# Visualizing the Uninsured: A Data Science Perspective on U.S. Health Coverage

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## Contents



**Part 1 – Identify a Social Problem**

### 0.1 1.1 Describe the Social Problem

The large number of uninsured people in the United States represents a significant social issue with serious consequences for individuals and the healthcare system. As of 2022, over 27 million Americans—approximately one in twelve people—lacked health insurance coverage (KFF, 2023). This lack of coverage creates substantial barriers to healthcare access and has wide-ranging effects on both personal and public health.

For individuals without insurance, the consequences are often severe. Uninsured people are much more likely to delay or avoid necessary medical care due to cost concerns, which leads to worse health outcomes, preventable emergency room visits, and higher rates of preventable deaths. The financial impact is equally serious, as uninsured individuals must pay full price for medical services, often resulting in medical debt, damaged credit, and long-term financial hardship (Davis, 2007).

The problem extends beyond individual impacts to affect the entire healthcare system. When uninsured patients cannot pay for their care, hospitals and clinics must absorb these costs as uncompensated care. This financial burden strains healthcare providers and ultimately increases costs for everyone else through higher insurance premiums and taxes. As Davis (2007) explains, the uninsured population includes "our neighbors, co-workers, and family members," making this a community-wide issue that affects society as a whole.

### 0.2 1.2 Provide Background on the Problem

The Affordable Care Act (ACA), enacted in 2010, significantly expanded health insurance coverage through Medicaid expansion and subsidized insurance marketplaces. However, millions of Americans remain uninsured despite these reforms. According to the Kaiser Family Foundation, most uninsured individuals today are low-income workers, disproportionately people of color, and residents of states that chose not to expand Medicaid under the ACA (KFF, 2023).

A major factor contributing to this problem is the employment-based nature of the U.S. health insurance system. Many uninsured individuals work in jobs that do not offer health benefits, including part-time, temporary, or service sector positions. These workers often earn too much to qualify for traditional Medicaid but too little to afford private insurance, creating what Davis (2007) describes as falling "through the cracks" of the current system.

Geographic disparities also play a significant role. States that expanded Medicaid under the ACA have substantially lower uninsured rates than non-expansion states, creating uneven access to coverage across the country. This policy variation has resulted in particularly high uninsured rates in many Southern and some Western states.

The persistence of uninsurance reflects broader structural challenges in American healthcare, including affordability, accessibility, and policy gaps that leave vulnerable populations without coverage options.

# 1 Part 2 – Describe and Acquire Data

## 1.1 2.1 Describe the Data sets

This analysis utilizes two primary datasets to examine patterns in health insurance coverage and their relationship to economic conditions across U.S. states.

**U.S. Census Bureau Data** The main data set comes from the U.S. Census Bureau's American Community Survey (ACS) 1-Year Estimates, specifically the table "Selected Characteristics of the Uninsured in the United States." This data set covers the period from 2010 to 2023, excluding 2020 due to the absence of 1-year estimates for that year.

Eight smaller states and territories were excluded from the analysis—Delaware, District of Columbia, Hawaii, Puerto Rico, North Dakota, Rhode Island, Vermont, and Wyoming—because they are not consistently included in the 1-year estimates. The 1-year estimates were chosen over 5-year estimates because they provide more timely data that can capture short-term changes from economic shifts or policy reforms.

The ACS data set provides state-level information on the civilian non-institutionalized population, including total population counts, number of uninsured individuals, and various demographic and socioeconomic characteristics. For this analysis, we focused on total population figures and household income data (adjusted for inflation) to calculate uninsured rates and understand the economic context.

**Bureau of Economic Analysis Data** Economic data comes from the Bureau of Economic Analysis (BEA) table SAGDP1 – State Annual Gross Domestic Product Summary. This data set provides real GDP figures in millions of chained 2017 dollars for each state from 1997 through 2024. Using inflation-adjusted GDP enables consistent comparisons over time and across different states.

