

Changes in Gun Laws and Their Impact on Lethal Violence:

A Causal Inference Study using a Difference-in-Differences Design.



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Introduction

- Between 2000 and 2010, 21 states adopted 'Stand Your Ground' legislation.
- Stand Your Ground, Castle Doctrine, and Duty to Retreat.
- Currently, 25 states have Stand Your Ground, 8 states have Castle Doctrine, and 17 states have Duty to Retreat legislation.
- What is the impact on homicides?

Problem

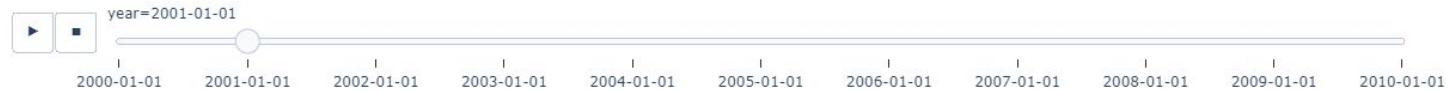
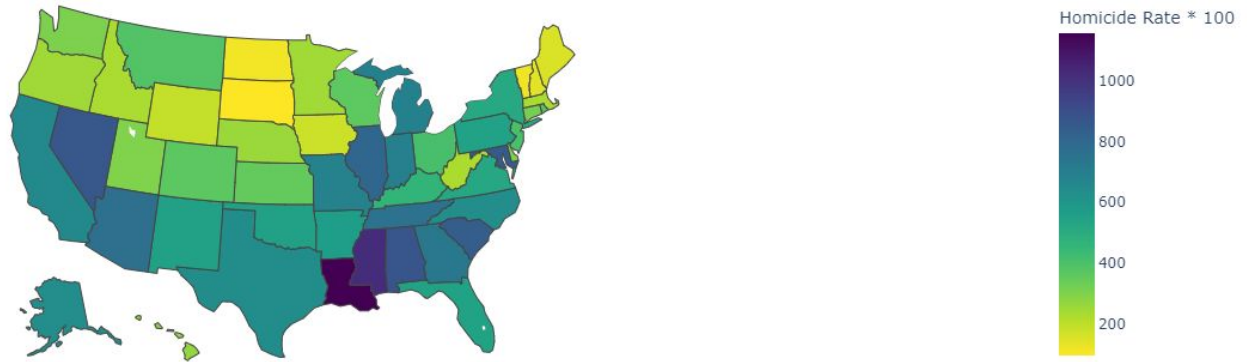
- How did changing state laws impact lethal violence? What causal inference can be drawn between changes in state law and homicide rates?
- True Positive: homicide rates remain constant
False Positive: homicide rates increase
Deterrent Effect: homicide rates decrease
- A causal inference study will determine causation and control for all confounding factors.

Data Wrangling

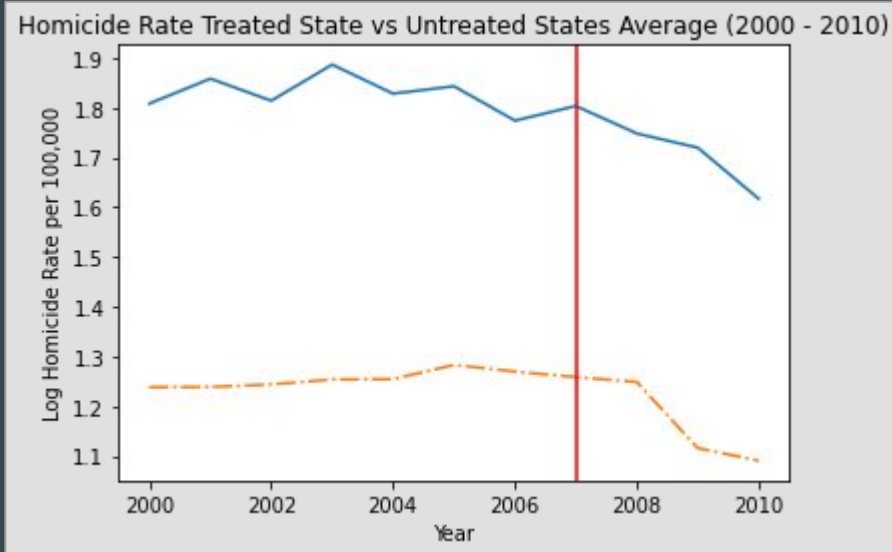
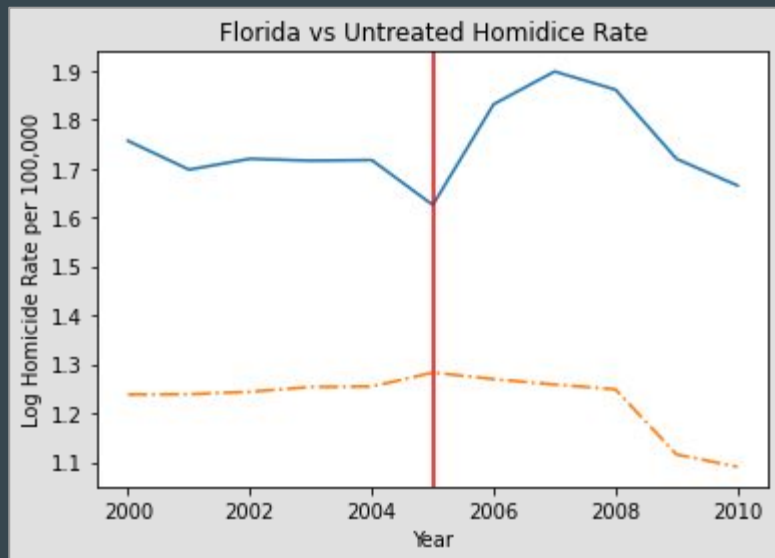
- Dataset derived from the Uniform Crime Reporting Program: homicides, rape, burglary, aggravated assault, larceny, motor vehicle theft, arson.
- Volunteering reporting by local police agencies with high response rate.
- Maintained by the FBI. Statistics converted into rate - incidents per 100,000 population.
- Natural experiment - 50 states but maintained statistics maintained by a central government.

Exploratory Data Analysis

(Homicide Incidents * 100) per 100,000 by State, years 2000 - 2010



Exploratory Data Analysis



Analysis

Difference-in-Differences - John Snow & Cholera Hypothesis

Company name	1849	1854
Southwark and Vauxhall	135	147
Lambeth	85	19

Companies	Time	Outcome	D_1	D_2
Lambeth	Before	$Y = L$		
	After	$Y = L + T + D$	$T + D$	
			D	
Southwark and Vauxhall	Before	$Y = SV$		
	After	$Y = SV + T$	T	

$$\hat{\delta}_{kU}^{2 \times 2} = \underbrace{E[Y_k^1 | \text{Post}] - E[Y_k^0 | \text{Post}]}_{\text{ATT}} + \underbrace{\left[E[Y_k^0 | \text{Post}] - E[Y_k^0 | \text{Pre}] \right] - \left[E[Y_U^0 | \text{Post}] - E[Y_U^0 | \text{Pre}] \right]}_{\text{Non-parallel trends bias in } 2 \times 2 \text{ case}}$$

Analysis

Difference-in-Differences - Regression Models

$$Y_{its} = \alpha + \gamma NJ_s + \lambda D_t + \delta(NJ \times D)_{st} + \varepsilon_{its}$$

