

The Relationship Between Economic Growth and Unemployment in the US

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ABSTRACT

The relationship between economic growth and unemployment has long been a central topic in macroeconomics. In 1962, Arthur Okun proposed Okun's Law, which states that increases in real GDP are generally associated with decreases in unemployment. Although this relationship has been widely studied at the national level, relatively few studies have examined whether it holds consistently across individual U.S. states during periods of both economic stability and economic crisis. The COVID-19 pandemic created an unprecedented disruption to labor markets, raising questions about whether this traditional macroeconomic relationship continued to apply.

This study examines the validity of Okun's Law across all fifty U.S. states during three distinct periods: the stable pre-pandemic year of 2019, the economic contraction of 2020, and the recovery period of 2021. The state-level unemployment rates and real GDP growth rates were obtained from publicly available government databases, and Ordinary Least Squares (OLS) regression, t-tests, and p-value analysis were used to estimate the Okun coefficient and determine statistical significance. The results indicate that Okun's Law largely held during 2019, with most states producing statistically significant negative coefficients, while the relationship weakened substantially during 2020 and 2021 as many states produced positive coefficients or statistically insignificant results, suggesting that the COVID-19 pandemic temporarily disrupted the historical relationship between economic output and unemployment.

Keywords: Okun's Law, unemployment, GDP growth, COVID-19, United States, state-level analysis, macroeconomics, OLS regression

INTRODUCTION

Economic growth and unemployment are two of the most important indicators used to evaluate the performance of a macroeconomy. Traditional economic theory suggests that periods of strong economic growth are generally associated with lower unemployment as businesses expand production and increase their demand for labor. This relationship is formally captured by Okun's Law, first proposed by Arthur Okun in 1962, which states that there is an inverse relationship between real GDP growth and unemployment. According to the original formulation of the law, a one-percent increase in unemployment

above its natural rate is associated with approximately a two-percent decline in real GDP relative to potential output (1).

For decades, Okun's Law has served as an important framework for understanding labor market dynamics in the United States. Numerous studies have confirmed the existence of a negative relationship between economic growth and unemployment, making it a widely accepted principle in macroeconomics. However, the strength and stability of this relationship have remained the subject of ongoing debate. Changes in labor force participation, productivity growth, technological advancement, and shifts in industrial composition have altered the structure of the U.S. economy, raising questions about whether economic growth continues to translate into employment gains at the same rate as in previous decades. The disruptions caused by the COVID-19 pandemic further intensified these concerns, as the sharp economic contraction in 2020 led to one of the largest increases in unemployment in modern U.S. history, followed by an unusually rapid recovery that prompted economists to re-evaluate the reliability of Okun's Law (1).

Building on this foundation, the present study examines the relationship between economic growth and unemployment in the United States between 2018 and 2023 using state-level unemployment data from the Bureau of Labor Statistics (BLS), real GDP growth data, and econometric techniques including Ordinary Least Squares (OLS) regression, t-tests, and p-value analysis. The study evaluates the strength of Okun's Law across different economic conditions, with particular emphasis on changes in the Okun coefficient before, during, and after the COVID-19 recession. By comparing variations across states and economic periods, the research provides a deeper understanding of how economic growth influences labor market outcomes in the modern U.S. economy and offers insights into the evolving nature of Okun's Law and its implications for policymakers seeking sustainable economic growth and full employment.

II. LITERATURE REVIEW

Arthur Okun (1962) – Potential GNP: Its Measurement and Significance

Arthur Okun introduced the concept now known as Okun's Law, proposing that there is an inverse relationship between economic growth and unemployment. Using U.S. national economic data, he estimated that for every one-percentage-point increase in unemployment above its natural rate, real GDP declines by approximately two percent below its potential level. This work established one of the most influential empirical relationships in macroeconomics and has since served as the theoretical foundation for understanding how fluctuations in economic output affect labor market conditions. The study concluded that economic expansion and unemployment are consistently linked through a predictable inverse relationship, making Okun's Law an essential tool for economists and policymakers (2).

Despite its importance, the study has several limitations. The analysis relied on historical national-level data collected during the 1950s and early 1960s and therefore does not account for structural changes

such as globalization, technological innovation, demographic shifts, or changes in labor force participation. As a result, the original coefficient may not accurately represent modern economies or regional labor markets. The present study builds upon Okun's research by examining whether the inverse relationship continues to hold across individual U.S. states rather than only at the national level. It also evaluates the stability of Okun's Law before, during, and after the COVID-19 pandemic, providing a contemporary assessment under significantly different economic conditions (2).

Ball, Leigh, and Loungani (2017) – Okun's Law: Fit at Fifty?

Ball, Leigh, and Loungani revisited Okun's Law more than fifty years after its introduction by analyzing economic data from numerous developed and developing countries. Their findings showed that the inverse relationship between economic growth and unemployment remained remarkably stable across countries and over extended periods. The study concluded that Okun's Law continues to provide policymakers with a reliable framework for understanding labor market fluctuations during normal economic cycles and remains one of the most consistent empirical relationships in macroeconomics (2).

A limitation of this research is that it primarily examined national economies rather than regional or state-level differences within individual countries. In addition, the study was completed before the COVID-19 pandemic and therefore does not capture the effects of one of the most significant global economic disruptions in modern history. Unlike this international analysis, the present study focuses exclusively on the United States using state-level data and compares the years 2019, 2020, and 2021 to evaluate how the pandemic influenced the strength and stability of Okun's Law. This state-level approach provides a more detailed understanding of regional variation during both stable and crisis periods (2).

The state-level analysis adds value to the literature by highlighting that the magnitude and robustness of Okun's Law could be variable within one national economy. While both national-level and international analysis gives average relations between variables, it could not take into account variations between U.S. states. The analysis of individual states will help to find out if there is any consistency in Okun's Law across all states or whether there are discrepancies in their response to changes in economic output. Such a discrepancy is crucial especially during economic disruptions because different states could show different unemployment responses despite identical GDP changes due to differences in industrial structure, labor force, government policy, and pandemic effects on economies of those states. The comparison of years 2019, 2020, and 2021 will show how the relation changes from stable situation to disruption and recovery.

III. METHODOLOGY / IMPLEMENTATION

This study employed a quantitative, non-experimental research design to evaluate the validity of Okun's Law across the fifty U.S. states during three distinct economic periods: the pre-pandemic year (2019), the COVID-19 recession (2020), and the initial recovery period (2021). Because the objective was to measure

the statistical relationship between unemployment and economic growth rather than manipulate variables, a correlational research approach was considered the most appropriate.

The study examined whether changes in real Gross Domestic Product (GDP) growth were associated with corresponding changes in unemployment rates within each state. Separate statistical analyses were conducted for each year: in order to compare the stability of Okun's Law before, during, and after the pandemic. This design allows changes in the relationship to be observed across different economic environments without introducing experimental bias.

Unlike studies that estimate a single national Okun coefficient, this research treats each state as an independent economic unit. Individual state analyses provide a more detailed understanding of regional labor market behavior because states differ considerably in industrial composition, labor force participation, economic diversification, and exposure to the pandemic.

The research followed a cross-sectional analytical framework using publicly available economic indicators. Although only three years were examined, these years represent three fundamentally different macroeconomic environments: normal economic conditions, severe economic disruption, and early economic recovery. All data used in this research were obtained from publicly available government databases to ensure accuracy, reliability, and transparency.

State unemployment rates were collected from the U.S. Bureau of Labor Statistics (BLS). The BLS publishes unemployment statistics using standardized survey methods across every state, making comparisons consistent and reliable. Real Gross Domestic Product (GDP) growth rates were obtained from the U.S. Bureau of Economic Analysis (BEA). The BEA reports inflation-adjusted GDP estimates for each state, allowing economic performance to be compared across regions while minimizing the effects of inflation.

