Opioid Policy Evaluation in the United States

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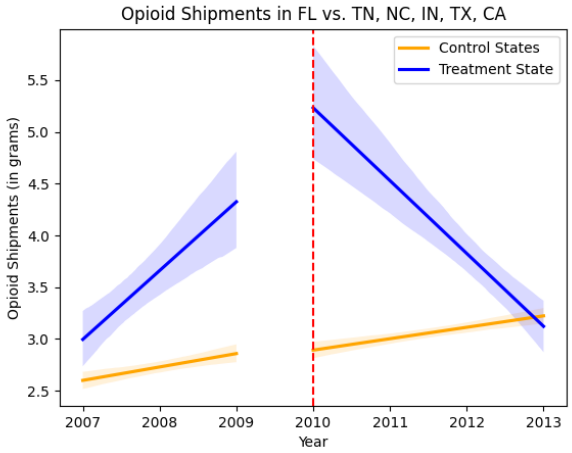
Executive Summary

The opioid epidemic is a public health crisis with a significant impact on society and which demands deliberate intervention at the State level to mitigate. The purpose of this report is to explore policies implemented at the state level to address the opioid epidemic and to determine which policies are most effective. To conduct this analysis we will look at two metrics: opioid overdose deaths per capita and gross opioid shipments as measured in grams via opioid conversions from the Drug Enforcement Agency (DEA). The specific policies we will investigate are from the states of Florida, Washington, and Texas where legislation was passed to enforce stronger due dilligence on the part of physicians and pharmacists when prescribing and dispensing opioids. The intuition behind these metrics are, principally, the direct evaluation of the policies which regulate the distribution of medical opioids. If physicians and pharmacists are dispensing lower quantities of opioids, the demand signal through the supply chain is assumed to decrease, and so the shipment rates should also decrease. Secondarily, we look at the opioid related deaths per capita as an assessment of critical secondary effects of the policies. More importantly, the secondary effect of opioid related deaths is what drove the policy changes in the first place and so the evaluation of this metric is crucial along with the intermediate assessment of supply chain trends.

In order to accurately investigate the impact of these policies, we have used a set of control states whose trends of opioid shipments and opioid related deaths remain relatively constant over the span of policy implementation. The states of interest, or treatment states, have policies that were implemented in 2007 (TX), 2010 (FL), and 2012 (WA). The control states were selected based on the similarity of their opioid shipment and opioid related death trends to the treatment states prior to the implementation of the policies. This allows us to conduct both a pre-post analysis of the treatment states in isolation as well as a difference-in-difference analysis of the treatment states relative to the control states which act as a proxy for the behavior of the treatment states in the absence of the policies.

We have taken data from US Vital Statistics and the DEA via the Washington Post to compile data for every county in the treatment and control states spanning three years prior and three years after the implementation of their respective policies. We then fit a linear regression or line of best fit through the county-year data before and after the policy implementation. The

slope of the line of best fit is used as a proxy for the trend of the data and the difference in slope between the pre and post policy implementation is used as a proxy for the impact of the policy.



An example difference-in-difference plot can be seen to the right and shows our results for Florida policy impact on opioid shipments. The blue line represents the trend of the treatment state (FL) and the red line represents the trend of the control states. The vertical line represents the year of policy implementation. We can see here that Florida had a positive trend in opioid shipments in excess of the control states (which were selected on their similarity to the treatment state prior to policy implementation). After the policy implementation, the trend of the treatment state decreased relative to the control states. This visually indicates the success of the policy in reducing opioid shipments.

A complete set of results is detailed further in the report but our assessment showed a similar decrease in opioid related deaths for Florida, indicating that the policy implemented in 2010 addressed both primary and secondary effects of the opioid epidemic. The results for Washington State indicated a policy implementation in 2012 which was both ineffective in reducing opioid shipments and which had negligible impact on opioid related deaths. Our data for Texas was prohibitive to an assessment for opioid shipments since the earliest data available was one year prior to the 2007 policy implementation. However, the data for opioid related deaths was less conclusive than for Florida but indicated that the policy had some positive impact. The policies implemented are largely similar in their approach of regulating the prescription of opioids with the key difference in Florida being the close cooperation with law enforcement to aggressively enforce the policy. This is illustrative of the importance of enforcement in the success of policy implementation.

The complete details of our analysis are included in the following report.

Methods

Initially, our analysis involved working with three distinct datasets. The first dataset, sourced from the Washington Post, encompasses comprehensive details about opioid shipments across various counties, states, and years in the United States. This dataset is notably extensive, with a file size of around 100 GB, presented in a large TSV (Tab-Separated Values) format. The second dataset, obtained from the US Vitality Statistics Dataset, consists of information

on diverse types of deaths occurring over multiple years and states in the US. This dataset is structured as 12 separate CSV files, each corresponding to a specific year. The third dataset, sourced from the US Census Bureau, provides insights into populations across different states and counties in the US.

Due to the substantial size of the opioid shipments dataset, a one-time parsing and cleaning process proved impractical. Consequently, we leveraged the Dask library to efficiently parse the data into 207 distinct Parquet files. Parquet was chosen as the storage format for its columnar structure, which enhances performance and storage efficiency. In the analysis, we opted not to normalize the opioid shipment data by population, as normalization yielded skewed results during pre-post and Difference-in-Differences (DiD) analyses. The selected variables for further analysis include county, state, year, and the total gross opioid shipments in grams for each county in each state across different years.

The "Underlying Cause of Death" datasets, spanning from 2003 to 2015, were structured as 12 separate files, each corresponding to a specific year. Our approach involved systematically iterating through these 12 datasets, extracting information related to drug overdose deaths and drug-related suicides. These subsets were consolidated into a comprehensive CSV file, encompassing overdose deaths for all counties from 2003 to 2015. Subsequently, this dataset underwent a merger with the population dataset, utilizing the unique combination of state and county (State-County). The choice of this unique combination is crucial, ensuring precision in the dataset linkage, especially considering the potential presence of certain counties in multiple states.

The combined dataset resulting from the merger of opioid-related deaths and population data exhibited notable gaps due to instances where certain counties reported zero opioid-related deaths in a given year. To address these missing values judiciously, a death rate was computed for each county, calculated as the total number of deaths divided by the total population. Subsequently, for counties with zero reported deaths, the missing values were imputed by multiplying the total population by the corresponding death rate. This approach ensured a nuanced estimation of opioid-related deaths in counties with sparse or no recorded incidents. Additionally, a threshold of 10 was enforced to cap the estimated number of deaths, maintaining a realistic range for the imputed values.

In the pursuit of discerning the impact of policy implementation on opioid shipments and overdose deaths in Texas, Florida, and Washington, our analysis designated these states as treatment groups. The crucial task of identifying suitable reference states, pivotal for conducting a robust Difference-in-Differences (DiD) analysis, involved an in-depth exploration of the trends exhibited by each treatment state before and after policy implementation. This exploration extended to studying the geographical and historical context of these states, including their association with opioids. By meticulously comparing the trends of potential reference states with the treatment states, we sought states that mirrored the pre-policy trends and represented a counterfactual scenario for the treatment states. This strategic approach facilitated the construction of reliable counterfactuals, crucial for causal inference in the DiD analysis, enhancing the accuracy of our findings.

To ensure consistency and precision in our analyses, we maintained the unit of observation at the county level for both opioid shipment and overdose death analyses. Although we aggregated data to the state level for certain aspects, our primary focus remained at the county level, ensuring a more detailed and nuanced examination of the impact of policy changes on specific communities.

Results

Conclusion

In our comprehensive assessment utilizing pre-post and difference-in-difference analyses, the evaluation of Texas's 2007 drug policy reveals a nuanced picture. Although the overall trend of the average mortality rate did not exhibit a decline following the policy implementation, there was a notable moderation in the steepness of the increasing slope. It is crucial to note, however, that despite this reduction in slope, the mortality rate continued to rise. In sharp contrast, the drug policy enacted in Florida in 2010 emerges as a clear success, demonstrating its efficacy through a substantial reduction in opioid shipments and a discernible impact on the overall ascending trajectory of mortality rates. Conversely, Washington's drug policy in 2012 appears less effective, evidenced by the absence of declines in both opioid shipments and the average mortality rate post-implementation. In summary, our analysis underscores the dynamic and state-specific nature of drug policy outcomes. Florida's success in 2010 serves as a notable exemplar, while the impact of Washington's 2012 policy appears less pronounced. The Texas case in 2007 introduces complexity, with a moderated increasing trend but lacking a definitive reduction in mortality rates. This nuanced evaluation emphasizes the importance of context in shaping the effectiveness of drug policies. It is imperative for policymakers to consider the multifaceted nature of these interventions, recognizing the need for tailored approaches that align with the unique challenges and dynamics of each state and timeframe.

Reference:

'"How deeply did prescription opioid pills flood your county? See here." The Washington Post. (https://www.washingtonpost.com/investigations/interactive/2023/opioid-epidemic-pain-p ills-sold-oxycodone-hydrocodone/)'

'County Population Totals 2000 - 2009, US Census Bureau (https://www2.census.gov/programs-surveys/popest/datasets/2000-2009/counties/totals/co-est2 009-alldata.csv)'

'County Population Totals 2010 - 2019, US Census Bureau (https://www2.census.gov/programs-surveys/popest/datasets/2010-2019/counties/totals/co-est2 019-alldata.csv)'