**Data Integration** These two datasets together provide a comprehensive view of how health insurance coverage has changed across the United States over time and how coverage patterns may relate to state-level economic conditions. The combination allows for analysis of both temporal trends and cross-state variations in uninsured rates.

## 1.2 2.2 Import and Prepare the Data set

**First data set: "Selected Characteristics of The Uninsured in the U.S."**

- Here we imported the first data set from the U.S. Census Bureau and named them "dataset_uninsured_population_*year* from 2010-2023, excl 2020.

**Second Data set: "SAGDP1 State Annual Gross Domestic Product Summary", Statistic: "Real GDP (millions of chained 2017 dollars)"**

- Here we imported the second data set from the Bureau of Economic Analysis of the annual GDP of the states from 2009-2023 and named it "table_GDP"

## 1.3 Data cleaning: Data sets of Uninsured Population and The Creation of The New Variable: The Uninsured Share

To prepare the data for analysis, we began by removing all margins of error from the original Census data sets. While margins of error are important for assessing statistical precision, they were not necessary for our purposes, which focused on comparing overall trends in health insurance coverage across states and years. Removing them helped simplify the data set and reduce complexity without compromising our analytic goals.

A more structural challenge involved the inclusion of smaller states and territories. Since 2016, the Census Bureau's 1-year estimates no longer cover certain low-population areas, meaning they are missing from some years in our timespan. To ensure consistency across time, we decided to exclude eight such places entirely from our analysis. These were Delaware, the District of Columbia, Hawaii, Puerto Rico, North Dakota, Rhode Island, Vermont, and Wyoming. By removing them, we ensured that our data set included only states that were present in every applicable year from 2010 to 2023 (with the exception of 2020, when no data was published due to the COVID-19 pandemic).

After resolving issues of consistency and coverage, we turned our attention to the structure of the data itself. Each annual data set included a wide range of metadata—demographic and socioeconomic characteristics that, while valuable for other types of research, were not essential to our primary analysis of insurance coverage trends. We removed variables related to age, sex, race and Hispanic or Latino origin, nativity and U.S. citizenship status, disability status, residence one year ago, educational attainment, employment status,

work experience, civilian non-institutionalized workers aged 16 and over, earnings in the past 12 months, and the ratio of income to the poverty level in the past 12 months. From all this, we retained only the total civilian non-institutionalized population and household income (adjusted for inflation), which were directly relevant to our questions about insurance and economic context.

To ensure the data was ready for calculations, we then converted all numeric values that had been stored as character strings—often due to formatting like commas—into actual numeric variables. This was a necessary step for performing any reliable mathematical operations.

One of the most important transformations in our cleaning process was the creation of a new variable: uninsured share. The original data provided the total population and the total number of uninsured individuals for each state and year. To make this more interpretable and comparable, we calculated the uninsured share by dividing the number of uninsured people by the total population and multiplying the result by 100. This gave us a percentage that reflects the proportion of each state's population without health insurance. Expressing the data this way allows for easier comparisons across time and across states, regardless of differences in population size. It helps illuminate broader patterns in insurance coverage that would be difficult to spot using absolute numbers alone.

After all these cleaning and transformation steps, we combined the individual yearly data sets into a single, comprehensive data set covering the period from 2010 to 2023 (excluding 2020). This final merged file allowed us to analyze long-term trends and relationships in a consistent and structured way.

### 1.4 Data cleaning: Annual GDP Table and The Creation of The New Variable: Annual Real GDP Growth per year and state

For the economic data from the Bureau of Economic Analysis, we worked with the *SAGDP1 – State Annual Gross Domestic Product Summary* table, which reports real GDP per state in millions of chained 2017 dollars. Before analysis, we cleaned this data set to align it with the structure and timeframe of our health insurance data. First, we removed all columns corresponding to years outside our scope—specifically, 1997 through 2008, as well as 2020 and 2024. We also filtered out states and regions that were not included in our main data set or that represented aggregate regions rather than individual states. Specifically, we excluded Delaware, District of Columbia, Hawaii, North Dakota, Puerto Rico, Vermont, Wyoming, and Rhode Island, as well as the regional aggregates: New England, Mideast, Great Lakes, Plains, Southeast, Southwest, Rocky Mountain, and Far West. Also here, the values were stored as "double", so we coerced the values to numeric, so that we are able to compute our new variable. After these adjustments, we renamed the cleaned data set `table_GDP` for use in our analysis.