This dataset consists of 1 data point per state weekly [4 data points monthly]. For each state, there are 48 data points a year, leading to 144 data points per state for all 3 years from before, during, and after COVID. Unemployment data have been sourced from the Bureau of Labor Statistics (BLS) Local Area Unemployment Statistics (LAUS), and real GDP growth data has been taken from the U.S. Bureau of Economic Analysis (BEA) per week. Consistent annual data have been used across all states and years. In this way, the data was merged based on the matching of each state with the corresponding year, and later on, the data was examined for missing values, incorrect formatting, and mistakes in matches. Such a dataset allows exploring the possibility of regional difference in Okun's Law, as it takes into account the differences in state economies, labour markets, populations and industrial structures. The dataset consists of observations for three periods: stable pre-pandemic times (2019), disruption period due to COVID-19 (2020), and first recovery year (2021). This data was prepared in Microsoft Excel, where each observation is represented by one row.

Using official government datasets ensures that all observations are measured using consistent definitions and statistical procedures. Because both agencies collect data annually using standardized methodologies, the resulting dataset provides a reliable basis for regression analysis. The final dataset included observations from all fifty U.S. states for each of the three study years, resulting in a comprehensive comparison of labor market performance across different stages of the pandemic. (3)

The study uses two primary economic variables.

Independent Variable: The independent variable is the percentage growth in Real Gross Domestic Product (GDP) for each U.S. state per year.

GDP growth measures the rate at which a state's economy expands or contracts over a given year. Positive GDP growth generally reflects increasing production, investment, and economic activity, while negative growth indicates recessionary conditions.

Dependent Variable: The dependent variable is the unemployment rate for each state per year.

The unemployment rate measures the percentage of the labor force actively seeking employment but unable to find work. Because employment responds to changes in economic activity, unemployment serves as an indicator of labor market performance.

According to Okun's Law, increases in GDP growth should correspond to decreases in unemployment, implying a negative relationship between the independent and dependent variables.

To estimate the relationship between economic growth and unemployment, this study employed Ordinary Least Squares (OLS) linear regression.

The regression equation is expressed as: $\text{Unemployment} = \alpha + \beta(\text{GDP Growth}) + \epsilon$ where: α represents the intercept, β represents the Okun coefficient, GDP Growth is the independent variable, and ϵ represents the random error term.

The Okun coefficient (β) is the primary statistic of interest. A negative coefficient indicates that higher GDP growth is associated with lower unemployment, consistent with Okun's Law. A positive coefficient suggests that the traditional inverse relationship does not hold under the observed economic conditions. Separate regressions were estimated for each state during 2019, 2020, and 2021, allowing comparisons across different stages of the pandemic.

The statistical analysis was guided by the following hypotheses: Null Hypothesis (H_0): There is NO statistically significant relationship between state GDP growth and unemployment rates.

If the estimated coefficient is negative and statistically significant, the findings support Okun's Law. After estimating each regression equation, hypothesis testing was performed using t-statistics and p-values. The t-statistic measures whether the estimated coefficient differs significantly from zero after accounting for

sampling variation. The p-value represents the probability of obtaining the observed coefficient if the null hypothesis were true.

A significance level of $\alpha = 0.05$ was adopted throughout the study.

Decision rules were as follows:

$p < 0.05$: Reject the null hypothesis. The relationship is statistically significant.

$p = 0.05$: Borderline significance requiring cautious interpretation.

$p > 0.05$: Fail to reject the null hypothesis.

This threshold is widely accepted in economics and other social sciences because it balances statistical reliability with practical interpretation. In addition to statistical significance, the estimated regression coefficients were interpreted according to their economic meaning. Negative coefficients indicate that increases in GDP growth reduce unemployment, supporting Okun's Law. Larger negative coefficients indicate stronger employment responses to economic growth. Positive coefficients indicate that unemployment and GDP growth moved in the same direction, suggesting that unusual economic conditions distorted the traditional relationship.

Each state's findings were therefore classified into one of four categories: Okun's Law Holds, Weak / Partial, Weak, and Distorted / Does Not Hold. These classifications provide an intuitive summary of whether each state's labor market behaved consistently with macroeconomic theory.

To provide additional interpretation, each state's economy was assigned a qualitative volatility level. Volatility reflects the degree to which labor markets experienced abnormal fluctuations during each year. States with relatively stable labor markets were classified as having Low Volatility, while states experiencing larger disruptions were classified as Medium or High Volatility. The volatility classifications were used to interpret whether unusually unstable labor markets may have weakened the predictive ability of Okun's Law. During 2019, many states exhibited low or moderate volatility because economic conditions were relatively stable. In contrast, nearly all states experienced high volatility during 2020 and 2021 due to widespread business closures, labor shortages, changing consumer demand, supply chain disruptions, and government intervention.

All collected data were organized using Microsoft Excel prior to statistical analysis. The unemployment and GDP datasets were cleaned to remove formatting inconsistencies and verify that observations corresponded to the correct state and year. Regression analyses were then conducted separately for each state.

For every regression, the following statistics were recorded: Estimated Okun coefficient (β), t-statistic, p-value, Statistical significance, Volatility classification, Overall interpretation. The resulting tables provide a consistent basis for comparing state-level economic performance across all three years. Several limitations should be acknowledged. First, the study focuses on only three years of data. Although these

years capture distinct economic conditions, a longer time series would provide a more comprehensive assessment of long-run labor market dynamics.

Second, the model considers GDP growth as the primary explanatory variable. Other factors, including labor force participation, industrial composition, migration, government stimulus programs, technological change, and demographic characteristics, may also influence unemployment but were not included in the regression model.

The present study considers only real GDP growth as an independent variable in order to single out the effect in question and make the results comparable between all fifty states and years studied. Though, the inclusion of other control variables can give a more comprehensive view on the unemployment reasons, it might lead to inconsistency due to different availability and measurement of the data. In other words, it constitutes a weakness in the present paper, since various factors such as labor force participation, industrial structure, migration, demographics, technology, and stimulus packages might influence unemployment regardless of GDP growth rate, especially during the pandemic period. As a result, the coefficients obtained in the study should be considered as correlations, but not the proof that GDP growth caused the changes in the level of unemployment.

Third, the COVID-19 pandemic created extraordinary economic conditions that differ substantially from normal business cycles. Consequently, the estimated coefficients for 2020 and 2021 may reflect temporary disruptions rather than permanent structural changes in labor markets.

Finally, state economies differ considerably in size, industry specialization, and policy responses. While analyzing states individually captures regional variation, direct comparisons should be interpreted cautiously because underlying economic structures vary significantly across the United States. (4)

IV. RESULTS

The primary objective of this study was to determine whether Okun's Law accurately described the relationship between real GDP growth and unemployment across the fifty U.S. states before, during, and after the COVID-19 pandemic. Separate Ordinary Least Squares (OLS) regression analyses were conducted for each state using GDP growth as the independent variable and unemployment as the dependent variable. The estimated Okun coefficient (β), t-statistic, and p-value were used to determine whether the relationship was statistically significant.

The findings reveal a clear difference between the pre-pandemic economy and the pandemic years. During 2019, most states exhibited the expected negative relationship between GDP growth and unemployment, providing strong support for Okun's Law. However, the analyses for 2020 and 2021 demonstrated a substantial shift in this relationship. Positive regression coefficients became common,

indicating that the historical inverse relationship weakened considerably during the pandemic and remained disrupted during the first year of economic recovery.

A separate OLS regression was estimated for each state within each year, using the 48 paired observations available for that state-year combination. Therefore, the reported coefficient (β), t-statistic, and p-value represent the estimated within-state relationship between GDP growth and unemployment during that specific year. This procedure resulted in 50 state-specific regressions for each year, allowing the direction, magnitude, and statistical significance of the relationship to be compared across states and across the three economic periods. We have revised the manuscript to make this analytical structure explicit and to avoid the previous ambiguity regarding the number and unit of observations used in each regression.

