

Waiting Periods and Firearm Suicides

The Effects of Waiting Periods on Firearm Suicides in the U.S.

Hussain Hadah

Murphy Inst. & Tulane U

01/30/2025

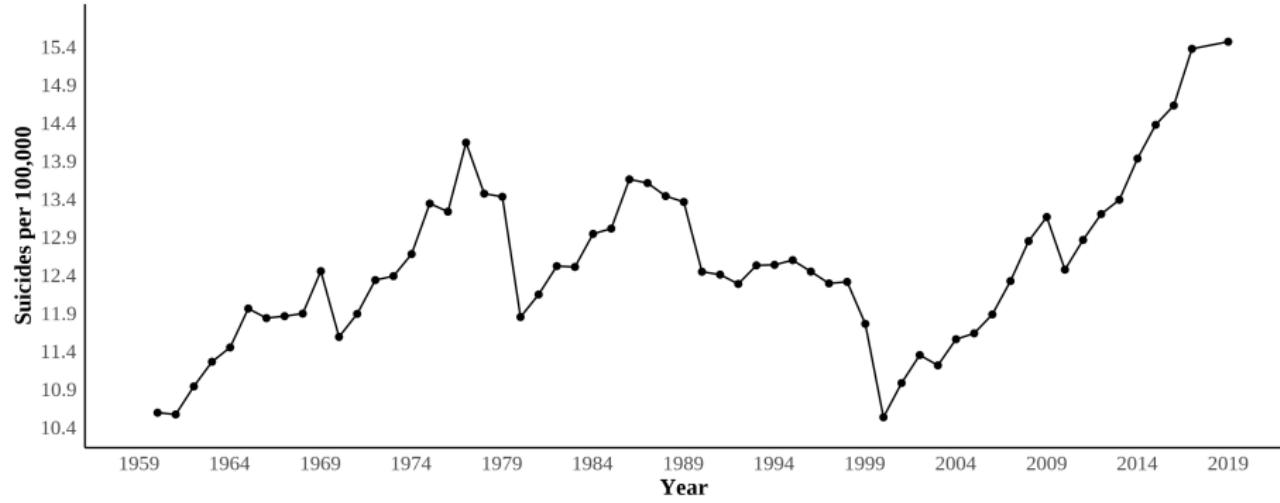
Section 1

Background

Stylized facts

- Suicides by firearms constitute the majority of gun deaths in the U.S. (approximately 60%)
- Suicides in the U.S. have been on the rise after a steady decline in the 1990s
- Men are more likely to use firearms to commit suicide (more on this in a few slides)

Suicides in the U.S have been on the rise



Suicides by firearms have also been on the rise



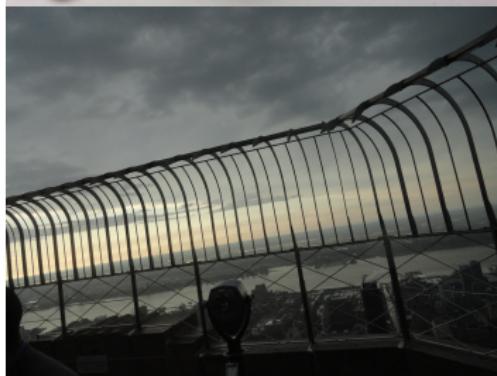
The medical and psychiatric literature

- Previous studies in medicine and psychiatry attempted to study the effect of waiting periods on suicides
- Most of the estimates are non-causal and use cross country analysis
 - e.g. comparing the U.S. to Australia and Europe

Most major medical and psychiatric organizations support waiting periods to reduce suicides

- The evidence are mixed, and most studies are non-causal
 - Waiting-period requirements were associated with reductions in firearm suicide rates (Edwards et al., 2018; Luca, Malhotra, and Poliquin, 2017)
 - States with Brady Act waiting periods saw firearm suicide declines (Ludwig and Cook, 2000)
 - Gun-related suicides correlated with gun ownership across 21 countries (Killias et al., 2001; Victimization Surveys, N=16–18)
 - Australian gun law reforms reduced firearm suicides but not overall suicides (Baker and McPhedran, 2007; Time-series: 1979–2004)
 - Waiting periods were advocated to mitigate gun-related suicides (Lewiecki and Miller, 2013)
 - Indiana's firearm seizure law was linked to a 7.5% drop in suicides (Kivisto and Phalen, 2018; State-level data: 1981–2015)
 - Gun ownership positively related to firearm suicides in 11 countries (Killias, 1993; Survey, N=28,000)

Suicide is often considered an impulsive decision that can be prevented by restricting access to means



Golden Gate Bridge's half-built suicide barrier already working



The Golden Gate Bridge suicide barrier's railing has been installed on the bridge's east tower and the approach between the two towers. | Courtesy Golden Gate Bridge, Highway and Transportation District

In an Op-Ed, Ronald Reagan supported the passage of the Brady Act and mentioned suicide as a reason

Why I'm for the Brady Bill

By Ronald Reagan

A“anniversary” is a word we usually associate with happy events that we like to remember: birthdays, weddings, the first job. March 30, however, marks an anniversary I would just as soon forget, but it is one that has been on my mind for many years.

It was on this day 10 years ago that a deranged young man standing among reporters and photographers shot a policeman, a Secret Service agent, my press secretary and me on a Washington street.

I have never forgotten the bullet that hit me bounced off a rib and lodged in my lung, an inch from my heart. It was a very close call. Twice they could not find my pulse. But the bullet's missing my heart, I still survived the shooting and surgery at George Washington University Hospital and the steadfast support of my wife, Nancy, saved my life.

Jim Brady, my press secretary, who was standing next to me, wasn't so lucky. A bullet entered the left side of his forehead and his brain had passed through the right side of his brain before it exited. The skills of the George Washington University medical team, plus his amazing determination and the grit and spirit of his wife, Sarah, helped him survive. His recovery has been remarkable, though he still lives with physical pain every day and must spend much of his time in a wheelchair.

Thomas Delahanty, a Washington police officer, also bulletined his neck. It ricocheted off his metal collar. Nerve damage to his left arm forced his retirement in November 1981.

Tim McCarthy, a Secret Service



ABC News

James A. Brady, wounded, on March 30, 1981.

agent, was shot in the chest and suffered a lacerated liver. He recovered and returned to duty.

Since four people were charged forever, and all by a Saturday-night special — a cheaply made .22 caliber pistol — purchased in a Dallas pawnshop by a young man with a history of mental disturbances.

The saddest part might never have happened if legislation that is before Congress now — the Brady bill — had been law back in 1981.

Named for Jim Brady, this legislation would establish a national seven-day waiting period before handgun purchases could take delivery. It would allow local law enforcement officials to do background checks for criminal records or known histories of mental disturbances. Those with such records would be prohibited from buying handguns.

While there has been a Federal law on the books for more than 20 years that prohibits the sale of firearms to felons, fugitives, drug addicts and the mentally ill, it has no enforcement mechanism. It really works on the honor system, with the purchaser filling out a statement that the gun

dealer sticks in a drawer.

The Brady bill would require the handgun dealer to provide a copy of the purchase receipt and a written statement to local law enforcement authorities so that background checks could be made. Based upon the evidence in states that already have handgun purchase waiting periods, the new laws will provide scale. They can't help but stop thousands of illegal handgun purchases.

And, since many handguns are acquired in the heat of passion (to settle a quarrel, for example) or at times of depression brought on by potential

If only
there had been
a waiting
period 10
years ago...

suicide, the Brady bill would provide a cooling-off period that would certainly have the effect of reducing the number of handgun deaths.

Critics claim that “waiting period” legislation in the states that have it doesn't stop criminals from going to nearby states that lack such laws to buy their weapons. True enough, and all the more reason to have a Federal law that fills the gaps. While the Brady bill would not apply to states that already have waiting periods of at least 10 days or that already require background checks, it would automatically cover the states that don't. The effect would be a uniform standard across the country.

Even with the current gaps among states, those that have waiting periods report lower crime. California, which has a 15-day waiting period that I supported and signed into law while Governor, stopped nearly 1,800 prohibited handgun sales in 1989. New Jersey has had a permit-to-purchase system for more than two decades. In that time, according to the state police, more than 10,000 convicted felons have been caught trying to buy handguns.

Every year, an average of 8,200 Americans are murdered by handguns, according to the Department of Justice statistics. This does not include suicides or the tens of thousands of robberies, rapes and assaults committed with handguns.

This level of violence must be stopped. Sarah and Jim Brady are working hard to do that, and I say more must be done. If the passage of the Brady bill were to result in a reduction of only 10 or 15 percent of those numbers (and it could be a good deal greater), it would be well worth making it the law of the land.

And there would be a lot fewer families facing reversals such as the Bradys, Delahantys, McCarthys and Reagans face every March 30. □

Sonoma Romeo, in announcing support for the Brady bill yesterday, reminded his audience he is a member of the National Rifle Association.

Using the development in the Difference-in-Differences literature, we will answer the following question

- Is there a causal effect of waiting periods on suicides by firearms in the U.S.?

Contribution of this paper

- I provide the first causal estimates of the effect of waiting periods on firearm suicides in the U.S.
- Provides evidence-based insights for key stakeholders and policymakers:
 - Healthcare providers and public health officials designing prevention strategies
 - State legislators crafting legislation to reduce suicides
 - Mental health advocates developing policy recommendations
 - Military stakeholders addressing suicide prevention among service members who have higher access to firearms
- I create a crosswalk to standardize the county level death file datasets from 1959 to 2019

I find that waiting periods cause a reduction in firearm suicides

- Waiting periods reduce firearm suicides by 0.6 deaths per 100,000 people
- These effects are larger among men, individuals aged 55+, and white individuals
- Waiting periods do not increase non-firearm suicides
- The benefits of waiting periods could be as high as \$37.9 billion per year

Section 2

Data

Suicide and state-level gun laws data

- My primary data source is the National Vital Statistics System (National Center for Health Statistics, 2020)
 - The National Center for Health Statistics collects data for the U.S. government to monitor and improve the nation's death rates
 - The Multiple Cause of Death files provide the cause of death of every mortality that occurs in the U.S.
 - The data is at the county level and from 1959 to 2019 and has information on sex, age, race, etc.
- For state level gun law policies, I use the RAND state firearm law database (RAND, 2022)
 - This dataset has information on all gun policies, including waiting periods

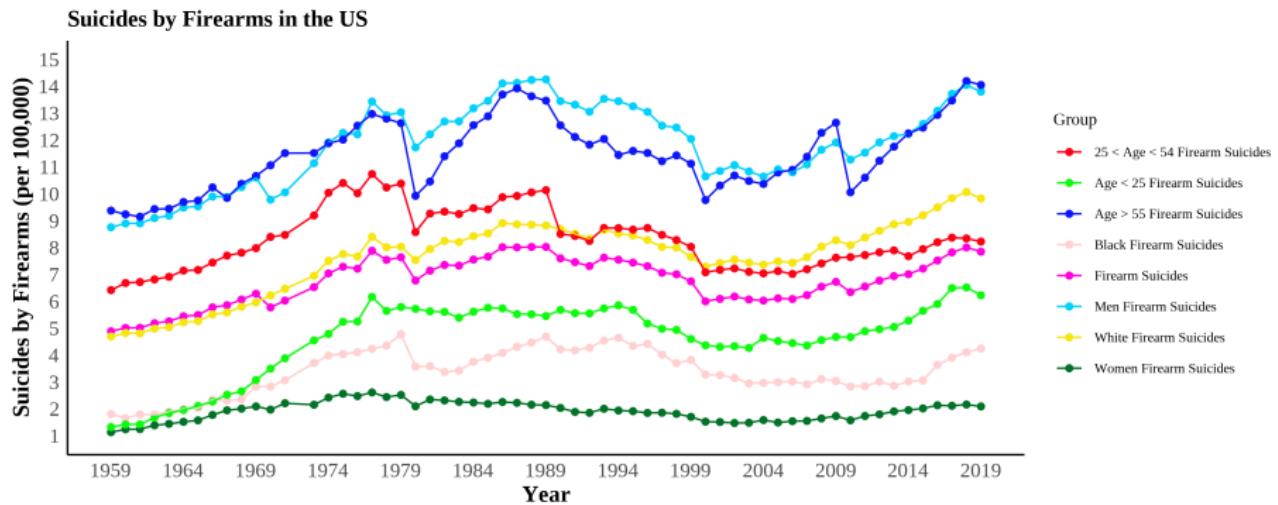
Firearm Suicides and Treatment Trends

Suicides and Treatment Trends

Firearm Suicides by Dem Vote

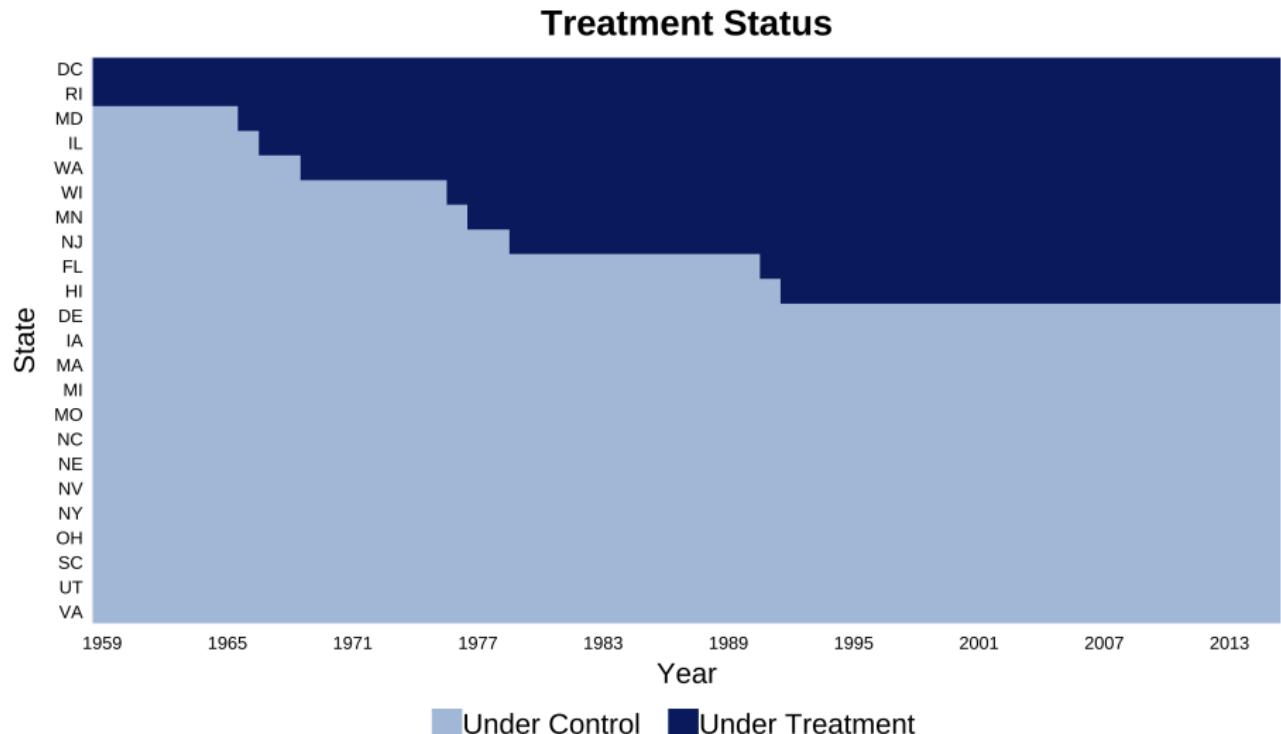
Firearm Suicides by Density

Firearms suicide by sex, age, and race



State-by-state rollout: Transition from treatment to control

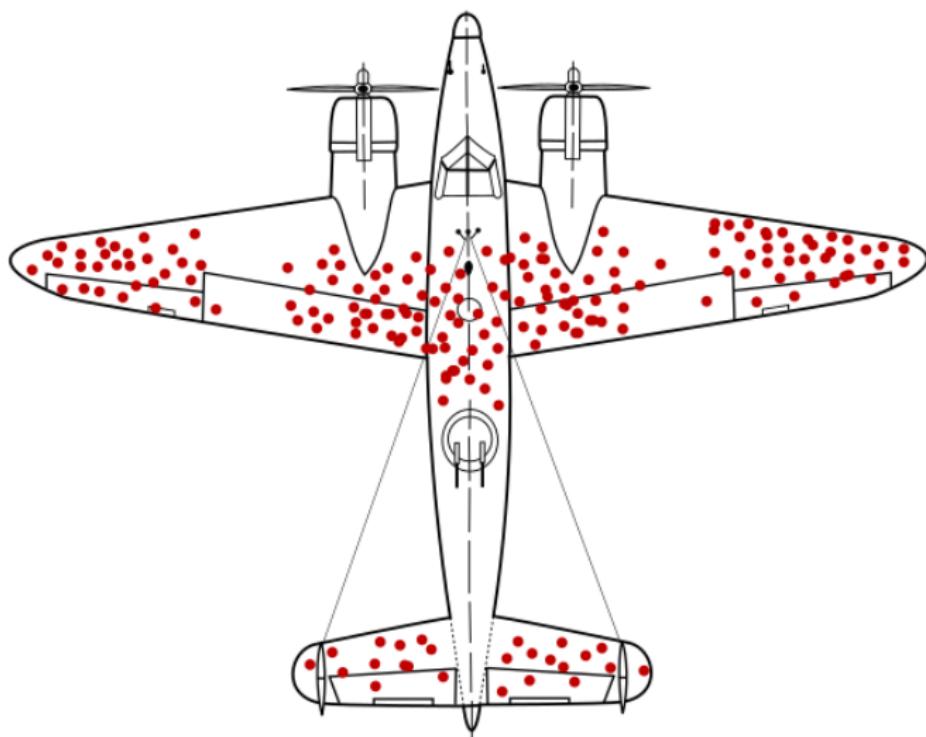
Clusters



Section 3

A Brief Intro to Difference-in-Differences

Selection bias could lead to misleading results



A Brief Intro to Difference-in-Differences

- Also called “Diff-in-Diff” or just DD or DID or DiD.
- This is a particular model used in regression analysis
- Instead of just comparing the “treated” firms/people/counties to the “control” firms/people/counties, you make this comparison over time
- Compare the pre-period (no one is “treated”) to the post-period (some firms/people/counties are “treated”)