From this cleaned table, we created a new variable: annual real GDP growth, calculated for each state and year by measuring the year-over-year percentage change in real GDP. This variable allowed us to capture how quickly or slowly each state's economy was growing over time. Including GDP growth in our analysis adds important context: it helps us explore whether changes in economic performance are linked to shifts in health insurance coverage. For example, we can examine whether periods of economic expansion correspond with improvements in coverage rates. By combining this with our uninsurance data, we gain a more nuanced understanding of how economic conditions may influence access to healthcare.

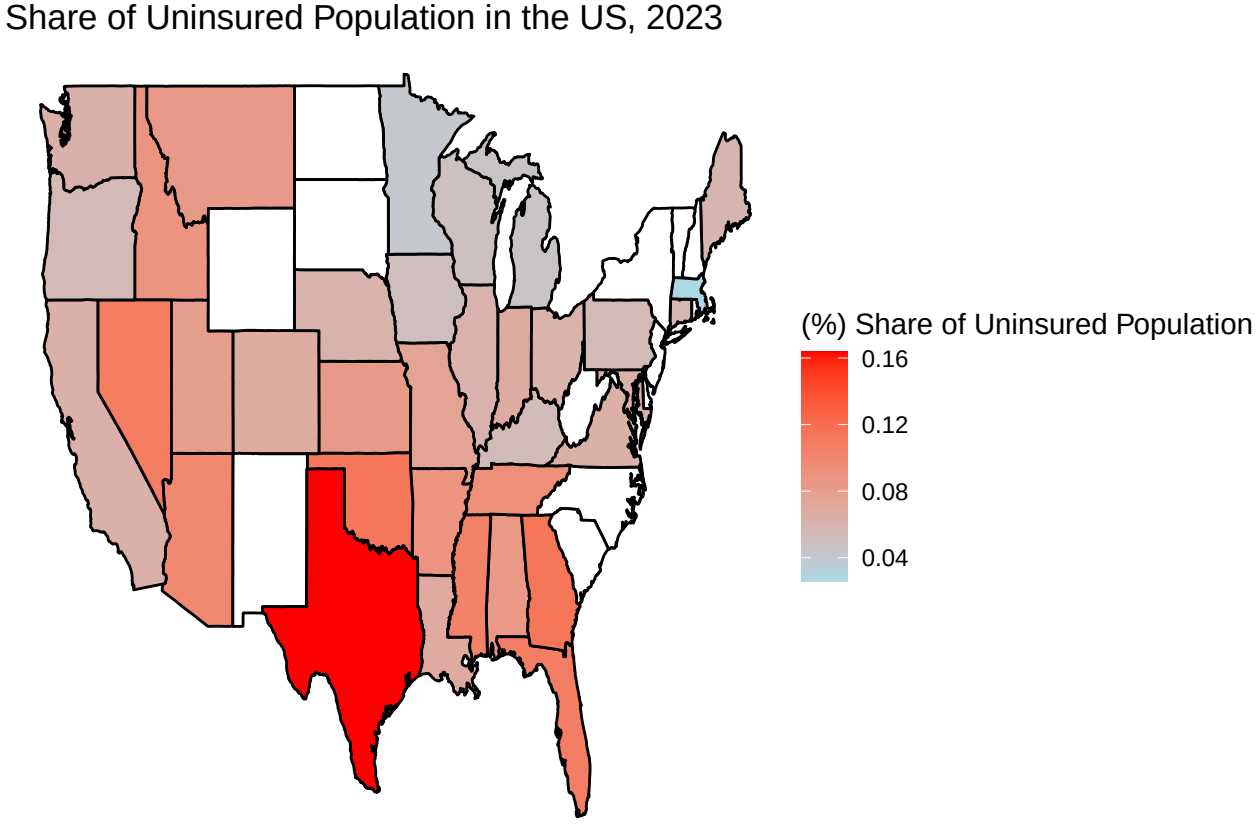
## 2 Part 3 – Visualize and Analyze the Data