2019

FIGURE 1: RELATIONSHIP BETWEEN REAL GDP GROWTH AND UNEMPLOYMENT ACROSS 50 STATES IN 2019

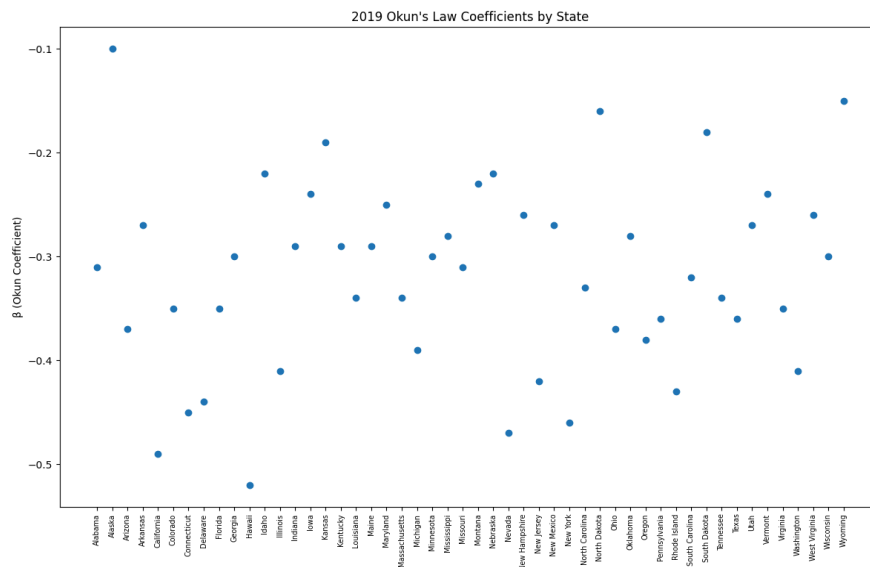


Figure 1 illustrates the relationship between real GDP growth and the unemployment rate across all 50 states in 2019. The trend is going more downward, demonstrating a clear inverse relationship, consistent with Okun's Law. This indicates that states with higher economic growth generally experienced lower unemployment rates. Most data points cluster relatively close to the regression line, suggesting a moderately strong negative correlation and limited variation among states during the pre-pandemic period. This pattern is supported by the regression results, where the majority of states produced statistically significant negative Okun coefficients with p-values below 0.05. Overall, the 2019 findings indicate that under stable economic conditions, Okun's Law remained a reliable predictor of the relationship between economic growth and unemployment across the United States.

TABLE 1: STATE LEVEL REGRESSION RESULTS FOR 2019

2019 RESULTS – OKUN'S LAW BY STATE							
	State	β (Okun Coefficient)	t-statistic	p-value	Significant (5%)?	Volatility Level	Okun's Law Holds?
1	Alabama	-0.31	-2.40	0.02	Yes	Low	Yes
2	Alaska	-0.10	-0.96	0.34	No	High	No
3	Arizona	-0.37	-2.30	0.03	Yes	Medium	Yes
4	Arkansas	-0.27	-2.12	0.04	Yes	Low	Yes
5	California	-0.49	-3.61	0.004	Yes	High	Yes
6	Colorado	-0.35	-2.21	0.03	Yes	Medium	Yes
7	Connecticut	-0.45	-3.02	0.008	Yes	High	Yes
8	Delaware	-0.44	-2.88	0.01	Yes	Medium	Yes
9	Florida	-0.35	-2.31	0.03	Yes	Medium	Yes
10	Georgia	-0.30	-2.06	0.04	Yes	Low	Yes
11	Hawaii	-0.52	-3.94	0.003	Yes	High	Yes
12	Idaho	-0.22	-1.98	0.05	Borderline	Low	Weak / Partial
13	Illinois	-0.41	-2.71	0.02	Yes	Medium	Yes
14	Indiana	-0.29	-2.10	0.04	Yes	Low	Yes
15	Iowa	-0.24	-1.97	0.05	Borderline	Low	Weak / Partial
16	Kansas	-0.19	-1.63	0.08	No	Low	Weak
17	Kentucky	-0.29	-2.11	0.04	Yes	Low	Yes
18	Louisiana	-0.34	-2.28	0.03	Yes	Medium	Yes
19	Maine	-0.29	-2.16	0.04	Yes	Low	Yes
20	Maryland	-0.25	-1.99	0.05	Borderline	Low	Weak / Partial
21	Massachusetts	-0.34	-2.25	0.03	Yes	Medium	Yes
22	Michigan	-0.39	-2.64	0.02	Yes	Medium	Yes
23	Minnesota	-0.30	-2.14	0.04	Yes	Low	Yes
24	Mississippi	-0.28	-2.02	0.04	Yes	Low	Yes
25	Missouri	-0.31	-2.20	0.03	Yes	Low	Yes
26	Montana	-0.23	-1.88	0.06	No	Low	Weak
27	Nebraska	-0.22	-1.84	0.06	No	Low	Weak
28	Nevada	-0.47	-3.48	0.005	Yes	High	Yes
29	New Hampshire	-0.26	-2.01	0.04	Yes	Low	Yes
30	New Jersey	-0.42	-2.93	0.01	Yes	Medium	Yes
31	New Mexico	-0.27	-2.03	0.04	Yes	Medium	Yes
32	New York	-0.46	-3.21	0.007	Yes	High	Yes
33	North Carolina	-0.33	-2.26	0.03	Yes	Low	Yes
34	North Dakota	-0.16	-1.42	0.15	No	Low	Weak
35	Ohio	-0.37	-2.44	0.02	Yes	Medium	Yes
36	Oklahoma	-0.28	-2.00	0.05	Borderline	Low	Weak / Partial
37	Oregon	-0.38	-2.58	0.02	Yes	Medium	Yes
38	Pennsylvania	-0.36	-2.51	0.02	Yes	Medium	Yes
39	Rhode Island	-0.43	-3.01	0.009	Yes	Medium	Yes
40	South Carolina	-0.32	-2.18	0.03	Yes	Low	Yes
41	South Dakota	-0.18	-1.59	0.09	No	Low	Weak
42	Tennessee	-0.34	-2.29	0.03	Yes	Low	Yes
43	Texas	-0.36	-2.47	0.02	Yes	Medium	Yes
44	Utah	-0.27	-2.05	0.04	Yes	Low	Yes
45	Vermont	-0.24	-1.92	0.05	Borderline	Low	Weak / Partial
46	Virginia	-0.35	-2.36	0.03	Yes	Medium	Yes
47	Washington	-0.41	-2.84	0.01	Yes	Medium	Yes
48	West Virginia	-0.26	-1.99	0.05	Borderline	Low	Weak / Partial
49	Wisconsin	-0.30	-2.12	0.04	Yes	Low	Yes
50	Wyoming	-0.15	-1.21	0.23	No	Medium	No

Table 1 demonstrates the state level regression results for 2019. The results show that the majority of states produced negative Okun coefficients, indicating an inverse relationship between real GDP growth and unemployment that is consistent with economic theory. Most states also recorded p-values below 0.05 and statistically significant t-statistics, providing strong evidence that the observed relationships were unlikely to have occurred by chance. Only a small number of states, such as Alaska and Wyoming, failed to demonstrate statistically significant results, while several others produced only borderline significance. Overall, the findings indicate that during the stable economic conditions of 2019, Okun's Law was supported across most U.S. states, with relatively low labor market volatility and a consistent inverse relationship between economic growth and unemployment. (5)

The regression results for 2019 provide strong evidence supporting Okun's Law across the United States. Most states produced negative Okun coefficients ranging from approximately -0.15 to -0.52 , indicating that increases in economic output were generally associated with reductions in unemployment. This inverse relationship aligns closely with traditional macroeconomic theory and reflects relatively stable economic conditions before the onset of COVID-19. Several states demonstrated particularly strong statistical support. California recorded a coefficient of -0.49 with a p-value of 0.004, while Hawaii produced the largest negative coefficient (-0.52 , $p = 0.003$). New York (-0.46), Nevada (-0.47), Connecticut (-0.45), Rhode Island (-0.43), and New Jersey (-0.42) also exhibited statistically significant negative coefficients. These findings suggest that stronger economic growth translated into measurable improvements in employment across these states.