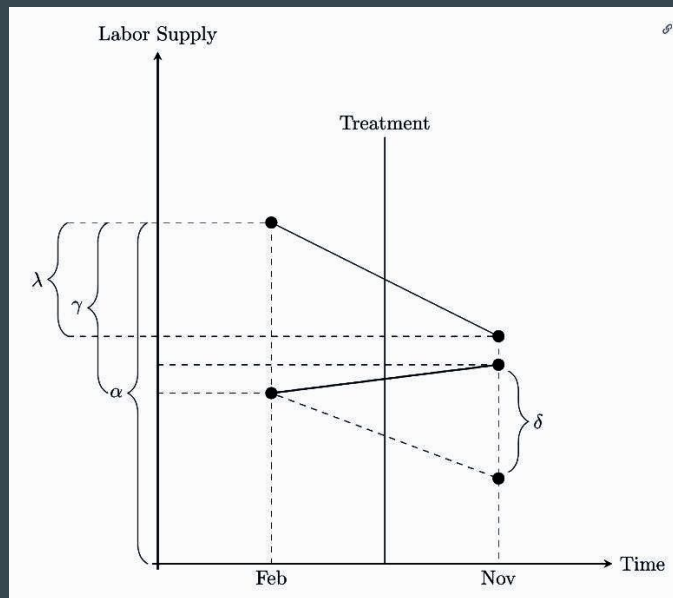
1. PA Pre: α

2. PA Post: $\alpha + \lambda$

3. NJ Pre: $\alpha + \gamma$

4. NJ Post: $\alpha + \gamma + \lambda + \delta$

- Assuming a constant state fixed effect and a time fixed effect, the brute force 2x2 diff-in-diff can be converted to a regression.
- This is only actually true when the unobservable counterfactual happens to align with the control group trend.
- The parallel trends assumption is just a restatement of the strict exogeneity assumption from the panels design.

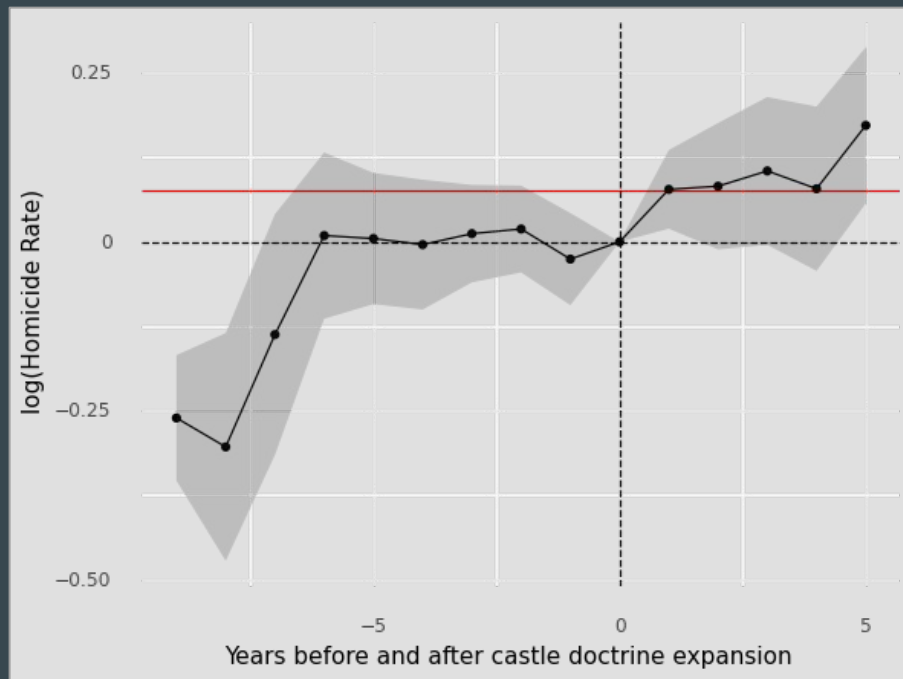


Analysis

Difference-in-Differences - Twoway Fixed Effects with Differential Timing

$$Y_{it} = \alpha + \delta D_{it} + \gamma X_{it} + \sigma_i + \tau_t + \varepsilon_{it}$$

Result: 8% Homicide Rate Increase
Causally linked to Stand Your Ground



Next Steps

- Bacon Decomposition
- Matrix Completion / Machine Learning
- Callaway & Sant'Anna, Sun & Abraham, and Athey models

Conclusion

- Stand Your Ground legislation *caused* an 8% increase in homicide rates.
- Stand Your Ground allows for situations to escalate to homicide.
- A factual characterization of the laws impact on this population.