### 2.1 3.1 Create Initial Visualizations

**Spatial Variation Visualization, U.S. Share of The Uninsured Population in 2023**

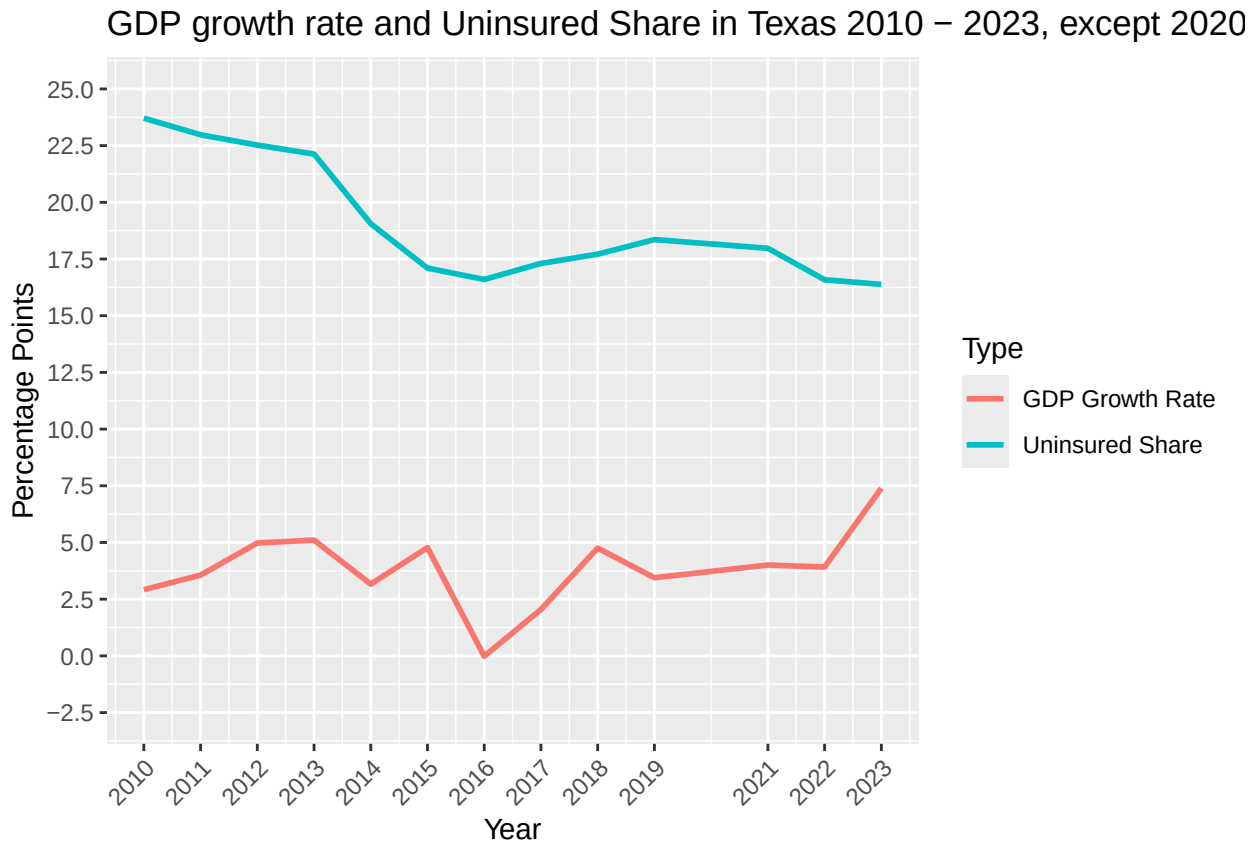
- describe here that we mapped here the spatial variation of the uninsured population of the states of which we have the ACS one year estimates of and that we first created a subset of 2023 of the big

dataset all_states_100 and that we plotted Alaska separately otherwise the whole map would be too small to visualize.



