ABSTRACT

Objective To estimate the effect of a handgun purchase waiting period repeal on handgun and firearm suicides in Wisconsin.

Methods Data for outcome and predictor variables were obtained for the 1999–2020 study period. Synthetic controls were used to assess the impact of Wisconsin’s waiting period repeal on mean-centred suicide rates. Placebo tests, difference-in-differences regression and augmented synthetic controls supplemented the synthetic control analyses.

Results Postrepeal suicides were more likely to involve handguns than those in the 5 years immediately preceding the repeal ($χ^2 (1, N=8269) = 49.25$, $p<0.001$). The waiting period repeal resulted in an estimated annual increase of 1.1 handgun suicides per 100,000, or roughly 65 handgun suicide deaths per year. Estimates from difference-in-differences regression and augmented synthetic control analyses indicated similar treatment effects. Relative to the synthetic control, firearm suicides increased 6.5% following the repeal.

Conclusion The waiting period repeal in Wisconsin was associated with increases in both handgun and firearm suicides. The findings suggest that waiting periods may be effective means restriction policies to reduce suicide. Additionally, the synthetic control’s ability to closely approximate preintervention handgun suicide trends despite a limited donor pool has implications for future policy analyses.

INTRODUCTION

Firearm suicide is a leading cause of injury death for nearly every age group in the USA. Although preventable, suicide is a difficult public health problem to address due to the complexity of identifying high-risk individuals and accessing them when they are at greatest risk of attempting suicide. Coupled with the elevated lethality of firearms relative to other suicide methods, the availability of firearms poses an additional challenge to suicide prevention.

In 2020, a firearm was used in over half of all suicides. Although it is unclear what proportion of firearms used in suicides are newly acquired, the convenience with which firearms can be purchased may contribute to impulsive suicides. The National Instant Criminal Background Check System’s immediate determination rate of nearly 90% suggests that most firearm purchases from licensed dealers can be completed within minutes.

Given that suicide attempts can be preceded by hours or less of planning, policies that delay firearm transfers may limit the capacity of prospective buyers experiencing transient suicidal ideation to commit suicide. States that implemented a 5-day handgun purchase waiting period along with background check requirements experienced a significant decrease (~6%) in the firearm suicide rate among older individuals. Edwards et al noted a similar reduction (up to a 5% decrease in firearm suicides) for mandated purchase delays, while Luca et al found that firearm purchase waiting periods were associated with a 7%-11% reduction in firearm suicides. A recent report by the RAND Corporation synthesising existing research concluded that there is ‘moderate evidence that waiting periods may reduce firearm suicides.’

Forty-four states had a firearm purchase waiting period at some point between 1970 and 2014 (19 of which were created in 1994 as part of the Brady Handgun Violence Prevention Act), but only 9 states mandate such purchase delays in 2022.

In 2015, Wisconsin repealed its 48-hour handgun purchase waiting period. As a result, handgun purchases from licensed firearm dealers could proceed without delay following a cleared background check. Dunton et al found that the repeal was associated with increased firearm-related suicide among urban county residents and people of colour; however, the study did not control for
METHODS

Measures

Mortality data for the 1999–2020 study period were obtained from the Centers for Disease Control and Prevention (CDC) WONDER database. Two outcome variables were included in the analysis: handgun suicide (International Classification of Disease, Tenth Revision (ICD-10) code X72) and firearm suicide (X72–74). Following the approach used by Kagawa et al14 when preintervention outcomes of the treated unit are larger than those of the donor units, suicide rates were centred around their preintervention means.

The following predictor variables were used in the study based on theoretical relevance13 and/or utility in constructing counterfactual suicide trends in other studies14 16 17: state population, population density, the proportion of a state’s population residing in metropolitan statistical areas, the proportions of each state’s population (see online supplemental table 4). Similarly, an ‘in-time’ placebo, ‘leave-one-out’ tests were performed to assess the robustness of estimated effects. The Synth21 and SCtools22 packages were used to construct synthetic controls and conduct placebo tests. The augsynth23 package was used to construct augmented synthetic controls as part of a secondary analysis. The augmented SCM (ASCM) is an extension of SCM that uses ridge regression and negative donor weights to reduce bias in SCM estimates.23 All statistical analyses were conducted using R V.4.2.1.

