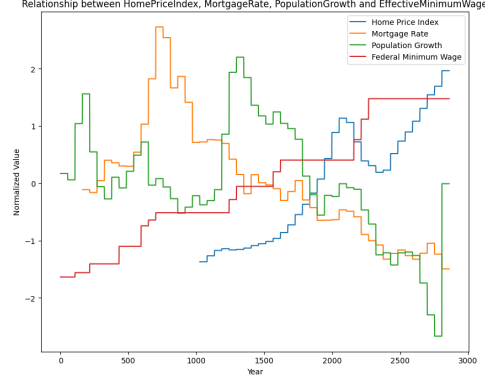


Figure 3: Relationship between HomePriceIndex, MortgageRate, PopulationGrowth, and EffectiveMinimumWage

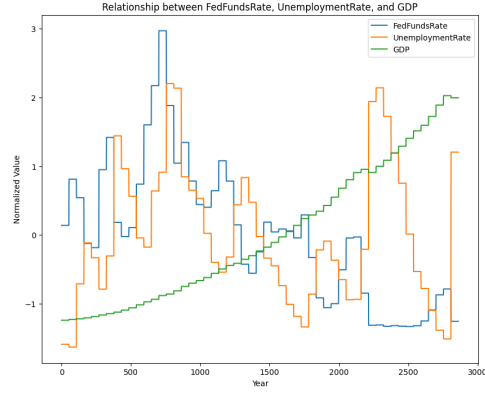


Figure 4: Relationship between FedFundsRate, UnemploymentRate and GDP

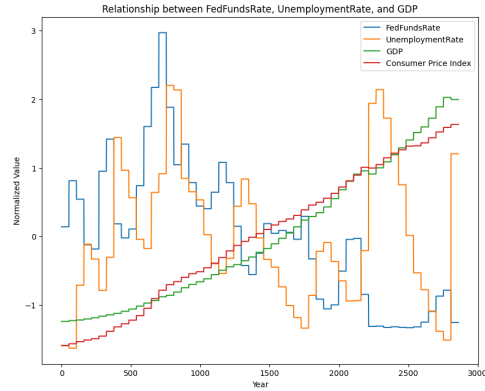


Figure 5: Relationship between FedFundsRate, UnemploymentRate, GDP and CPI

5 Experiments and Evaluation

In our experiments, we carefully looked at how changes in minimum wage laws affect different aspects of the economy. We started by analyzing lots of numbers to see which factors were most important and how they affected things like jobs and prices. We found that some factors, like StateMinimumWage and FederalMinimumWage, were closely related to each other, so we left them out to make our analysis clearer.

Next, we trained some regression models to predict how minimum wage changes would affect the economy. We tried different types of models and checked which one was the best at making accurate

predictions. It turned Linear Regression worked the best as seen in Table.1.

From our experiments, we learned some important things about how the economy works. Managing interest rates is really important for controlling unemployment and keeping the economy stable. Even though the economy grows over time, prices keep going up, which can be a challenge. We also found that changes in minimum wage laws don't always have a big impact on things like home prices or mortgage rates right away.

Overall, our experiments gave us a better understanding of how minimum wage policies affect the economy. This knowledge can help policymakers make better decisions to keep the economy growing while also making sure it's fair for everyone.

Model	MSE
Linear Regression	1.533
Random Forest	4.148
Lasso Regression	9.645
Ridge Regression	2.697

Table 1: Mean Squared Error (MSE) values for different models

6 Conclusion and Discussion

In summary, our study provides a comprehensive examination of how minimum wage policies interact with various aspects of the economy. We discovered that managing interest rates plays a pivotal role in controlling unemployment rates and maintaining overall economic stability. Despite observing consistent growth in the economy over time, the persistent challenge of inflation remains a significant consideration for policymakers. Additionally, our analysis underscores the intricate dynamics within the housing market, emphasizing the need for policymakers to carefully navigate factors such as mortgage rates and population growth to ensure housing affordability and stability.

Furthermore, while periodic increases in the Federal Minimum Wage contribute to promoting social equity, our findings suggest that their immediate macroeconomic impact may not be as pronounced as initially assumed. This underscores the importance of taking a balanced approach to economic policy-making, considering various factors beyond just minimum wage adjustments.

Looking ahead, further research is warranted to refine our analytical techniques and explore additional variables that may influence the relationship between minimum wage policies and economic dynamics. By continuing to build upon our findings, policymakers can make more informed decisions that promote sustainable economic growth and equitable outcomes for all members of society.

References

- Ansari, A., Riono, S. B., & Indriyani, A. (2022). Analysis of economic growth, regional minimum wage, and inflation on the unemployment rate in brebes regency. In *Tegal international conference on applied social science & humanities (ticassh 2022)* (pp. 393–402).
- Boesel, M., Chen, S., & Nothaft, F. E. (2021). Housing preferences during the pandemic: effect on home price, rent, and inflation measurement. *Business Economics*, 56(4), 200–211.
- Doh, T., & Van der Meer, L. (2023). The employment effect of an increase in the national minimum wage: Review of international evidence. *Economic Review*, 108(2), 1–15.
- Jardim, E., Long, M. C., Plotnick, R., Van Inwegen, E., Vigdor, J., & Wething, H. (2022). Minimum-wage increases and low-wage employment: Evidence from seattle. *American Economic Journal: Economic Policy*, 14(2), 263–314.
- Kandilov, A. M., & Kandilov, I. T. (2020). The minimum wage and seasonal employment: Evidence from the us agricultural sector. *Journal of Regional Science*, 60(4), 612–627.
- Kang, H. (2021). Analysis of the impact of covid-19 on the us economy based on big data processing and experimental analyses. In *2021 2nd international conference on big data economy and information management (bdeim)* (pp. 365–370).
- Leonard, E. I. (2023). More money fewer problems: Increasing the minimum wage. *The Gettysburg Journal for Public Policy*, 1(1), 6.
- Martínez, M. J., & Martínez, M. J. (2021). Are the effects of minimum wage on the labour market the same across countries? a meta-analysis spanning a century. *Economic Systems*, 45(1), 100849.

- Neumark, D., & Shirley, P. (2022). Myth or measurement: What does the new minimum wage research say about minimum wages and job loss in the united states? *Industrial Relations: A Journal of Economy and Society*, 61(4), 384–417.
- Neumark, D., & Yen, M. (2022). Effects of recent minimum wage policies in california and nationwide: Results from a pre-specified analysis plan. *Industrial Relations: A Journal of Economy and Society*, 61(2), 228–255.
- Otterby, D., Crawley, A., & Gabe, T. (2024). Effects of the minimum wage on us county labor markets. *Regional Science Policy & Practice*, 100008.
- Paun, C. V., Nechita, R., Patruti, A., & Topan, M. V. (2021). The impact of the minimum wage on employment: An eu panel data analysis. *Sustainability*, 13(16), 9359.