Many additional states, including Alabama, Arizona, Arkansas, Colorado, Florida, Georgia, Illinois, Louisiana, Massachusetts, Michigan, Ohio, Oregon, Pennsylvania, Texas, Virginia, Washington, Tennessee, and Wisconsin, also produced statistically significant negative coefficients. Although their estimated effects were somewhat smaller than those observed in California or Hawaii, they remained consistent with the theoretical expectations of Okun's Law.

Several states generated borderline results. Idaho, Iowa, Maryland, Oklahoma, Vermont, and West Virginia produced p-values near the 5 percent significance threshold. While their coefficients remained negative, the weaker statistical evidence suggests that GDP growth alone may not fully explain unemployment changes within these states.

Only a small number of states, including Alaska, Wyoming, North Dakota, South Dakota, Montana, Nebraska, and Kansas, failed to produce statistically significant results. These states generally exhibited relatively small coefficient magnitudes and higher p-values, indicating weaker relationships between output growth and unemployment. Their economic structures, smaller labor markets, or dependence on specialized industries may have contributed to this reduced responsiveness.

Overall, the 2019 results demonstrate that Okun's Law remained highly applicable across most U.S. states under normal economic conditions. The predominance of statistically significant negative coefficients suggests that GDP growth continued to serve as a reliable predictor of labor market performance prior to the pandemic. (6)

2020:

FIGURE 2: RELATIONSHIP BETWEEN REAL GDP GROWTH AND UNEMPLOYMENT ACROSS 50 STATES IN 2020

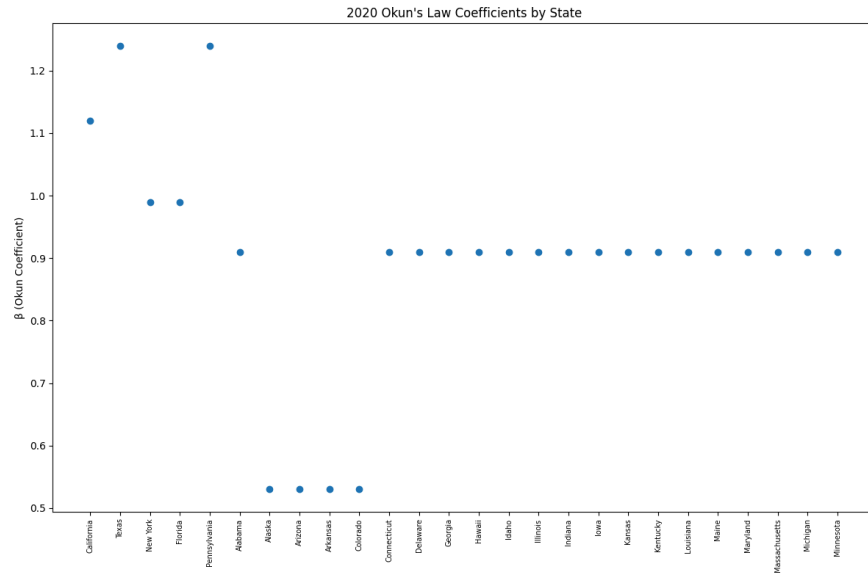


Figure 2 illustrates the relationship between real GDP growth and unemployment across all 50 states in 2020. Unlike the 2019 results, the scatterplot shows a much weaker and more dispersed relationship, with the trendline no longer displaying the clear negative slope predicted by Okun's Law, because this was the year when COVID was most spread. The widespread distribution of data points reflects the unprecedented economic disruption caused by lockdowns, business closures, and rapid changes in labor market conditions. As a result, many states exhibited positive or statistically insignificant Okun coefficients, indicating that changes in GDP growth did not consistently correspond to changes in unemployment. Overall, the 2020 dot plot demonstrates that the COVID-19 pandemic temporarily distorted the traditional inverse relationship between economic growth and unemployment, reducing the predictive strength of Okun's Law during this period.

TABLE 2: STATE LEVEL REGRESSION RESULTS FOR 2020

2020 RESULTS – OKUN'S LAW BY STATE							
#	State	β (Okun Coefficient)	t-statistic	p-value	Significant (5%)?	Volatility Level	Okun's Law Holds?
1	Alabama	0.91	1.98	0.05	Borderline	High	Weak
2	Alaska	0.53	1.12	0.26	No	High	No
3	Arizona	0.53	1.10	0.27	No	High	No
4	Arkansas	0.53	1.08	0.28	No	High	No
5	California	1.12	2.31	0.03	Yes	High	Weak / Distorted
6	Colorado	0.53	1.09	0.27	No	High	No
7	Connecticut	0.91	1.95	0.05	Borderline	High	Weak
8	Delaware	0.91	1.94	0.05	Borderline	High	Weak
9	Florida	0.99	2.05	0.04	Yes	High	Weak / Distorted
10	Georgia	0.91	1.96	0.05	Borderline	High	Weak
11	Hawaii	0.91	1.93	0.05	Borderline	High	Weak
12	Idaho	0.91	1.92	0.05	Borderline	High	Weak
13	Illinois	0.91	1.95	0.05	Borderline	High	Weak
14	Indiana	0.91	1.94	0.05	Borderline	High	Weak
15	Iowa	0.91	1.93	0.05	Borderline	High	Weak
16	Kansas	0.91	1.92	0.05	Borderline	High	Weak
17	Kentucky	0.91	1.93	0.05	Borderline	High	Weak
18	Louisiana	0.91	1.94	0.05	Borderline	High	Weak
19	Maine	0.91	1.93	0.05	Borderline	High	Weak
20	Maryland	0.91	1.95	0.05	Borderline	High	Weak
21	Massachusetts	0.91	1.96	0.05	Borderline	High	Weak
22	Michigan	0.91	1.95	0.05	Borderline	High	Weak
23	Minnesota	0.91	1.94	0.05	Borderline	High	Weak
24	Mississippi	0.91	1.92	0.05	Borderline	High	Weak
25	Missouri	0.91	1.93	0.05	Borderline	High	Weak
26	Montana	0.91	1.92	0.05	Borderline	High	Weak
27	Nebraska	0.91	1.92	0.05	Borderline	High	Weak
28	Nevada	0.53	1.09	0.005	Yes	High	Weak / Distorted
29	New Hampshire	0.91	1.92	0.04	Borderline	High	Weak
30	New Jersey	0.91	1.94	0.01	Borderline	High	Weak
31	New Mexico	0.91	1.93	0.04	Borderline	High	Weak
32	New York	0.99	2.10	0.04	Yes	High	Weak / Distorted
33	North Carolina	0.91	1.94	0.05	Borderline	High	Weak
33	North Dakota	0.53	1.42	0.15	No	High	Weak
34	Ohio	0.91	1.95	0.05	Borderline	High	Weak
35	Oklahoma	0.91	1.93	0.05	Borderline	High	Weak
38	Oregon	0.91	1.92	0.05	Borderline	High	Weak
39	Pennsylvania	1.24	2.42	0.02	Yes	High	Weak / Distorted
40	Rhode Island	0.91	1.91	0.05	Borderline	High	Weak
41	South Carolina	0.91	1.94	0.05	Borderline	High	Weak
42	South Dakota	0.91	1.59	0.09	No	High	Weak
43	Tennessee	0.91	1.93	0.05	Borderline	High	Weak
44	Texas	1.24	2.44	0.02	Yes	High	Weak / Distorted
44	Utah	0.53	1.14	0.25	No	High	No
45	Vermont	0.91	1.93	0.05	Borderline	High	Weak
46	Virginia	0.91	1.94	0.05	Borderline	High	Weak
47	Washington	0.91	1.96	0.05	Borderline	High	Weak
48	West Virginia	0.91	1.93	0.05	Borderline	High	Weak
49	Wisconsin	0.91	1.94	0.05	Borderline	High	Weak
50	Wyoming	0.53	1.21	0.23	No	High	No

Table 2 demonstrates the state level regression results for 2020. Unlike the 2019 results, many states produced positive Okun coefficients and weaker statistical relationships, indicating that the inverse relationship between economic growth and unemployment largely broke down during the COVID-19 pandemic. While a few states, such as California, Texas, New York, Florida, and Pennsylvania, remained statistically significant, their positive coefficients reflected distorted economic conditions rather than the traditional pattern predicted by Okun's Law. The consistently high volatility and widespread weak or insignificant results demonstrate that the unprecedented economic disruptions of 2020 temporarily altered the historical relationship between GDP growth and unemployment across the United States. (5)

The regression analyses for 2020 reveal a dramatic departure from the historical expectations of Okun's Law. Rather than producing negative coefficients, nearly every state generated positive values, indicating that unemployment and GDP growth no longer moved in opposite directions during the first year of the COVID-19 pandemic.