Top Gun Training: A simple example

Suppose you are interested in the effect of a “Top Gun Training” program on successful maneuvers in the air

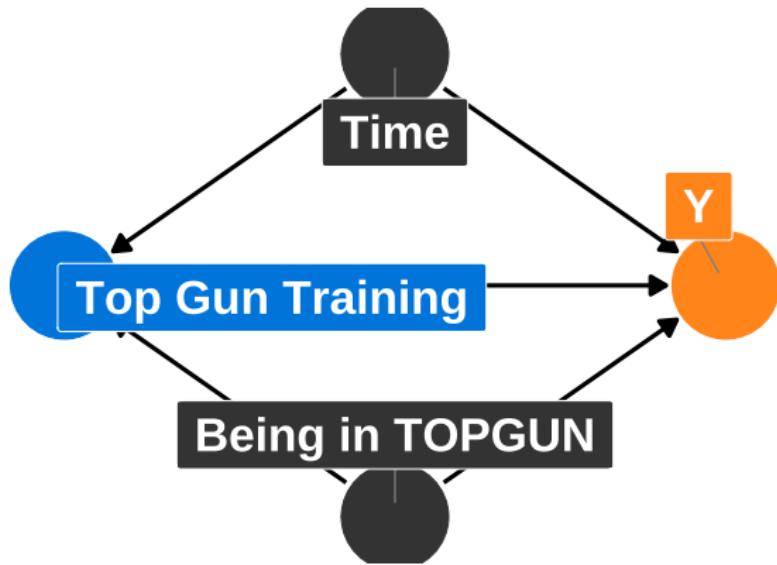
- We can compare the performance of pilots who have gone through the training before and after the training
- In this case, you're only looking at the treatment group!

We can compare the performance of pilots who have gone through the training to those who have not

- You're only looking at post-treatment values

Impossible to know if change happened because of natural growth

The basic idea: Top Gun Training



	Pre mean	Post mean
No Training	A (never treated)	B (never treated)
Top Gun Training	C (not yet treated)	D (treated)

	Pre mean	Post mean	Δ (post - pre)
No Training	A (never treated)	B (never treated)	$B - A$
Top Gun Training	C (not yet treated)	D (treated)	$D - C$

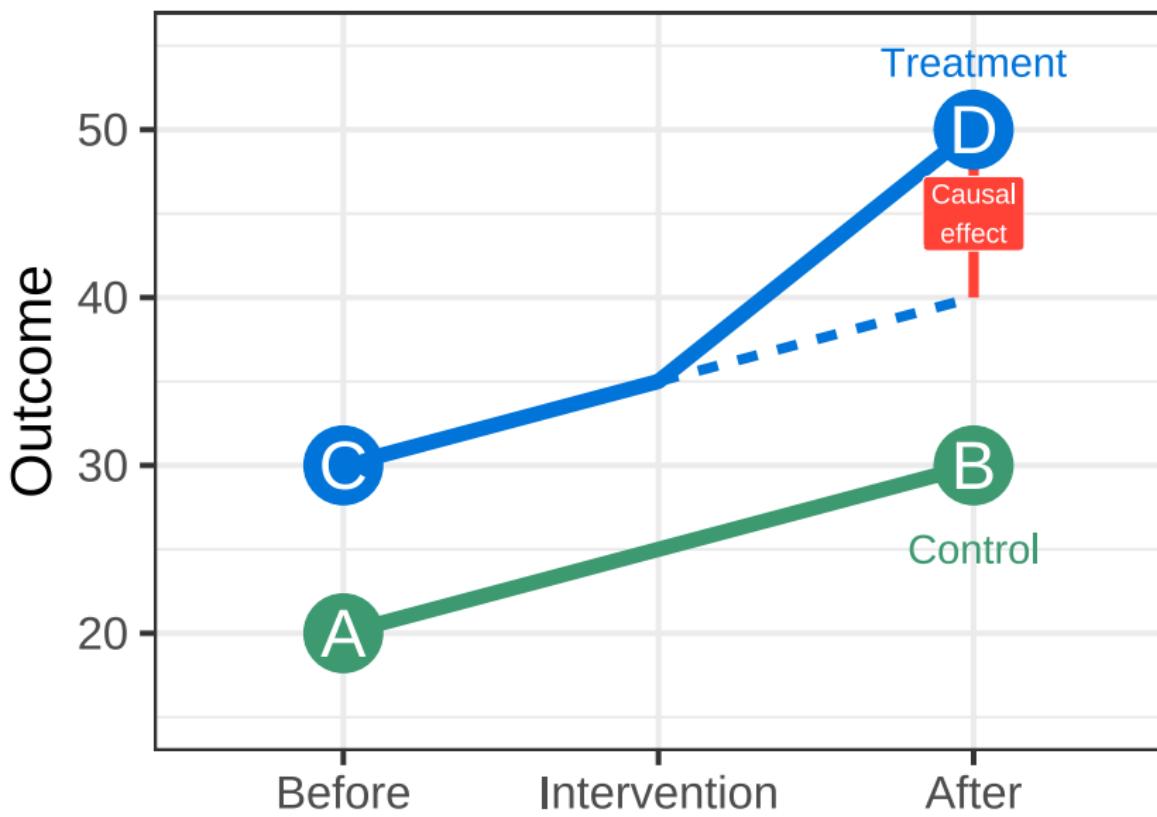
Δ (post - pre) = within-pilot change

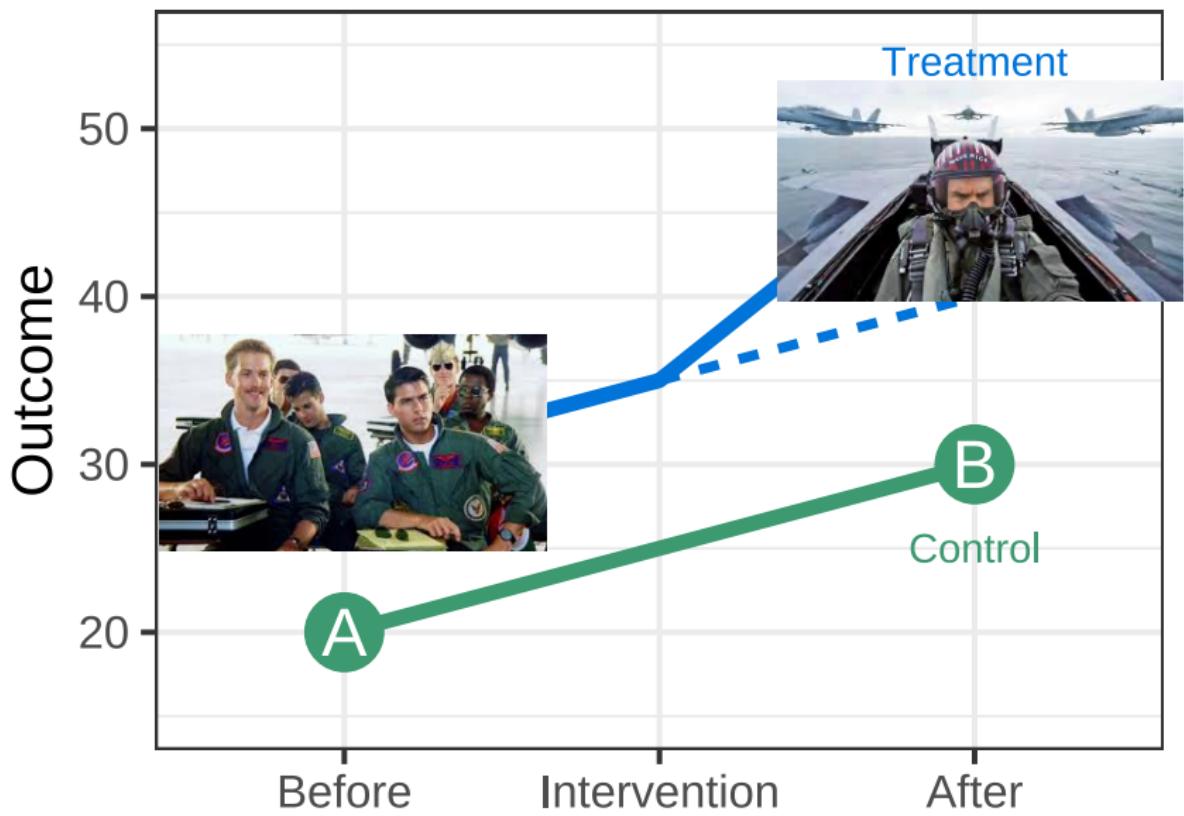
	Pre mean	Post mean
No Training	A (never treated)	B (never treated)
Top Gun Training	C (not yet treated)	D (treated)
Δ (Treatment - Control)	$C - A$	$D - B$