**Temporal Variation Visualization, Texas's Share of Uninsured Population and Texas's GDP growth rate over time**

- describe that Texas stood out in our spatial variation analysis and that we wanted to dig deeper into Texas's share of uninsured population over time from 2010 until 2023, except for 2020 and that we wanted to see if economic growth played a role in this.



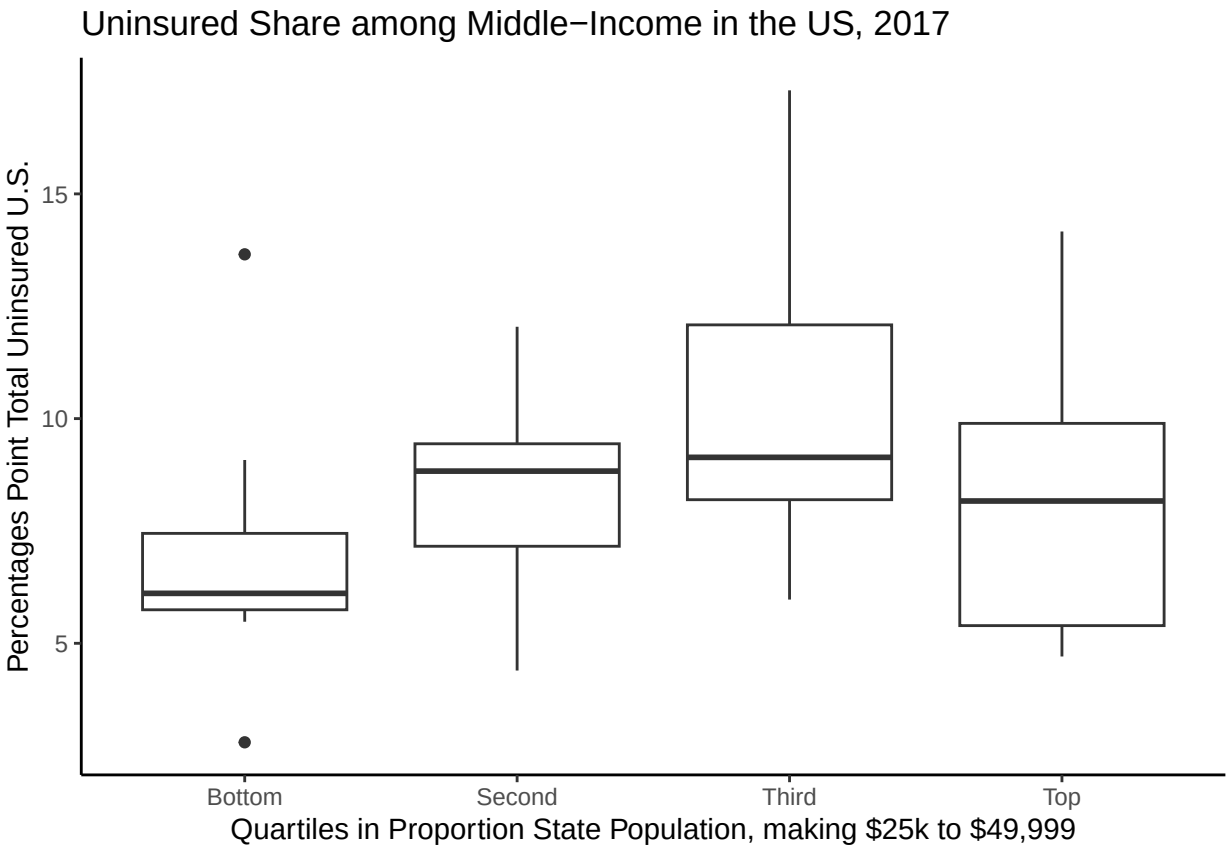

**Sub-Group Variation Visualization, The Uninsured Rates of the Middle-Income Group in 2017 in the U.S.**

- describe that already the KFF (2024) found that the uninsured people in the US are more likely to be low income and that we were wondering what the state of the middle-income group is as they earn too much for Medicaid but not enough for private insurance. 2017 is the year after Trump became president in 2016.

```
## [1] "First quartile (Q1): 26.625"
```

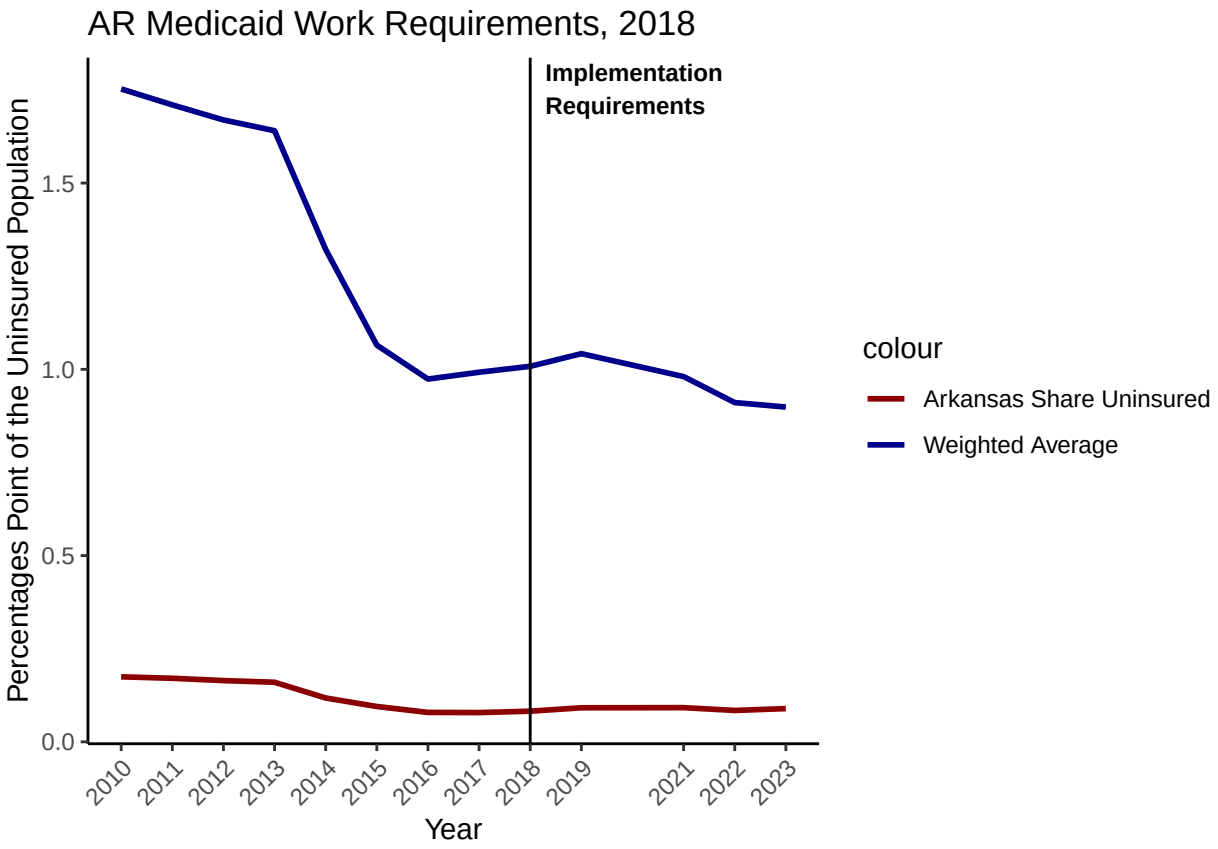
```
## [1] "Second quartile (Q2): 29.35"
```

```
## [1] "Third quartile (Q3): 31.25"
```




**Event Analysis Visualization, The Impact of The Implementation of Work Requirements for Medicaid in Arkansas, 2018**

- describe here what happened in Arkansas in 2018 and why the wanted to implement the work requirements and what these requirements were. and that Arkansas is the treatment group and the other 43 states are the control group and the ware analysing if the implementation had significant impact on the uninsured rates compared to the change in the control group which is the weighted average of the uninsured rates.




## 2.2 3.2 Identify Trends and Patterns

**Spatial Variation Visualization, U.S. Share of The Uninsured Population in 2023**

The spatial distribution of uninsured rates across the U.S. in 2023 reveals a stark regional divide. States in the South, especially Texas and Florida, report the highest uninsured shares. In contrast, Northeastern and Upper Midwestern states show much lower rates, likely due to more expansive Medicaid programs, higher employer-based coverage, and more generous state-level health initiatives (Bailey et al., 2017).

More nuanced is the case of Western states like Nevada and Arizona, which also exhibit elevated uninsured rates despite having relatively progressive policy environments. This may reflect labor market characteristics—such as a higher prevalence of gig work, part-time jobs, and self-employment—which are often associated with lower access to employer-sponsored insurance (Collins et al., 2020). Furthermore, undocumented immigrant populations, more common in some Western and Southern states, are often excluded from public coverage (KFF, 2023), further contributing to uninsured rates.

The findings support existing literature showing that health coverage in the U.S. is not solely driven by state policy, but is deeply intertwined with employment structures, income levels, and demographic profiles (Davis, 2007; Sommers et al., 2012). Thus, even among states with similar political leanings, uninsured rates can diverge significantly based on labor and population dynamics.

**Temporal Variation Visualization, Texas's Share of Uninsured Population and Texas's GDP growth rate over time**

The line graph illustrates the relationship between GDP growth rate and the uninsured share in Texas from 2010 to 2023 (excluding 2020).

We observe a clear downward trend in the uninsured share, falling from about 23% to 17% over this period. However, despite economic fluctuations—particularly a dip in GDP growth around 2016 and a spike in 2023—the uninsured rate remained relatively high and stable, especially after 2016.

This pattern suggests that economic growth alone doesn't guarantee increased health insurance coverage. Even in years with strong GDP growth, Texas continued to have one of the highest uninsured rates in the country. A likely explanation is Texas's decision not to expand Medicaid under the ACA, which left many low-income adults without affordable coverage options (KFF, 2023; Davis, 2007). In other words, policy choices, not just economic performance, shape access to insurance.

**Sub-Group Variation Visualization, The Uninsured Rates of the Middle-Income Group in 2017 in the U.S.**

The boxplot shows the total uninsured share per U.S. state in 2023, grouped by quartiles of the proportion of middle-income earners (those earning $25,000–$49,999). Importantly, the y-axis reflects the overall uninsured rate, not just for middle-income individuals.

We observe that the second and third quartiles have nearly the same median uninsured rate, suggesting that having more middle-income residents doesn't clearly correlate with a higher or lower uninsured share. This supports the idea that income alone doesn't determine insurance coverage—other factors such as cost of living, Medicaid eligibility rules, and state-level policy differences play major roles.

For example, two states may have similar income distributions, but very different uninsured rates due to differences in insurance affordability, healthcare access, or Medicaid expansion status (Davis, 2007; KFF, 2023). This makes it clear that middle-income presence is not a consistent predictor of how many people remain uninsured at the state level.

**Event Analysis Visualization, The Impact of The Implementation of Work Requirements for Medicaid in Arkansas, 2018**

The graph shows the share of uninsured people in Arkansas compared to the national weighted average from 2010 to 2023, excluding Arkansas. Arkansas saw a sharp decline in its uninsured rate after expanding Medicaid under the Affordable Care Act, reaching a low around 2016–2017. However, after implementing work requirements for Medicaid in 2018, the trend reversed: the uninsured rate in Arkansas increased slightly, while the national average stayed low and stable.

This suggests the policy had a negative impact on coverage. Although the goal was to encourage employment, research shows many people lost coverage not because they were unwilling to work, but because of administrative hurdles and confusion about reporting (Sommers et al., 2019). As a result, thousands of eligible people were dropped from Medicaid, increasing the uninsured share.

The work requirements likely influenced the y-axis variable, which is the percentage uninsured, by creating new barriers to maintaining insurance, especially for low-income adults.

# 3 Part 4 – Communicate Findings

## 3.1 4.1 Summarize Key Insights

To summarize our key insights, the spatial variation analysis showed us that regional policy choices and labour market structures significantly influence uninsured rates and not just political ideology that influences health care policies. Besides that, we can conclude based on the temporal analysis that economic growth alone does not automatically translate into improved health coverage, especially in states that did not expand Medicaid. Also, our subgroup analysis gave us the insight that income alone does not fully explain the variation in uninsured rates. Factors like the overall cost of living in a state, state policies and insurance access also play major roles. Finally, the event analysis showed us that the implementation of work requirements for Medicaid may reverse coverage gains and disproportionately impact low-income adults who face employment instability.

#### 3.1.1

## 3.2 4.2 Propose Solutions or Policy Recommendations

## 3.3 Key Policy Solutions

Based on the analysis findings, four targeted policy interventions are recommended:

#### 3.3.1 1. Medicaid Expansion Incentives

Provide enhanced federal funding to encourage remaining non-expansion states like Texas and Florida to adopt Medicaid expansion. The temporal analysis shows economic growth alone cannot close coverage gaps without policy action.

#### 3.3.2 2. Gig Economy Coverage Framework

Develop portable benefits systems for independent contractors and part-time workers. Western states' elevated uninsured rates reflect changing labor markets that traditional employer-based coverage cannot address.

#### 3.3.3 3. Administrative Simplification

Eliminate Medicaid work requirements and streamline enrollment processes. The Arkansas case study demonstrates that administrative barriers reverse coverage gains and disproportionately harm vulnerable populations.

#### 3.3.4 4. Targeted Affordability Support

Expand premium subsidies beyond current income thresholds, as the middle-income analysis reveals that affordability challenges persist across income levels due to varying state costs and policies.

# 4 Appendix

## 4.1 A.1 References


- Davis, K. (2007). *Uninsured in America: Problems and possible solutions. BMJ*, 334(7589), 346–348. https://doi.org/10.1136/bmj.39091.493588.be
- KFF (2023). *Key Facts About the Uninsured Population.* https://www.kff.org/uninsured/issue-brief/key-facts-about-the-uninsured-population/
- Sommers, B. D., et al. (2019). *Medicaid Work Requirements—Results from the First Year in Arkansas. New England Journal of Medicine*, 381(11), 1073–1082. https://doi.org/10.1056/NEJMsr1901772
- Bailey, M. J., et al. (2017). *State Medicaid expansions and mortality, revisited: A cost-benefit analysis. American Journal of Health Economics*, 3(4), 392–421. https://doi.org/10.1162/AJHE_a_00080
- Collins, S. R., Gunja, M. Z., & Aboulafia, G. N. (2020). *U.S. health insurance coverage in 2020: A looming crisis in affordability. The Commonwealth Fund.*
- Sommers, B. D., Baicker, K., & Epstein, A. M. (2012). *Mortality and access to care among adults after state Medicaid expansions. New England Journal of Medicine*, 367(11), 1025–1034. https://doi.org/10.1056/NEJMsa1202099

## 4.2 A.2 Session Info

https://github.com/catherinamikhail/Programming-for-Economists-uninsured-US-population.git