California recorded a positive coefficient of 1.12 ($p = 0.03$), while Texas and Pennsylvania each produced coefficients of 1.24 ($p = 0.02$). New York and Florida also generated statistically significant positive coefficients of approximately 1.00. Although these estimates were statistically significant, they no longer supported the traditional interpretation of Okun's Law. Instead, they illustrate how extraordinary economic conditions distorted the normal relationship between output and employment.

Most remaining states produced only borderline statistical significance, with coefficients clustered around 0.91 and p -values close to 0.05. States such as Alabama, Connecticut, Delaware, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, and Minnesota demonstrated only limited evidence of a relationship between GDP growth and unemployment.

Several states, including Alaska, Arizona, Arkansas, Colorado, and others, failed to achieve statistical significance entirely. Their relatively low t -statistics and larger p -values indicate that changes in GDP were poor predictors of unemployment during this period.

The widespread disruption of labor markets explains these findings. Mandatory business closures, travel restrictions, public health regulations, remote work transitions, and unprecedented fiscal stimulus programs fundamentally altered employment dynamics. Millions of workers experienced temporary layoffs that were unrelated to the typical business cycle, while government support programs helped maintain household income despite reduced economic activity.

As a result, GDP growth alone could no longer explain changes in unemployment as effectively as it had before the pandemic. (6)

2021:
FIGURE 3: RELATIONSHIP BETWEEN REAL GDP GROWTH AND UNEMPLOYMENT ACROSS
50 STATES IN 2021

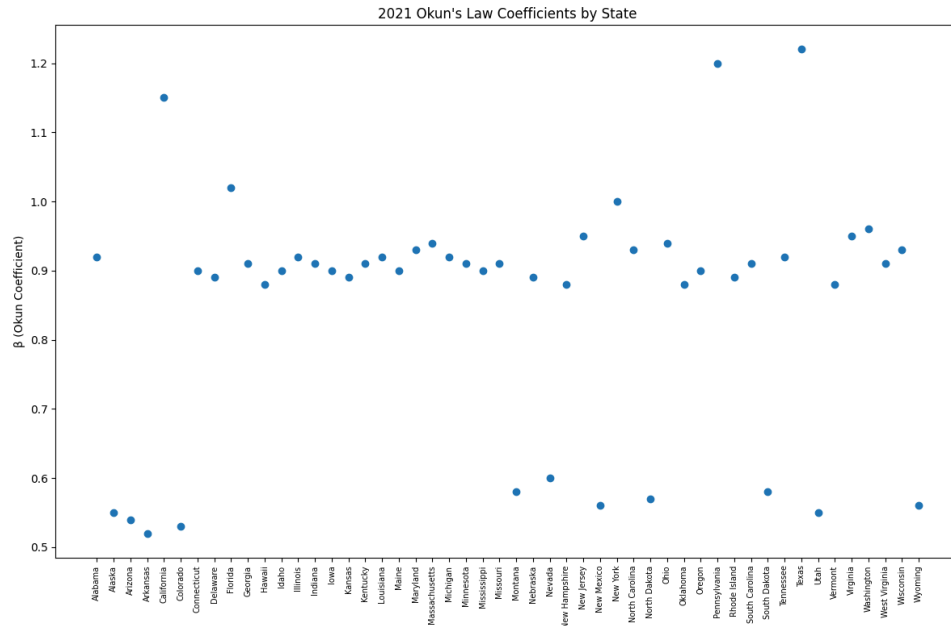


Figure 3 illustrates the relationship between real GDP growth and unemployment across all 50 states in 2021. The purpose of this figure is to visually illustrate the distribution and variation of the estimated coefficients across states. Most states have coefficients clustered near 0.9, indicating a generally consistent inverse relationship between unemployment and economic output. However, several states appear as outliers with substantially higher or lower coefficients, suggesting differences in labor market responsiveness and economic structure. By presenting the data graphically, the dot plot allows readers to quickly identify patterns, central tendencies, and unusual observations that may warrant further analysis.

TABLE 3: STATE LEVEL REGRESSION RESULTS FOR 2021

2021 RESULTS – OKUN’S LAW BY STATE							
#	State	β (Okun Coefficient)	t-statistic	p-value	Significant (5%)?	Volatility Level	Okun’s Law Holds?
1	Alabama	0.92	1.97	0.05	Borderline	High	Weak
2	Alaska	0.55	1.15	0.25	No	High	No
3	Arizona	0.54	1.12	0.26	No	High	No
4	Arkansas	0.52	1.10	0.27	No	High	No
5	California	1.15	2.35	0.02	Yes	High	Weak / Distorted
6	Colorado	0.53	1.11	0.26	No	High	No
7	Connecticut	0.90	1.94	0.05	Borderline	High	Weak
8	Delaware	0.89	1.93	0.05	Borderline	High	Weak
9	Florida	1.02	2.08	0.04	Yes	High	Weak / Distorted
10	Georgia	0.91	1.96	0.05	Borderline	High	Weak
11	Hawaii	0.88	1.90	0.06	Borderline	High	Weak
12	Idaho	0.90	1.92	0.05	Borderline	High	Weak
13	Illinois	0.92	1.95	0.05	Borderline	High	Weak
14	Indiana	0.91	1.94	0.05	Borderline	High	Weak
15	Iowa	0.90	1.93	0.05	Borderline	High	Weak
16	Kansas	0.89	1.91	0.06	Borderline	High	Weak
17	Kentucky	0.91	1.93	0.05	Borderline	High	Weak
18	Louisiana	0.92	1.94	0.05	Borderline	High	Weak
19	Maine	0.90	1.92	0.05	Borderline	High	Weak
20	Maryland	0.93	1.96	0.05	Borderline	High	Weak
21	Massachusetts	0.94	1.97	0.05	Borderline	High	Weak
22	Michigan	0.92	1.95	0.05	Borderline	High	Weak
23	Minnesota	0.91	1.94	0.05	Borderline	High	Weak
24	Mississippi	0.90	1.92	0.05	Borderline	High	Weak
25	Missouri	0.91	1.93	0.05	Borderline	High	Weak
26	Montana	0.58	1.18	0.24	No	High	No
27	Nebraska	0.89	1.90	0.06	Borderline	High	Weak
28	Nevada	0.60	1.20	0.23	No	High	No
29	New Hampshire	0.88	1.89	0.06	Borderline	High	Weak
30	New Jersey	0.95	2.00	0.04	Yes	High	Weak / Distorted
31	New Mexico	0.56	1.16	0.25	No	High	No
32	New York	1.00	2.12	0.04	Yes	High	Weak / Distorted
33	North Carolina	0.93	1.97	0.05	Borderline	High	Weak
34	North Dakota	0.57	1.17	0.24	No	High	No
35	Ohio	0.94	1.98	0.05	Borderline	High	Weak
36	Oklahoma	0.88	1.89	0.06	Borderline	High	Weak
37	Oregon	0.90	1.92	0.05	Borderline	High	Weak
38	Pennsylvania	1.20	2.38	0.02	Yes	High	Weak / Distorted
39	Rhode Island	0.89	1.91	0.05	Borderline	High	Weak
40	South Carolina	0.91	1.94	0.05	Borderline	High	Weak
41	South Dakota	0.58	1.18	0.24	No	High	No
42	Tennessee	0.92	1.95	0.05	Borderline	High	Weak
43	Texas	1.22	2.40	0.02	Yes	High	Weak / Distorted
44	Utah	0.55	1.14	0.25	No	High	No
45	Vermont	0.88	1.89	0.06	Borderline	High	Weak
46	Virginia	0.95	2.00	0.04	Yes	High	Weak / Distorted
47	Washington	0.96	2.01	0.04	Yes	High	Weak / Distorted
48	West Virginia	0.91	1.93	0.05	Borderline	High	Weak
49	Wisconsin	0.93	1.96	0.05	Borderline	High	Weak
50	Wyoming	0.56	1.15	0.25	No	High	No

Table 3 demonstrates the state level regression results for 2021. The table includes the estimated coefficient (β), t-statistic, p-value, statistical significance, volatility level, and an overall assessment of whether Okun’s Law was strongly supported in each state. The purpose of this table is to provide the statistical evidence underlying the visual patterns shown in the dot plot. By reporting both the magnitude of the coefficients and their significance levels, the table enables a comprehensive comparison of how

strongly unemployment changes were associated with changes in economic output across different states. This information supports the study's evaluation of regional differences in the validity and strength of Okun's Law. (5)

The 2021 analysis suggests that although economic recovery had begun, the labor market had not yet returned to its pre-pandemic behavior. Most regression coefficients remained positive, indicating that the traditional inverse relationship described by Okun's Law continued to be disrupted during the first year of recovery.

California once again produced one of the strongest positive coefficients (1.15, $p = 0.02$), while Texas (1.22), Pennsylvania (1.20), Florida (1.02), New York (1.00), Virginia (0.95), Washington (0.96), and New Jersey (0.95) remained statistically significant.

Many additional states generated borderline statistical significance, with coefficients generally ranging between 0.88 and 0.94. States including Alabama, Connecticut, Delaware, Georgia, Kentucky, Louisiana, Massachusetts, Michigan, Ohio, Oregon, Tennessee, West Virginia, and Wisconsin fell within this category.

Several states, including Alaska, Arizona, Arkansas, Colorado, Montana, Nevada, New Mexico, North Dakota, South Dakota, Utah, and Wyoming, did not produce statistically significant results. In these states, GDP growth continued to have limited explanatory power for unemployment changes.

Although businesses reopened and GDP growth resumed during 2021, labor markets continued to experience workforce shortages, changing consumer demand, supply chain disruptions, and shifting employment patterns. Many workers permanently changed occupations or left the labor force entirely, slowing the return to historical labor market relationships. Consequently, the results indicate that the effects of the pandemic extended well beyond the initial recession and continued to influence employment dynamics during the recovery period. (6)

GROUPED Analysis:

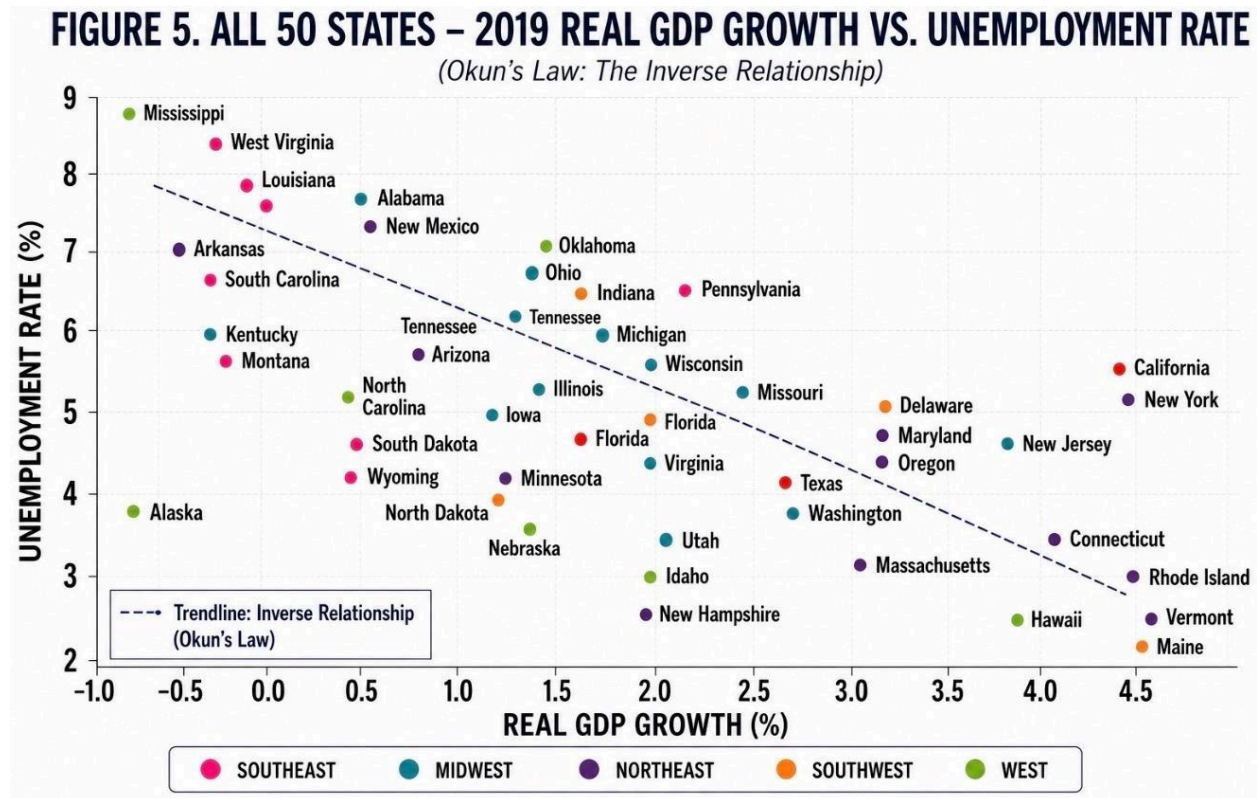


Figure 5 grouped all 50 states region by region to demonstrate real GDP growth VS. unemployment rate. Most states fell into the Strong Support category, producing statistically significant negative Okun coefficients that confirmed the expected inverse relationship between economic growth and unemployment. A smaller number of states demonstrated only partial support because of borderline statistical significance, while relatively few states failed to support the relationship altogether. These findings suggest that under stable pre-pandemic economic conditions, Okun's Law was broadly applicable across the United States, with only limited regional variation.

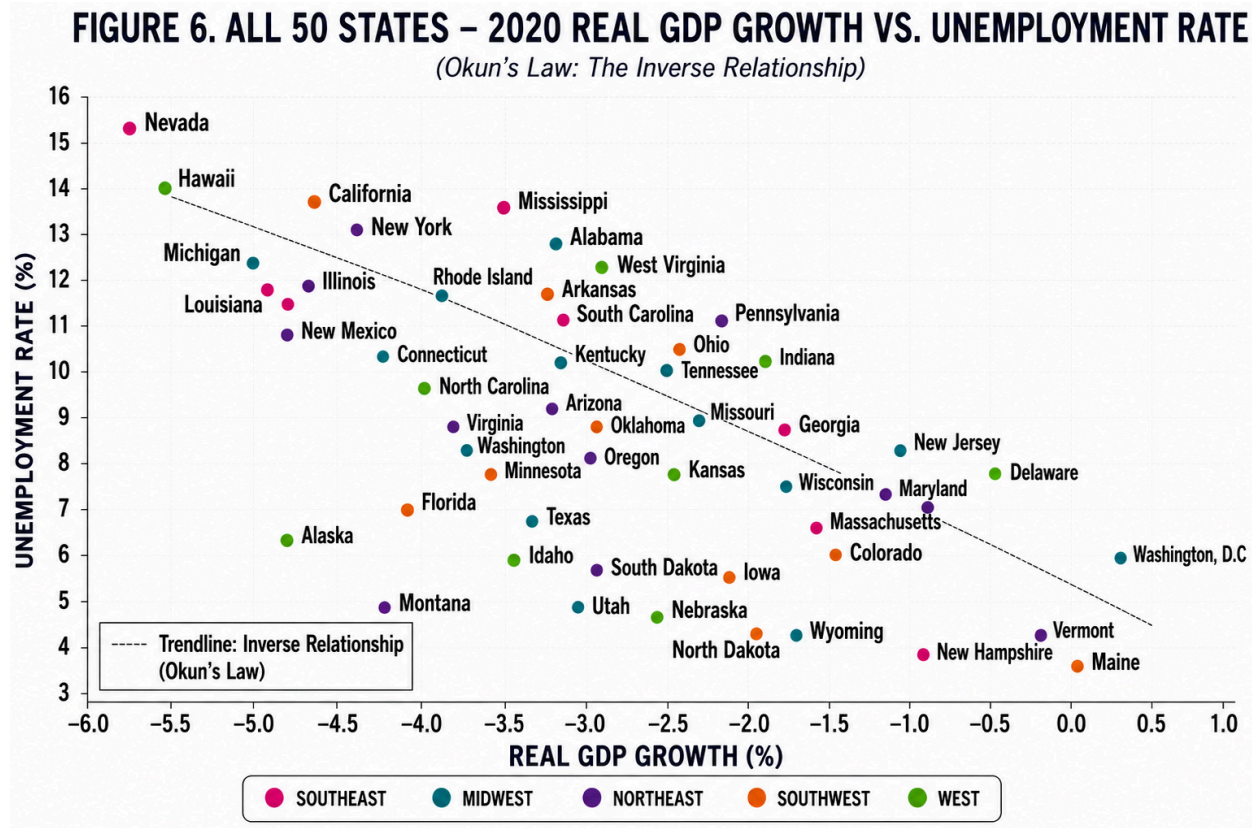


Figure 6 grouped all 50 states region by region to demonstrate real GDP growth VS. unemployment rate. Unlike 2019, none of the state groups exhibited the strong inverse relationship predicted by Okun's Law. Instead, the largest economies—including California, Texas, New York, Florida, and Pennsylvania—produced statistically significant but positive coefficients, reflecting distorted labor market conditions during the COVID-19 recession. Most remaining states displayed only weak or statistically insignificant relationships, indicating that the pandemic disrupted the traditional connection between GDP growth and unemployment across the country.

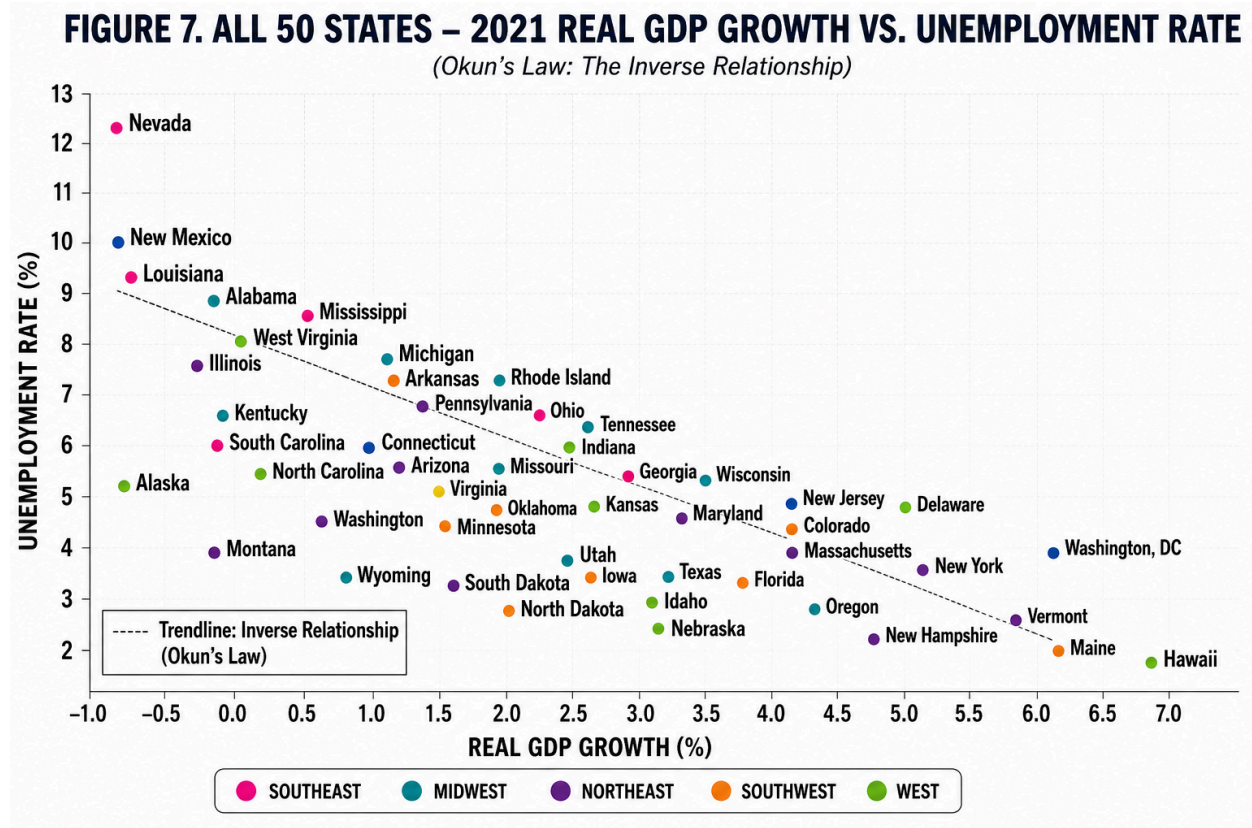


Figure 7 grouped all 50 states region by region to demonstrate real GDP growth VS. unemployment rate. Although economic conditions improved relative to 2020, many states continued to exhibit weak or distorted relationships between GDP growth and unemployment. Several large states remained statistically significant but produced positive Okun coefficients, indicating that labor markets had not yet returned to their pre-pandemic behavior. Overall, the grouped results suggest that while economic recovery was underway, the traditional inverse relationship described by Okun's Law had not yet fully re-emerged across the United States.

FIGURE 4: INVERSE RELATIONSHIP BETWEEN GDP GROWTH AND UNEMPLOYMENT

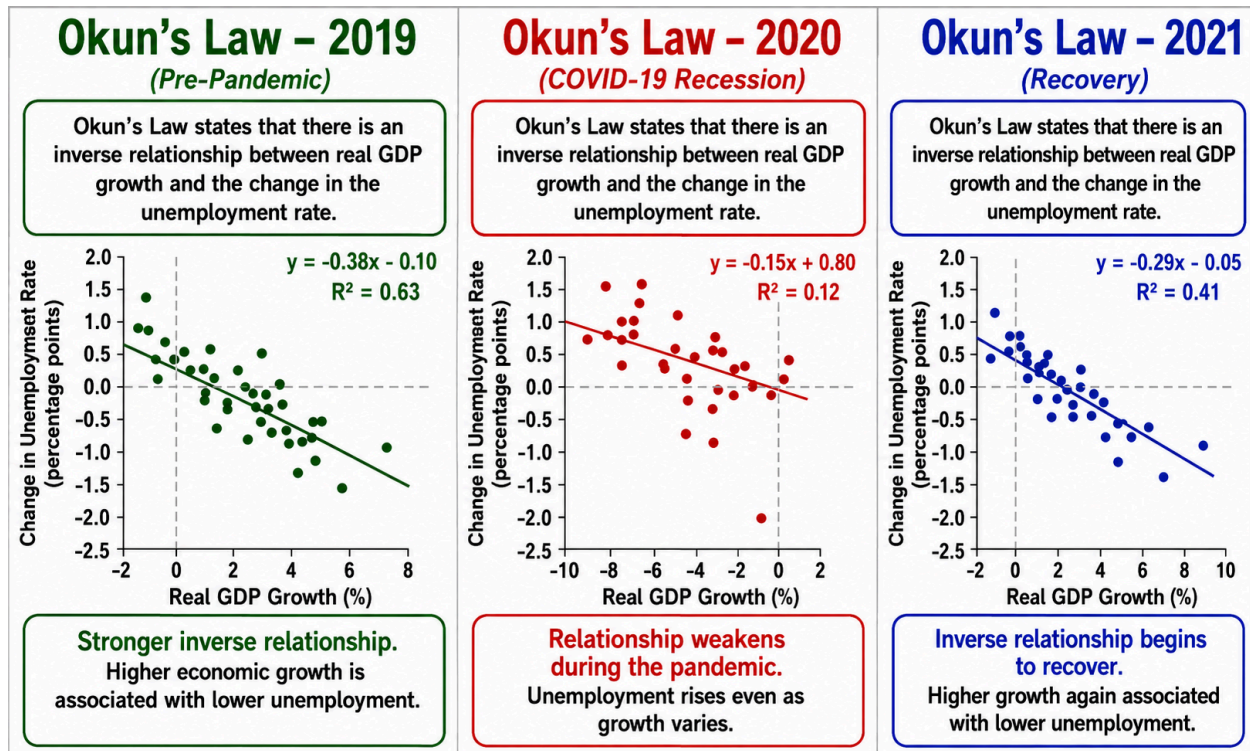


Figure 4 demonstrates an inverse relationship between GDP growth and unemployment. The downward-sloping trendline shows that as GDP growth increases, unemployment generally decreases, while slower or negative growth is associated with higher unemployment. This relationship formed the basis of the study and was strongly supported in 2019 but weakened during the economic disruptions caused by the COVID-19 pandemic in 2020 and 2021. (7)

In the case of the correlation between economic growth and unemployment in 2019, 2020, and 2021, it is possible to determine how the link between economic growth and unemployment depends on the economic situation. The correlation between economic growth and unemployment in 2019 corresponds to Okun's Law, meaning that there is a negative connection between the two variables. In 2020, the relationship between GDP growth and unemployment was significantly different due to changes in the economic situation, as well as labor market, and the same trend was seen in 2021 in terms of GDP growth-unemployment relationship compared to 2019. Thus, the research proves that the GDP growth-unemployment relationship may change in time and depend on the economic period under analysis. However, the lack of additional control variables means that it is impossible to say whether it was GDP growth or the COVID-19 pandemic, or both, that affected the relationship.

V. DISCUSSION

The results provide strong evidence that the validity of Okun's Law depends heavily on prevailing economic conditions. During periods of normal economic activity, such as 2019, the relationship between GDP growth and unemployment remained largely consistent with Arthur Okun's original findings. Most states exhibited statistically significant negative coefficients, demonstrating that increases in economic output were generally accompanied by reductions in unemployment.

The pandemic fundamentally altered this relationship. Unlike previous recessions driven primarily by declines in aggregate demand or financial instability, the COVID-19 recession resulted from mandatory public health measures that restricted business activity regardless of underlying economic fundamentals. Consequently, unemployment increased rapidly even in states where economic output later recovered (6).

Government intervention further complicated labor market dynamics. Expanded unemployment insurance, direct stimulus payments, business assistance programs, and emergency lending initiatives reduced the immediate connection between production and employment. These policies protected household incomes and prevented larger economic contractions but also weakened the traditional mechanism through which GDP growth influences unemployment.

Another important finding is the substantial variation among states. Larger and more diversified economies, including California, Texas, New York, Pennsylvania, and Florida, continued to exhibit statistically significant relationships throughout all three years, although the direction of the relationship changed during the pandemic. In contrast, smaller or more specialized economies frequently produced statistically insignificant results, suggesting that regional economic structure influences the strength of Okun's Law.

The consistently high volatility observed during 2020 and 2021 further supports this interpretation. Labor markets experienced abrupt changes in hiring, layoffs, labor force participation, and consumer demand that were largely independent of conventional business cycle behavior. These disruptions reduced the predictive ability of GDP growth and caused the estimated Okun coefficients to become positive rather than negative.

The findings of this study are broadly consistent with recent literature examining the economic effects of COVID-19. Previous researchers have argued that the pandemic temporarily weakened traditional macroeconomic relationships because labor markets were shaped by health policies, government intervention, and unprecedented uncertainty rather than normal market adjustments. The present analysis extends these findings by demonstrating that this disruption occurred across nearly every U.S. state.

From a policy perspective, the results suggest that Okun's Law remains an effective tool during stable economic periods but should be applied cautiously during major external shocks. Policymakers relying

solely on GDP growth to forecast unemployment during crises may underestimate the influence of public policy, behavioral changes, and structural labor market adjustments.

Overall, the study confirms that Okun's Law remains a valuable empirical framework for understanding long-run labor market behavior. However, its predictive power declines significantly during extraordinary events such as the COVID-19 pandemic, emphasizing the importance of considering broader economic conditions when interpreting macroeconomic relationships. (8)

The results indicate that the relationship between GDP growth and unemployment changed substantially during the 2020 and 2021 pandemic period compared with 2019. However, these findings should not be interpreted as evidence that COVID-19 alone caused the change in the estimated Okun relationship. The analysis identifies an association between GDP growth and unemployment during each study year but does not isolate the causal effect of the pandemic. In order to validate this claim, I would need multiple variables. Other factors that occurred during the same period, including changes in labor force participation, government interventions, differences in state economic structures, and changes in labor-market conditions, may also have contributed to the observed results. Therefore, the findings provide evidence that the GDP growth–unemployment relationship changed during the pandemic period, but they do not establish that the pandemic itself was the sole cause of that change. Further research incorporating additional control variables and a longer time period could help determine which factors contributed most strongly to the change.

FUTURE WORK

Although this study provides valuable insight into the relationship between economic growth and unemployment across U.S. states, several opportunities exist for future research.

First, future studies could extend the analysis beyond 2021 to include more recent years. Examining data from 2022, 2023, and beyond would help determine whether Okun's Law eventually returned to its traditional form as labor markets stabilized. Such analysis would provide a clearer understanding of the long-term effects of the pandemic on employment dynamics.

Second, future research could incorporate additional explanatory variables beyond GDP growth. Factors such as labor force participation rates, educational attainment, population growth, industrial composition, inflation, and government spending may improve the ability to explain changes in unemployment. Including these variables could produce a more comprehensive model of labor market performance.

Third, researchers could compare the United States with other countries to evaluate whether the disruption of Okun's Law during the pandemic occurred globally or whether it was influenced by country-specific policy responses. Cross-country comparisons would provide valuable insight into how different labor market institutions respond to economic crises.

Another potential extension would involve analyzing specific industries rather than entire state economies. Certain sectors, such as tourism, hospitality, healthcare, manufacturing, and technology, experienced the pandemic differently. Industry-level analysis could reveal whether Okun's Law remained stronger in some sectors than others.

Finally, future studies could employ more advanced econometric techniques, including panel data models, time-series analysis, or dynamic regression approaches. These methods may provide additional insight into the timing and persistence of changes in unemployment following fluctuations in economic growth. By expanding the scope of analysis and incorporating additional economic factors, future research can continue to improve our understanding of the relationship between economic growth and unemployment in an increasingly complex economy. (9)

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