Δ (Treatment - Control) = across-pilot change

	Pre mean	Post mean	Δ (post - pre)
No Training	A (never treated)	B (never treated)	$B - A$
Top Gun Training	C (not yet treated)	D (treated)	$D - C$
Δ (Treatment - Control)	$C - A$	$D - B$	$(D - C) - (B - A)$ or $(D - B) - (C - A)$

- The difference-in-differences estimate of the causal effect is:
 $(D - C) - (B - A)$
- The $B - A$ tells us the change over time of Top Gun pilots. How did maneuvering change for Top Gun pilots?
- The $D - C$ tells us an estimate of the counterfactual. If Top Gun pilots are similar to non-Top Gun pilots in their maneuvering trends then $C - D$ gives us an estimate of what would have happened without Top Gun training.





Section 4

Empirical Strategy

The question I will answer

What is the causal effect of waiting periods on firearm suicides in the U.S.?

I will compare the change in firearm suicides in treated counties to the change in firearm suicides in untreated counties

How I measure the impact of waiting periods on firearm suicides

What I am doing:

- I want to see whether introducing a waiting period for purchasing firearms reduces the rate of firearm suicides
- I track each county's "event date," which is the year (or period) it starts requiring waiting periods
- Then, for each county, we look at its suicide rate before and after that event date and compare it to counties that haven't yet started waiting periods
- By doing this comparison in each time period before and after adoption, we get a picture of how firearm suicide rates change when a waiting period is introduced

Empirical Specification

How I measure the impact of waiting periods on firearm suicides

What I am doing:

- I assume that, if no waiting period had been put in place, the counties introducing it would have followed the same trends in firearm suicides as the counties not yet introducing it
- I also assume that people don't change their behavior in advance (i.e., no "rush" to buy guns just before a waiting period starts)
- These comparisons (often called an "event study") help us estimate the true effect of waiting periods on reducing firearm suicides over time

Regression equation

$$Y_{cst} = \alpha + \beta \text{Waiting}_c + \gamma \text{Year}_t + \delta(\text{Waiting}_c \times \text{Year}_t) + \varepsilon_{it}$$

Regression equation

$$Y_{cst} = \alpha + \beta \text{Waiting}_c + \gamma \text{Year}_t + \delta(\text{Waiting}_c \times \text{Year}_t) + \varepsilon_{it}$$

where:

- Y_{cst} is the number of firearm suicides per 100,000 people in county c state s in year t
- Waiting_c is a variable that equals 1 if county c has a waiting period in year t
- Year_t is a variable that equals 1 in year t

Regression equation (cont.)

$$Y_{cst} = \alpha + \beta \text{Waiting}_c + \gamma \text{Year}_t + \delta(\text{Waiting}_c \times \text{Year}_t) + \varepsilon_{it}$$

Regression equation (cont.)

$$Y_{cst} = \alpha + \beta \text{Waiting}_c + \gamma \text{Year}_t + \delta (\text{Waiting}_c \times \text{Year}_t) + \varepsilon_{it}$$

where:

- α is the number average of counties without waiting periods pre-treatment years
- β is increased firearm suicides across all counties regardless of when waiting periods are introduced
- γ is the increase in firearm suicides over time within counties
- δ is the difference-in-differences estimate of the causal effect of waiting periods on firearm suicides

Regression equation (cont.)

$$Y_{cst} = \alpha + \beta \text{Waiting}_c + \gamma \text{Year}_t + \delta (\text{Waiting}_c \times \text{Year}_t) + \varepsilon_{it}$$

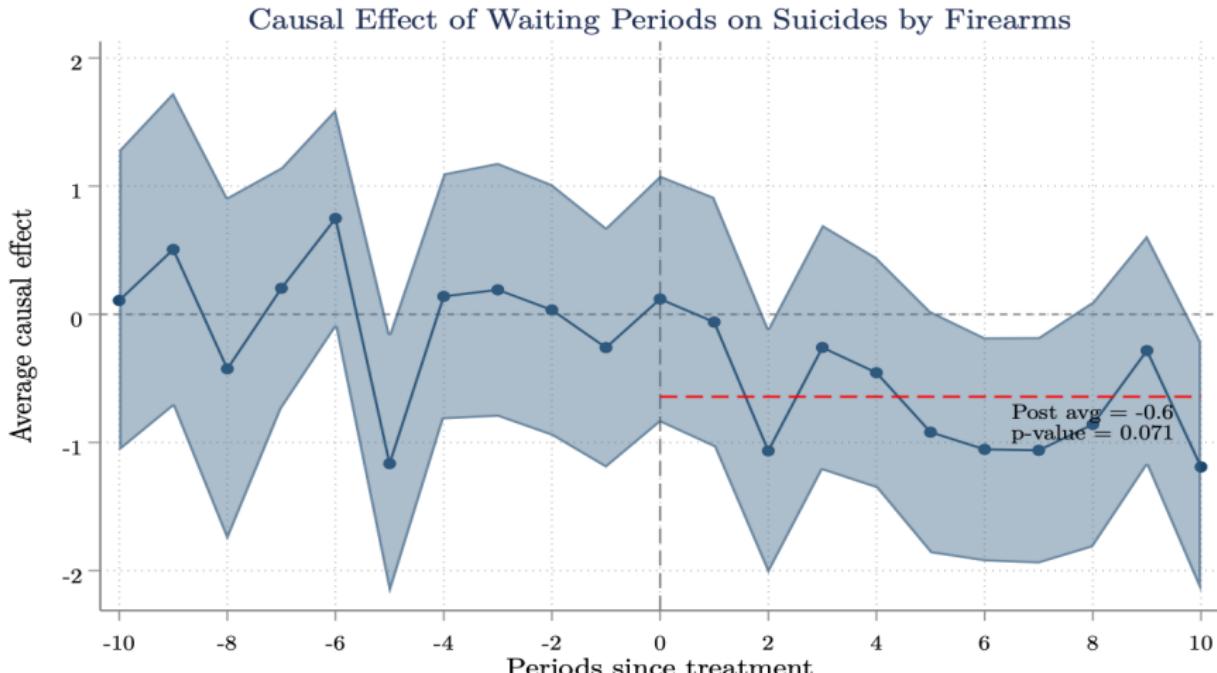
where:

- α is the number average of counties without waiting periods pre-treatment years
- β is increased firearm suicides across all counties regardless of when waiting periods are introduced
- γ is the increase in firearm suicides over time within counties
- δ is the difference-in-differences estimate of the causal effect of waiting periods on firearm suicides
- To avoid comparison between treated counties, I use Callaway and Sant'Anna (2021) to estimate the causal effect of waiting periods

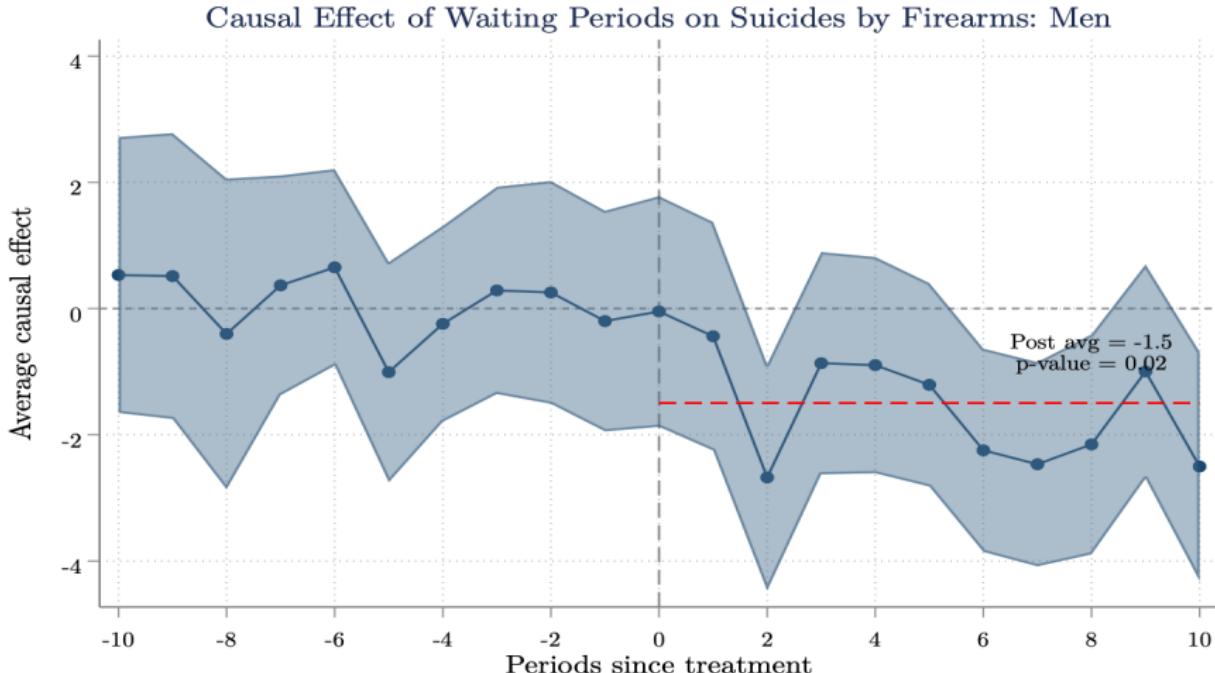
Section 5

Results

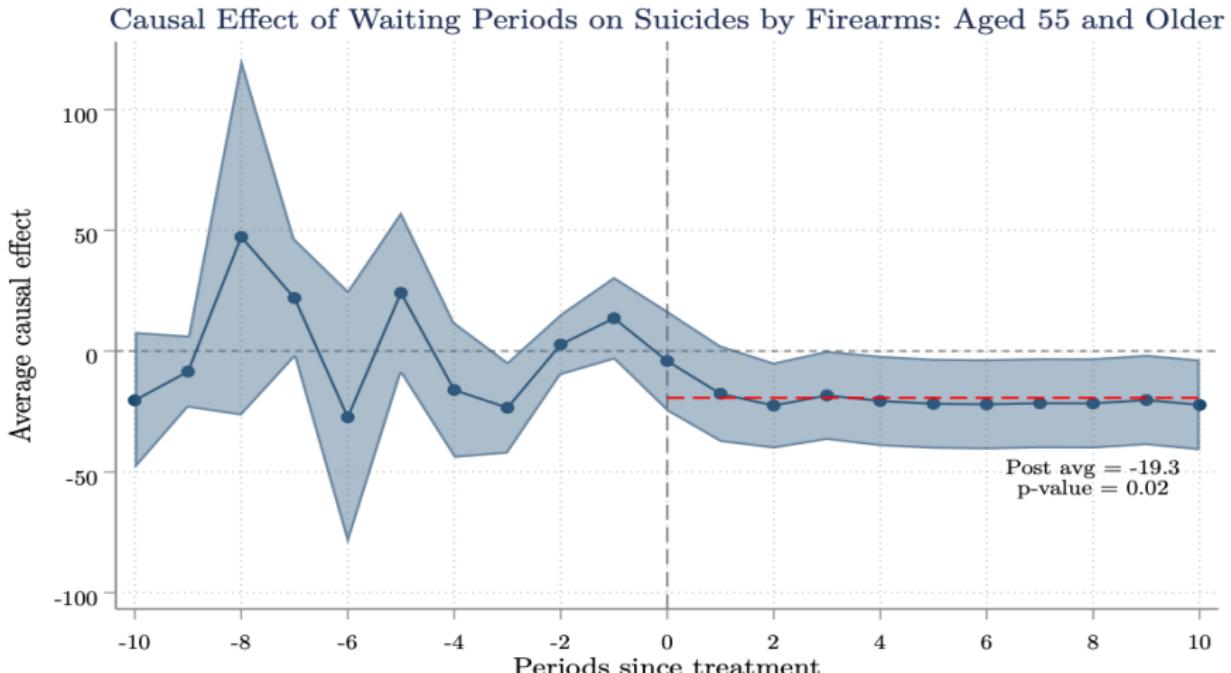
I find that waiting periods cause a small reduction in firearm suicides



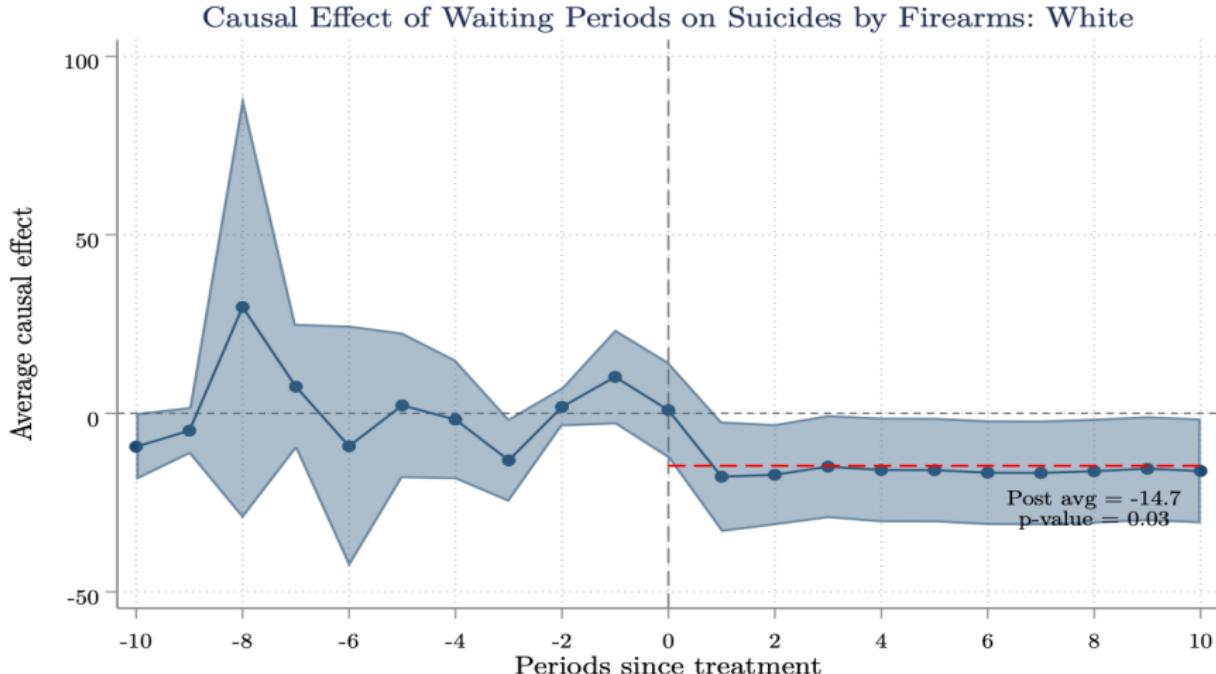
I find more significant effects of waiting periods on male firearm suicides



I find large and significant effects of waiting periods on firearm suicides among individuals aged 55+



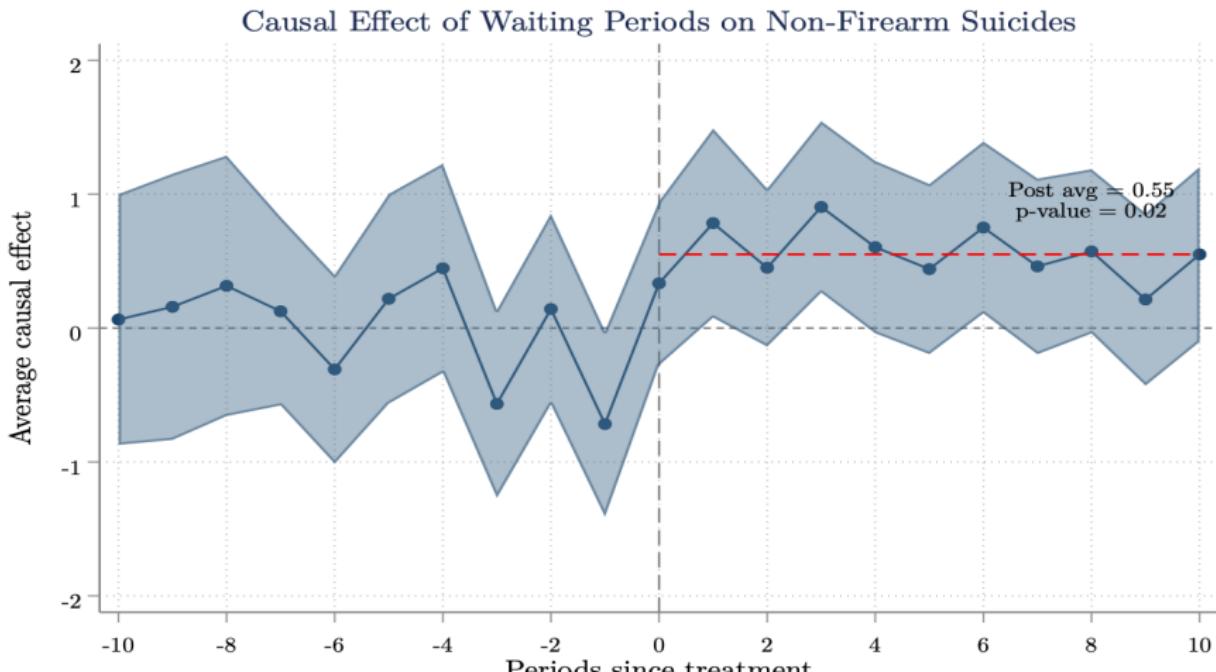
I find large and significant effects of waiting periods on firearm suicides among white individuals



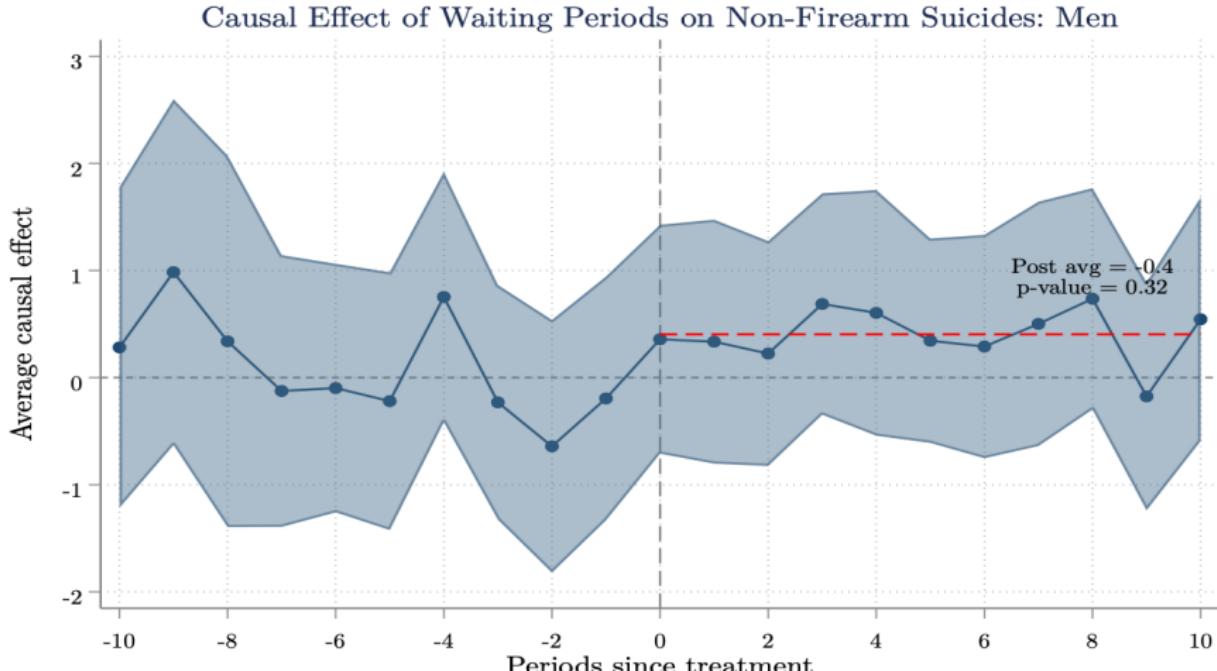
Section 6

Results: Non-Firearm Suicides

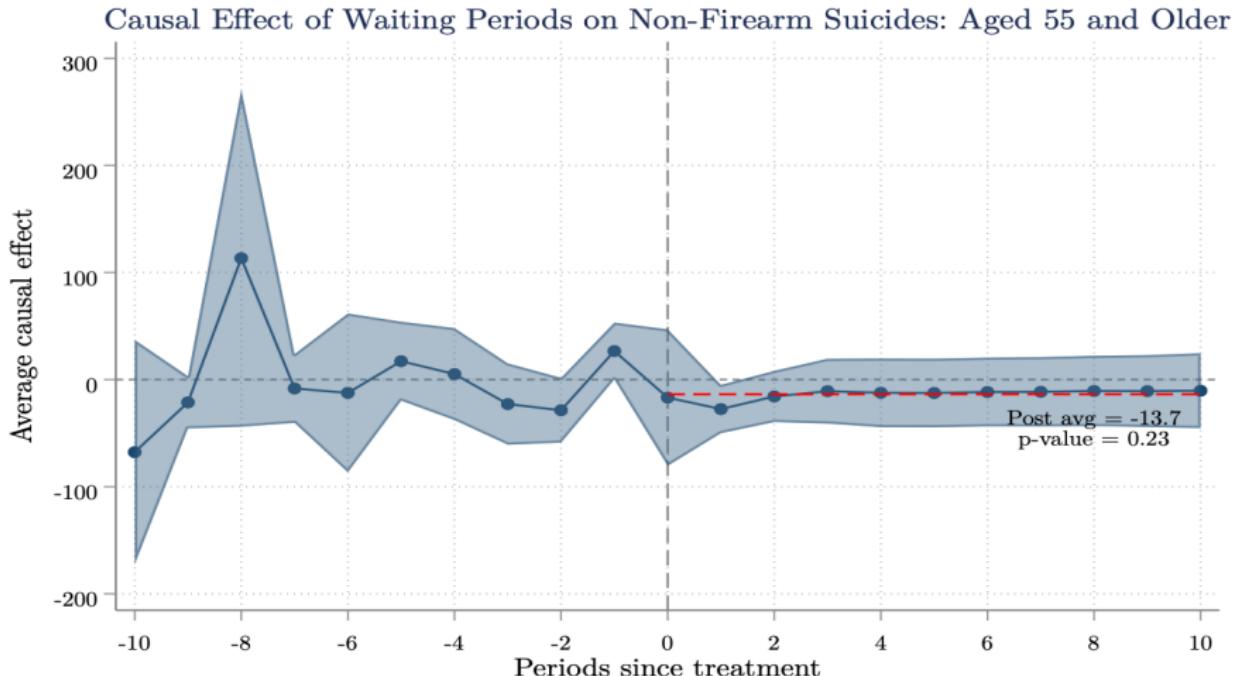
I find that waiting periods do increase non-firearm suicides



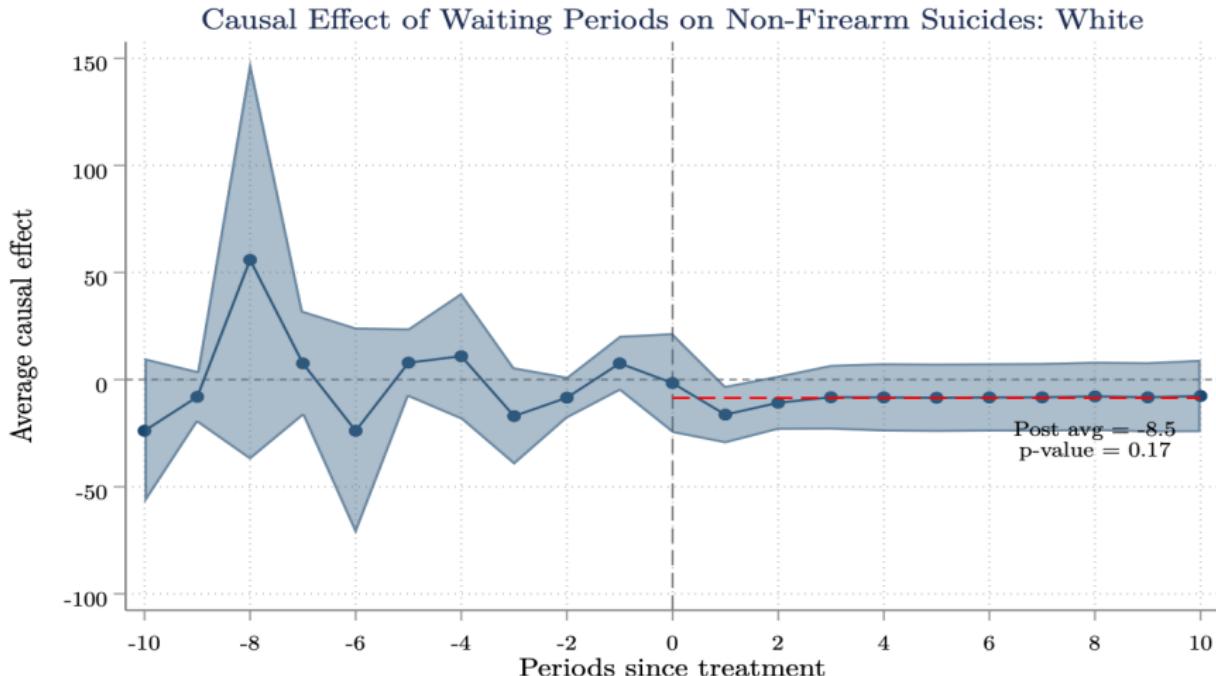
I find that waiting periods do not increase non-firearm suicides among men



I find that waiting periods do not increase non-firearm suicides among individuals aged 55+



I find that waiting periods do not increase non-firearm suicides among white individuals



Section 7

Conclusion

Back of the envelope calculations

- Waiting periods decrease firearm suicides by 0.6 deaths per 100,000 people
 - That is an 8% decrease in firearm suicides
 - That is a reduction of 1,924 firearm suicides per year
- The benefits of waiting periods could range from \$11.7 to \$37.9 billion per year
 - Value of statistical life = ranges from \$6.4 to \$19.7 million (HHS, 2024)

Waiting periods are effective in reducing firearm suicides

- Waiting periods reduce firearm suicides by 0.6 deaths per 100,000 people
- These effects are larger among men, individuals aged 55+, and white individuals
- Waiting periods do not increase non-firearm suicides
- The benefits of waiting periods could be as high as \$37.9 billion per year

Thank you!

Section 8

Appendix

Event Study Specification

$$Y_{ist} = \sum_{l=-K}^L \beta_l \mathbb{I}\{t - E_s = l\} + \theta_i + \lambda_t + \varepsilon_{ist}$$

Event Study Specification

$$Y_{ist} = \sum_{l=-K}^L \beta_l \mathbb{1}\{t - E_s = l\} + \theta_i + \lambda_t + \varepsilon_{ist}$$

where:

- Y_{ist} is the number of firearm suicides per 100,000 in county i in state s at time t
- E_s is the time period when state s implemented a waiting period
- $\mathbb{1}\{t - E_s = l\}$ is an indicator variable equal to 1 when time t is l periods away from the implementation of waiting periods in state s

Back

Event Study Specification

$$Y_{ist} = \sum_{l=-K}^L \beta_l \mathbb{1}\{t - E_s = l\} + \theta_i + \lambda_t + \varepsilon_{ist}$$

where:

- Y_{ist} is the number of firearm suicides per 100,000 in county i in state s at time t
- E_s is the time period when state s implemented a waiting period
- $\mathbb{1}\{t - E_s = l\}$ is an indicator variable equal to 1 when time t is l periods away from the implementation of waiting periods in state s

Event Study Specification (Cont'd)

$$Y_{ist} = \sum_{l=-K}^L \beta_l \mathbb{1}\{t - E_s = l\} + \theta_i + \lambda_t + \varepsilon_{ist}$$

Event Study Specification (Cont'd)

$$Y_{ist} = \sum_{l=-K}^L \beta_l \mathbb{1}\{t - E_s = l\} + \theta_i + \lambda_t + \varepsilon_{ist}$$

- For $l < 0$, β_l captures the differences in firearm suicides between treated and control counties before the implementation of waiting periods

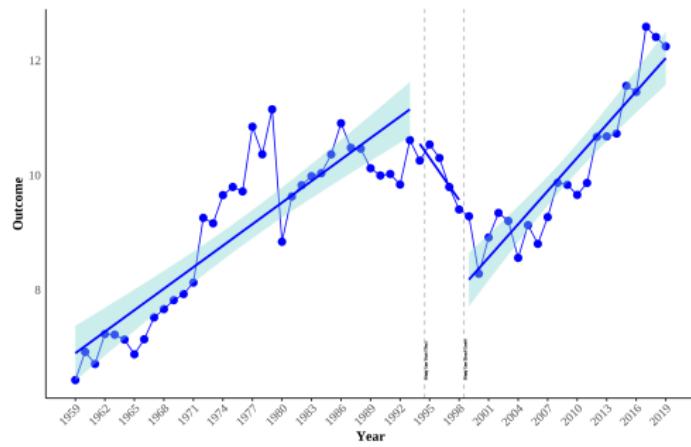
Event Study Specification (Cont'd)

$$Y_{ist} = \sum_{l=-K}^L \beta_l \mathbb{1}\{t - E_s = l\} + \theta_i + \lambda_t + \varepsilon_{ist}$$

- For $l < 0$, β_l captures the differences in firearm suicides between treated and control counties before the implementation of waiting periods
- For $l \geq 0$, β_l captures the post-treatment effect of waiting periods
- To identify causal estimates of β_l , we need the parallel trends and no anticipation assumptions to hold

Brady Act and the Parallel Trends Assumption

- The Brady Act was signed into law in 1993 and required a five-day waiting period for the purchase of a handgun
- Supreme Court ruled that the Brady Act was unconstitutional in 1997



Average Treatment Effect Using Callaway and Sant'Anna (2021)

- I estimate the average treatment effect of waiting periods on firearm suicides by using the not-yet-treated counties as a control group
- The average treatment effect is given by:

$$ATT(g, t) = \mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i = g] - \mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i \in \mathcal{G}_{comp}]$$

where:

- $\mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i = g]$ is expected change in outcome for cohort g between periods $g - 1$ and t
- $\mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i \in \mathcal{G}_{comp}]$ is the expected change in outcome for the comparison group that is not-yet-treated at time t
- G_i is the cohort of counties that are treated at time t
- \mathcal{G}_{comp} is the set of cohorts that are not-yet-treated at time t

Average Treatment Effect Using Callaway and Sant'Anna (2021) (Cont'd)

$$ATT(g, t) = \mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i = g] - \mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i \in \mathcal{G}_{comp}]$$

where:

- $\mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i = g]$ is expected change in outcome for cohort g between periods $g - 1$ and t
- $\mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i \in \mathcal{G}_{comp}]$ is the expected change in outcome for the comparison group that is not-yet-treated at time t
- G_i is the cohort of counties that are treated at time t
- \mathcal{G}_{comp} is the set of cohorts that are not-yet-treated at time t
- $\hat{ATT}(g, t) = \hat{\beta}_I$ if the parallel trends and no anticipation assumptions hold

Back

Average Treatment Effect Using Callaway and Sant'Anna (2021): Example

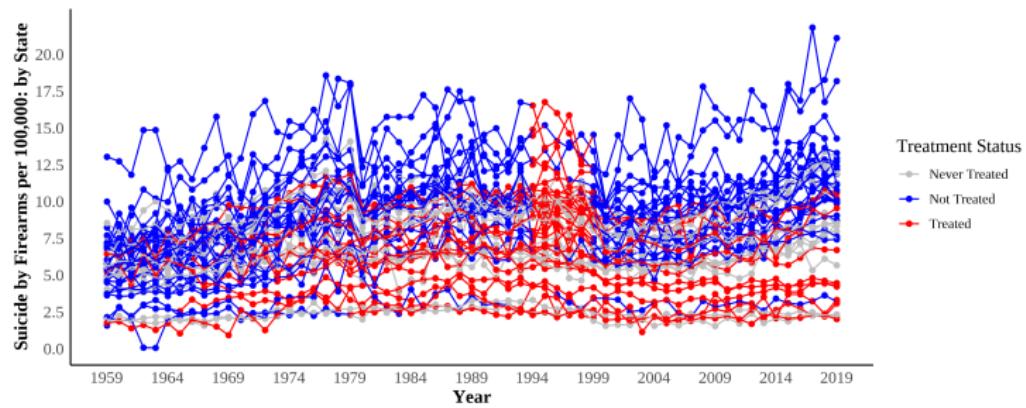
$$ATT(g, t) = \mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i = g] - \mathbb{E}[Y_{is,t} - Y_{is,g-1} \mid G_i \in \mathcal{G}_{comp}]$$

where:

- $G_i = \{\text{Group A (treated in 2020), Group B (treated in 2022), Group C (never treated)}\}$
- $ATT(A, 2021) = \mathbb{E}[Y_{is,2021} - Y_{is,2020} \mid G_i = A] - \mathbb{E}[Y_{is,2021} - Y_{is,2020} \mid G_i = B]$
- $ATT(B, 2023) = \mathbb{E}[Y_{is,2023} - Y_{is,2022} \mid G_i = B] - \mathbb{E}[Y_{is,2023} - Y_{is,2022} \mid G_i = C]$

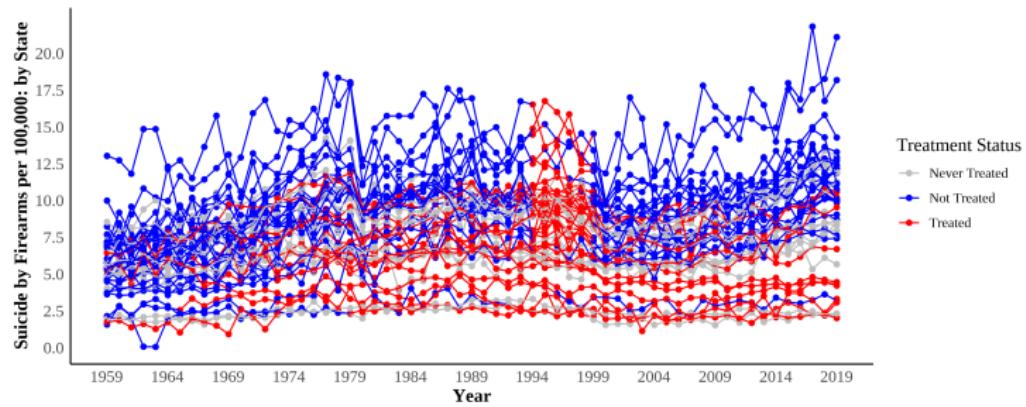
Back

Trends in Suicide by Firearms: Treatment and Control States Over Time



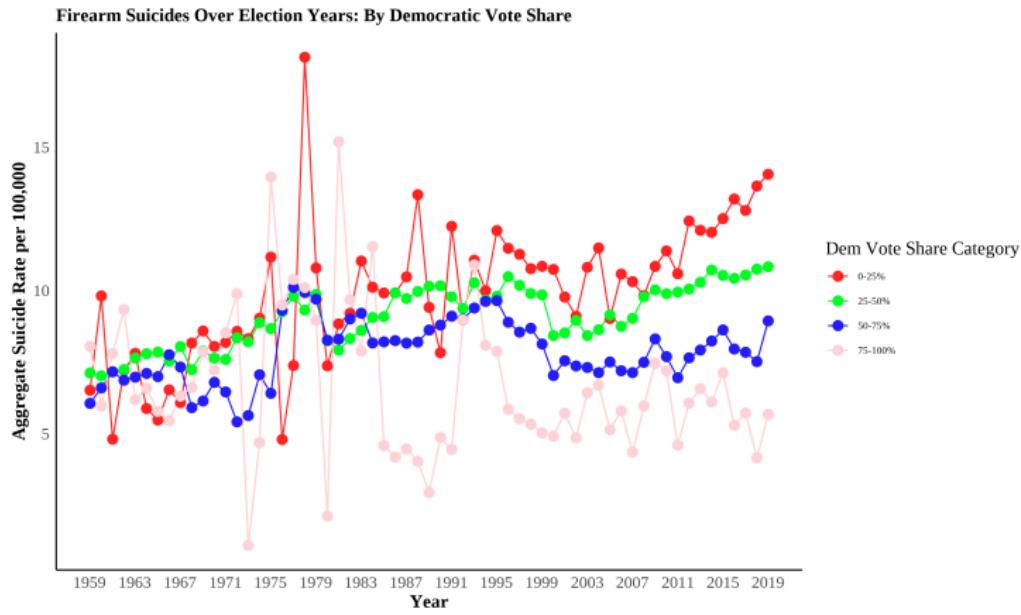
Back

Trends in Suicide by Firearms: Treatment and Control States Over Time



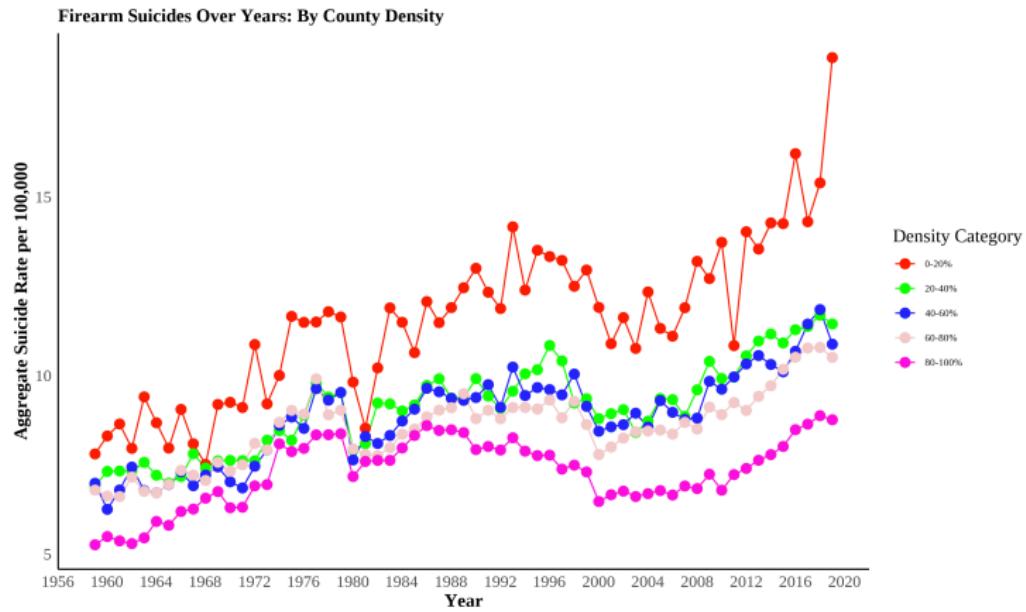
Back

Trends in Suicide by Firearms: By Democratic Vote Share Over Time



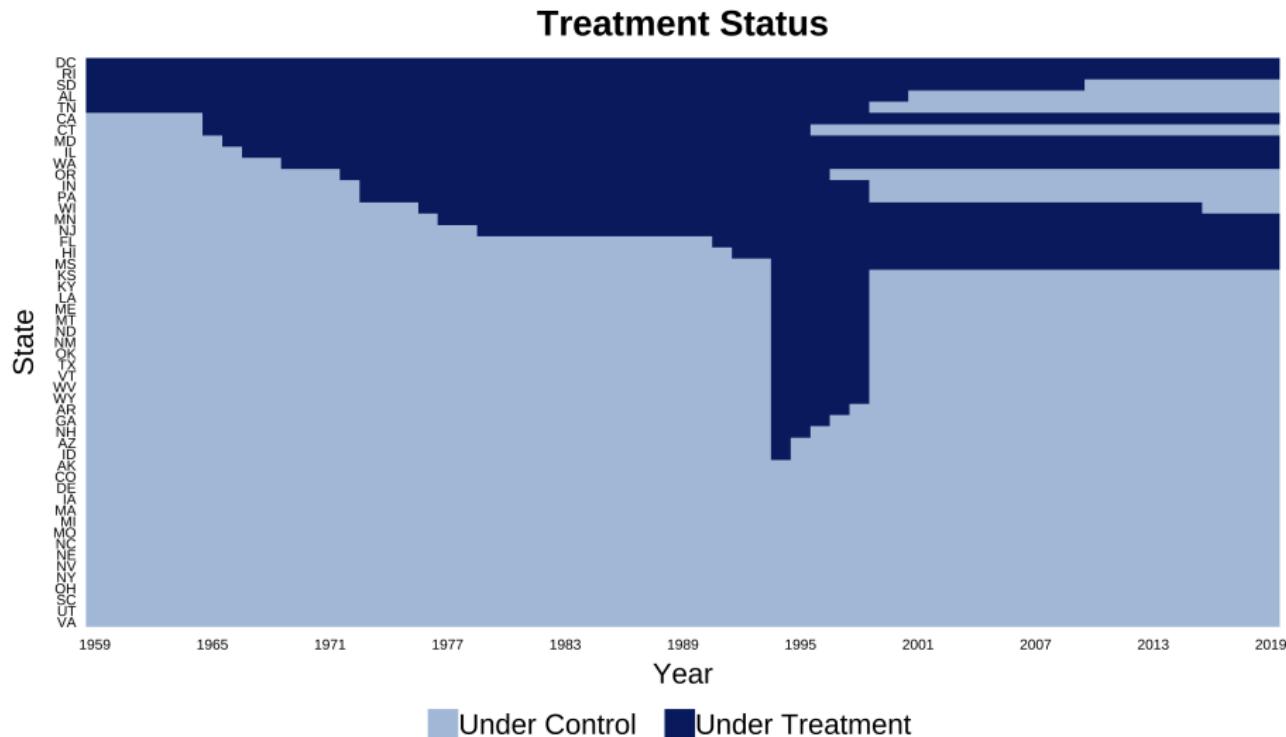
Back

Trends in Suicide by Firearms: By Density Over Time



Back

State-level variation in waiting period policies



Number of clusters per treatment history

Unique Treatment Histories