RESULTS

Handgun suicide

Synthetic Wisconsin (MSPE=0.04), composed of Minnesota (weight=0.546), Iowa (0.243) and Illinois (0.21), closely approximates preintervention handgun suicide trends in Wisconsin (figure 1). Preintervention mean characteristics of Wisconsin and its synthetic control are appropriately similar across all predictor variables (table 1). The handgun purchase waiting period repeal resulted in an estimated increase of 1.14 deaths per 100 000, which translates to 66 additional handgun suicides per year or a 30.3% increase relative to Synthetic Wisconsin (see online supplemental table 3).

Synthetic controls were constructed for each donor pool state to model counterfactual handgun suicide trends and placebo effects. The postintervention deviation in demeaned handgun suicide rates is substantially larger in Wisconsin following the waiting period repeal than in any of the control states following a placebo intervention (figure 1). In place of traditional significance tests, the post-MPSE/pre-MPSE ratios of Wisconsin and donor states were compared. Wisconsin’s postintervention/preintervention MSPE ratio of 33.9 is 12 times larger than that of any donor state. Therefore, the probability of obtaining an effect at least as large as that in Wisconsin on random assignment of the intervention to one of the five states is 1/5, or 0.2. ‘Leave-one-out’ robustness tests, in which a different donor state is excluded from each synthetic control, were used to assess the robustness of results to donor pool modifications. Given that Iowa’s purchase delay was a byproduct of its permit requirement (and not simply a waiting period), it was important to determine whether the estimated treatment effect was robust to its exclusion. Consistent with the original estimate of 1.14 deaths per 100 000, treatment effects using leave-one-out synthetic controls range from 1.15 to 1.19—demonstrating that the estimated effect is not driven by the weight of a single donor state (see online supplemental table 4). Similarly, an ‘in-time’ placebo test involving an artificially backdated repeal date did not lead to substantively different results (see online supplemental figure 1).

A supplementary difference-in-differences regression using Minnesota’s parallel handgun suicide rate trend as a control (see online supplemental figure 2), several relevant covariates (obtained through 2019), and SEs clustered at the state level
estimated a similar treatment effect (0.95 deaths per 100,000, p=0.03). Notably, suicides in Wisconsin between 2015 and 2019 were more likely to involve handguns than those in 2010–2014 ($\chi^2(1, N=8269) = 49.25$, p<0.001). The share of overall suicide deaths identified as having been caused by handgun discharge rose from 26.0% in 2010–2014 to 32.4% after the repeal, whereas no donor state recorded an increase of more than 1.3 percentage points.

**Firearm suicide**

As shown in figure 2, Synthetic Wisconsin (MSPE=0.07) closely approximates firearm suicide trends in Wisconsin. The waiting period repeal resulted in an estimated treatment effect of 0.45 per 100,000, which translates to 26 additional firearm suicide deaths per year and a 6.5% increase in the firearm suicide rate. Using a restricted permutation distribution of states with preintervention MSPEs less than five times that of Wisconsin, the probability of obtaining an effect at least as large as that in Wisconsin relative to its synthetic control. Moreover, suicides in Wisconsin between 2015 and 2019 were significantly more likely to involve handguns than those that occurred in the 5 years preceding the repeal. Consistent with prior research examining waiting periods, the estimated 7% increase in firearm suicides following the repeal of the handgun waiting period policy change on suicide rates. Allowing more immediate transfers of handguns from licensed firearm dealers led to a substantial increase in the handgun suicide rate in Wisconsin relative to its synthetic control. Moreover, suicides in 2015–2019 were significantly more likely to involve handguns than those that occurred in the 5 years preceding the repeal. Consistent with prior research examining waiting periods, the estimated 7% increase in firearm suicides following the repeal of a handgun waiting period suggests that firearm purchase delays are an effective form of temporary lethal means restriction to reduce suicide.

Two explanations may account for the findings described above. First, the waiting period repeal eliminated a potentially important barrier to practical capacity; individuals who

**DISCUSSION**

Waiting periods are hypothesised to reduce impulsive suicides by delaying the possession of purchased firearms. This is the first study to use synthetic controls to estimate the impact of a waiting period policy change on suicide rates. Allowing more immediate transfers of handguns from licensed firearm dealers led to a substantial increase in the handgun suicide rate in Wisconsin relative to its synthetic control. Moreover, suicides in 2015–2019 were significantly more likely to involve handguns than those that occurred in the 5 years preceding the repeal. Consistent with prior research examining waiting periods, the estimated 7% increase in firearm suicides following the repeal of a handgun waiting period suggests that firearm purchase delays are an effective form of temporary lethal means restriction to reduce suicide.

Two explanations may account for the findings described above. First, the waiting period repeal eliminated a potentially important barrier to practical capacity; individuals who
were suicidal but would not have attempted another form of suicide were instead able to purchase a handgun during a crisis without delay. Second, suicidal individuals who may have otherwise resorted to less lethal methods were able to access more lethal means which previously required a 48-hour delay. Either scenario represents an outcome that means restriction is expressly intended to prevent.

As conceptualised in Barber and Miller, restricting access to lethal means leads to (1) temporary or permanent delays in attempts or (2) substitution to less lethal methods. In either case, fewer fatal attempts occur due to the inaccessibility of lethal means during an acute suicidal crisis. Means restriction approaches such as waiting periods thus hinder the progression from strong suicidal ideation to attempt by limiting the practical capacity to commit suicide. Regardless of the extent to which the handgun purchase waiting period prevented method-specific attempts or the use of more lethal means to attempt suicide, the findings suggest that the increases in handgun and firearm suicide deaths were preventable had the policy remained in effect.

The findings also add to the supportive evidence of universal prevention strategies. A substantial challenge to preventing suicide is identifying and accessing individuals when they are at greatest risk of attempting suicide. The impulsive nature of some attempts leaves few opportunities for targeted intervention. Universal prevention strategies at the societal level that do not rely on identifying high-risk individuals during acute crises (eg, delaying firearm transfers) can complement selective or indicated interventions at the individual level (eg, lethal means counselling).

A primary strength of this study, which has implications for future policy analyses, is the efficacy of the synthetic control approach despite a limited donor pool. Namely, the close approximation of preintervention handgun suicide trends by Synthetic Wisconsin suggests that synthetic controls can be constructed with substantially restricted donor pools under advantageous conditions (eg, similar sociodemographic measures and comparable outcome trends). All three states comprising the handgun suicide synthetic control border Wisconsin and exhibited similar preintervention suicide trends.

Limitations

Despite the methodological strengths of the study, the findings are not without important limitations. Most notably, the handgun suicide analysis involves only the subset of overall handgun suicides that were assigned ICD-10 code X72. Although 94% of firearm suicides in Wisconsin from 1999 to 2019 were classified specifically as handgun (X72) or long gun (X73) suicides, 54% and 76% of firearm suicides in Minnesota and Illinois, respectively, were coded as suicide ‘by other and unspecified firearm discharge’ (X74). To an extent, the threat posed by the lack of...
specification in firearm type in donor states was mitigated by the mean-centring transformation of handgun and non-handgun suicide rates. Differential classification of firearm suicides over space and time could introduce bias; however, handgun suicide rates were mean-centred and exhibited highly similar trends throughout the preintervention period.

Second, as with any analysis, the omission of important covariate measures or confounders could also bias estimates. Several relevant covariate measures, which have been used in other firearm suicide analyses, were included in the study. Additionally, no other firearm policy changes occurred in Wisconsin around 2015. Lastly, as outlined in a recent report by the RAND Corporation,29 the generalisability and statistical significance of synthetic control analyses assessing single-state policy changes is uncertain. More research is needed to fully assess the effect of waiting period repeals on suicide rates.

CONCLUSION
Waiting periods may be an effective form of means restriction to reduce suicide. This study adds to the limited research on firearm purchase delays by using synthetic controls to estimate the causal effect of a waiting period repeal. Repealing the waiting period requirement in Wisconsin, thereby allowing more immediate possession of handguns, resulted in estimated increases in handgun suicide and overall firearm suicide. Future research should explore firearm purchasing behaviour and examine the impact of purchase delays at the individual level.

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Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data used in this study are publicly available from the sources listed in the supplemental file, mentioned in the text, and included here: CDC WONDER, the US Census Bureau (including the Current Population Survey and the American Community Survey), the Federal Bureau of Investigation’s Uniform Crime Reporting Program, the National Institute on Alcohol Abuse and Alcoholism, the Bureau of Economic Analysis, and the Bureau of Labor Statistics.

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Stephen N Oliphant http://orcid.org/0000-0002-5225-173X

REFERENCES
### SUPPLEMENTAL MATERIAL

**Supplemental Table 1.** Description of variables and data sources.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Data Source(s)</th>
<th>Years</th>
<th>Source Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population density</td>
<td>Yearly population totals obtained from CDC WONDER divided by land area measures from the 2010 Census</td>
<td>State Area Measurements and Internal Point Coordinates, U.S. Census Bureau</td>
<td>1999-2014</td>
<td><a href="https://www.census.gov/geographies/reference-files/2010/geo/state-area.html">https://www.census.gov/geographies/reference-files/2010/geo/state-area.html</a></td>
</tr>
<tr>
<td>Proportion of population white</td>
<td>Proportion of the state population that identify as white</td>
<td>Underlying Cause of Death, 1999-2019 Request, CDC WONDER</td>
<td>1999-2014</td>
<td><a href="https://wonder.cdc.gov/ucd-icd10.html">https://wonder.cdc.gov/ucd-icd10.html</a></td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>Number of unemployed persons divided by labor force (and multiplied by 100)</td>
<td>BLS Data Finder 1.1, Bureau of Labor Statistics</td>
<td>1999-2014</td>
<td><a href="https://beta.bls.gov/dataQuery/find?q=unadjusted+unemployment&amp;q=unemployment+rate:%20(U)&amp;st=0&amp;r=100&amp;st=0">https://beta.bls.gov/dataQuery/find?q=unadjusted+unemployment&amp;q=unemployment+rate:%20(U)&amp;st=0&amp;r=100&amp;st=0</a></td>
</tr>
<tr>
<td>Mean income</td>
<td>Per capita personal income</td>
<td>SAINC1 Personal Income Summary, Bureau of Economic Analysis</td>
<td>1999-2014</td>
<td><a href="https://apps.bea.gov/itable/iTable.cfm?ReqID=70&amp;step=1">https://apps.bea.gov/itable/iTable.cfm?ReqID=70&amp;step=1</a></td>
</tr>
<tr>
<td>Ethanol consumption</td>
<td>Per capita ethanol consumption (in gallons) among statewide population</td>
<td>April 2021 Surveillance Report #117, National Institute on Alcohol Abuse and Alcoholism</td>
<td>1999-2014</td>
<td><a href="https://apps.bea.gov/itable/iTable.cfm?ReqID=70&amp;step=1">https://apps.bea.gov/itable/iTable.cfm?ReqID=70&amp;step=1</a></td>
</tr>
</tbody>
</table>
# SUPPLEMENTAL MATERIAL

|-------------------------------------------|-------------------------------------------|-------------------------------------------------|----------|-----------------------------------|

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Description</th>
<th>Data Source(s)</th>
<th>Years</th>
<th>Source Link</th>
</tr>
</thead>
</table>
**Supplemental Table 2.** Weights of predictor variables used to construct Synthetic Wisconsin in the handgun and firearm suicide analyses.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Handgun</th>
<th>Firearm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>0.102</td>
<td>0.024</td>
</tr>
<tr>
<td>Population density</td>
<td>0.082</td>
<td>0.002</td>
</tr>
<tr>
<td>Proportion of pop. MSA</td>
<td>0.041</td>
<td>0.143</td>
</tr>
<tr>
<td>Proportion Black</td>
<td>0.05</td>
<td>0.078</td>
</tr>
<tr>
<td>Proportion white</td>
<td>0.058</td>
<td>0.031</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.086</td>
<td>0.056</td>
</tr>
<tr>
<td>Poverty rate</td>
<td>0.054</td>
<td>0</td>
</tr>
<tr>
<td>Mean individual income</td>
<td>0.119</td>
<td>0.261</td>
</tr>
<tr>
<td>Educational attainment</td>
<td>0.059</td>
<td>0.113</td>
</tr>
<tr>
<td>Ethanol consumption</td>
<td>0.145</td>
<td>0.055</td>
</tr>
<tr>
<td>Ratio of FS:S</td>
<td>0.022</td>
<td>0.142</td>
</tr>
<tr>
<td>2014 demeaned HSR</td>
<td>0.182</td>
<td>-</td>
</tr>
<tr>
<td>2014 demeaned FSR</td>
<td>0.094</td>
<td></td>
</tr>
</tbody>
</table>

Note: Firearm suicide and overall suicide are abbreviated as FS and S, respectively. Handgun suicide rate is abbreviated as HSR. Firearm suicide rate is abbreviated as FSR.
**Supplemental Table 3.** Estimated treatment effects and placebo test results for handgun and firearm suicide analyses.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>MSPE</th>
<th>Donor States</th>
<th>Donor Weights</th>
<th>Treatment Effect per 100,000</th>
<th>Percentage Change</th>
<th>Post-/Pre-MSPE Placebo test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handgun suicide</td>
<td>0.040</td>
<td>Illinois</td>
<td>0.210</td>
<td>1.14</td>
<td>30.3%</td>
<td>1/5 p = 0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iowa</td>
<td>0.243</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minnesota</td>
<td>0.546</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firearm suicide</td>
<td>0.073</td>
<td>Iowa</td>
<td>0.280</td>
<td>0.45</td>
<td>6.5%</td>
<td>3/8 p = 0.375</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minnesota</td>
<td>0.488</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rhode Island</td>
<td>0.232</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: The percentage change corresponds to the difference between untransformed rates of Wisconsin and its synthetic control in the post-intervention period. The placebo results represent the probability of obtaining a post-/pre-repeal MSPE ratio at least as extreme as that of Wisconsin upon random assignment. All tests were restricted to the subset of donor states with pre-repeal MSPEs less than 5 times that of Wisconsin.
## Supplemental Table 4

Weights of donor states comprising the original Synthetic Wisconsin for demeaned handgun suicide rates and each “leave-one-out” synthetic control.

<table>
<thead>
<tr>
<th>Donor State</th>
<th>Original</th>
<th>Synth 1</th>
<th>Synth 2</th>
<th>Synth 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>0</td>
<td>0.222</td>
<td>0</td>
<td>0.026</td>
</tr>
<tr>
<td>Illinois</td>
<td>0.210</td>
<td>-</td>
<td>0.218</td>
<td>0.276</td>
</tr>
<tr>
<td>Iowa</td>
<td>0.243</td>
<td>0.230</td>
<td>-</td>
<td>0.698</td>
</tr>
<tr>
<td>Minnesota</td>
<td>0.546</td>
<td>0.548</td>
<td>0.782</td>
<td>-</td>
</tr>
</tbody>
</table>

| MSPE        | 0.040    | 0.042   | 0.044   | 0.058   |

| Effect      | 1.14     | 1.15    | 1.17    | 1.19    |
**SUPPLEMENTAL MATERIAL**

**Supplemental Table 5.** Weights of donor states comprising the original Synthetic Wisconsin for demeaned firearm suicide rates and each “leave-one-out” synthetic control.

<table>
<thead>
<tr>
<th>Donor State</th>
<th>Original</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>S6</th>
<th>S7</th>
<th>S8</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.129</td>
</tr>
<tr>
<td>Hawaii</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.127</td>
<td>0</td>
<td>0.001</td>
</tr>
<tr>
<td>Illinois</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0.058</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.030</td>
</tr>
<tr>
<td>Iowa</td>
<td>0.280</td>
<td>0.280</td>
<td>0.280</td>
<td>-</td>
<td>0.280</td>
<td>0.586</td>
<td>0.280</td>
<td>0.227</td>
<td></td>
</tr>
<tr>
<td>Maryland</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Minnesota</td>
<td>0.488</td>
<td>0.488</td>
<td>0.488</td>
<td>0.488</td>
<td>0.721</td>
<td>0.488</td>
<td>-</td>
<td>0.488</td>
<td>0.613</td>
</tr>
<tr>
<td>New Jersey</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>0.232</td>
<td>0.232</td>
<td>0.232</td>
<td>0.232</td>
<td>0.221</td>
<td>0.232</td>
<td>0.288</td>
<td>0.232</td>
<td>-</td>
</tr>
<tr>
<td>MSPE</td>
<td>0.073</td>
<td>0.073</td>
<td>0.073</td>
<td>0.073</td>
<td>0.089</td>
<td>0.073</td>
<td>0.106</td>
<td>0.073</td>
<td>0.101</td>
</tr>
<tr>
<td>Effect</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.65</td>
<td>0.45</td>
<td>0.36</td>
<td>0.45</td>
<td>0.55</td>
</tr>
</tbody>
</table>
**SUPPLEMENTAL MATERIAL**

**Supplemental Table 6.** Mean pre-intervention (1999-2014) characteristics of Wisconsin, its augmented synthetic control, and the donor pool used to construct counterfactual handgun and firearm suicide trends.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Wisconsin</th>
<th>Synthetic WI</th>
<th>Sample Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Handgun Suicide Analysis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>5,575,741</td>
<td>5,990,227</td>
<td>14,264,826</td>
</tr>
<tr>
<td>Population density</td>
<td>102.953</td>
<td>89.034</td>
<td>144.857</td>
</tr>
<tr>
<td>Proportion of pop. MSA</td>
<td>0.716</td>
<td>0.754</td>
<td>0.780</td>
</tr>
<tr>
<td>Proportion Black</td>
<td>0.066</td>
<td>0.068</td>
<td>0.078</td>
</tr>
<tr>
<td>Proportion white</td>
<td>0.900</td>
<td>0.880</td>
<td>0.851</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>5.624</td>
<td>5.198</td>
<td>5.951</td>
</tr>
<tr>
<td>Poverty rate</td>
<td>10.469</td>
<td>9.114</td>
<td>11.191</td>
</tr>
<tr>
<td>Mean individual income</td>
<td>36,407</td>
<td>39,991</td>
<td>38,989</td>
</tr>
<tr>
<td>Educational attainment</td>
<td>89,088</td>
<td>91,122</td>
<td>87,303</td>
</tr>
<tr>
<td>Ethanol consumption</td>
<td>2.375</td>
<td>2.016</td>
<td>1.879</td>
</tr>
<tr>
<td>Ratio of FS:S</td>
<td>0.479</td>
<td>0.468</td>
<td>0.444</td>
</tr>
</tbody>
</table>

| **Firearm Suicide Analysis**    |           |              |             |
| Population                      | 5,575,741 | 3,923,836    | 9,216,740   |
| Population density              | 102.953   | 238.278      | 445.721     |
| Proportion of pop. MSA          | 0.716     | 0.756        | 0.848       |
| Proportion Black                | 0.066     | 0.032        | 0.108       |
| Proportion white                | 0.900     | 0.919        | 0.750       |
| Unemployment rate               | 5.624     | 5.388        | 5.864       |
| Poverty rate                    | 10.469    | 9.520        | 10.578      |
| Mean individual income          | 36,407    | 38,551       | 40,724      |
| Educational attainment          | 89,088    | 89,712       | 87,065      |
| Ethanol consumption             | 2.375     | 2.039        | 1.899       |
| Ratio of FS:S                   | 0.479     | 0.428        | 0.375       |

Note: Firearm suicide and overall suicide are abbreviated as FS and S, respectively. Handgun suicide is abbreviated as HS.
SUPPLEMENTAL MATERIAL

Supplemental Figure 1. Observed and synthetic handgun suicide (top) and firearm suicide (bottom) trends in an in-time placebo test artificially backdating the waiting period repeal to 2010.

![Graph of observed and synthetic handgun suicide trends](image1)

![Graph of observed and synthetic firearm suicide trends](image2)
SUPPLEMENTAL MATERIAL

**Supplemental Figure 2.** