

Supplementary Materials for “Judging How U.S. States Performed in the Pandemic Depends on the Metric”

Emma Castro

1. Introduction

The objective of this research was to examine the substantial variation across U.S. states during the COVID-19 pandemic in terms of health outcomes as well as states’ economic and educational performance. We sought to rank states against one another according to three separate criteria: (1) health, (2) economy and education, and (3) a composite “all-around” score that combined health, economy, and education measures. To do so, we constructed standardized measures of the state-level COVID-19 mortality rate, the SARS-CoV-2 infection rate, the observed gross domestic product (GDP) relative to expected, the observed employment rates relative to expected, and the changes in fourth grade math and reading scores between 2019 and 2022.

2. Data

2.1 COVID-19 Mortality Rates

State-level estimates of the cumulative COVID-19 mortality rate during the period from January 1, 2020, to July 31, 2022, originate from the Institute for Health Metrics and Evaluation’s (IHME) COVID-19 modeling database.¹ Mortality rates have been adjusted to account for underreporting by applying a scaling factor based on estimated all-cause excess mortality, reported COVID-19 deaths, and estimated COVID-19 mortality assuming the maximum observed infection-detection-ratio (IDR).² As such, these estimates represent total mortality from COVID-19 as opposed to the reported death count.

Mortality rates were standardized for age and the prevalence of major risk factors, recognizing that older age and certain health conditions and behaviors increase risk of dying from COVID-19. Specifically, we accounted for the age-standardized prevalence of asthma, cancer, chronic obstructive pulmonary disease, cardiovascular disease, and diabetes, as well as body-mass index (BMI) and smoking prevalence in each state. To account for differences in age patterns across states, we used indirect age standardization to ensure each state’s cumulative death rate reflected the national age structure. Modeled location and age-group-specific death proportions were based on data from the National Center for Health Statistics (NCHS).³

2.2 SARS-CoV-2 Infection Rates

State-level estimates of the cumulative SARS-CoV-2 infection rate during the period from January 1, 2020, through December 15, 2021, come from IHME’s COVID-19 modeling database. This date range deliberately excludes the Omicron wave, since the variant’s immune escape and transmissibility produced an explosion of infections nationally and muffled the variation across states. Estimated infection rates represent all infections, including asymptomatic infections and

those not confirmed by a test. To facilitate comparison across states, infection rates were standardized for population density.⁴

2.3 Gross Domestic Product

Quarterly real GDP data by state and industry were downloaded from the U.S. Bureau of Economic Analysis, expressed in millions of chained 2012 dollars.⁵ To facilitate comparison across states, we industry-standardized state GDP, generating industry weights from the Q4 2019 national values. The measure we used to rank each state's economic performance was the ratio of observed GDP per capita to the expected non-pandemic GDP per capita. In order to generate a counterfactual estimate of GDP in the absence of a global pandemic, we used the average slope between 2018 to 2019 to forecast GDP through 2022. To interpret the final measure, a value less than 1 indicates that a state did not meet their expected GDP while a value greater than 1 indicates that a state's GDP surpassed expected GDP.

2.4 Employment

Monthly, seasonally adjusted employment rates were extracted by state and sector from the Federal Reserve Economic Data site.⁶ Because the pandemic had differential effects on various sectors of the economy, we sector-standardized state-level employment rates. The sectors used in our analysis were:

- Construction, Mining, and Logging
- Education and Health Services
- Financial Activities
- Government
- Information
- Leisure and Hospitality
- Manufacturing
- Professional and Business Services
- Trade, Transportation, and Utilities
- Other Services

Sector weights were created using the Q4 2019 national values. The employment measure used to rank states was calculated as follows. First, we constructed the ratio of sector-standardized employment per capita to a counterfactual in which per-capita employment remained constant at the average Q4 2019 level. This ratio was summed across the time period and then normalized so that a value of 1 indicates full employment (matching the counterfactual) across the entire time period.

2.5 Student Test Scores

Fourth grade math and reading standardized test scores from the National Assessment of Educational Progress (NAEP) were downloaded from the National Center for Education Statistics.⁷ The NAEP sampling process is designed to be representative of the entire student population in the United States, so we did not make additional adjustments to the reported results.

State-level scores were downloaded for both 2019 and 2022, and states' educational performance was expressed by subject as the change in score from 2019 to 2022.

3. Methods

3.1 Health Ranking

To rank states according to their performance on COVID-19 health outcomes, we first assigned each state a death rank and an infection rank according to their standardized mortality rate and infection rate, calculated as described above in Sections 2.1 and 2.2, respectively. The state with the lowest rate was assigned a rank of 1 and the state with the highest rate was assigned a rank of 51 (analysis included 50 states plus Washington, DC). We then took a weighted average of the death rank and infection rate, assigning 75 percent of the weight to deaths and 25 percent of the weight to infections. Health ranks were assigned according to that composite score. In the event of a tie, where two states exhibited the same score, the state with the lower death rank was assigned the lower health rank.

3.2 Economy and Education Ranking

To rank states according to their economic and educational performance during the COVID-19 pandemic, we combined information across four outcome measures: GDP, employment, and fourth grade standardized testing scores for both math and reading level. Details on those measures are provided above in Sections 2.3 through 2.5. To create the composite score, we first calculated state rankings separately for each outcome. An economy score was calculated as the mean of the GDP rank and the employment rank and an intermediate economy rank was assigned based on that score. In the event of a tie, the state with the lower GDP rank was assigned the lower economy rank. Similarly, an education score was calculated as the mean of the math and reading rankings for each state and an education rank was constructed from that score. Math rank was the tie breaker. Finally, the economy rankings and education rankings were combined by taking a weighted average with two-thirds of the weight allocated to economy and one-third to education. The resulting score was used to assign the combined economy and education rank.

3.3 All-Around Ranking

The all-around ranking combined information across the methods described in 3.1 and 3.2. First, we took the weighted average of the health rank and the economy and education rank to produce an all-around score. Health received two-thirds of the weight and economy and education together received one-third. We then assigned an all-around rank based on the all-around score. In the event that two states exhibited the same score, the state with the lower health rank was assigned the lower all-around rank of the two states.

References

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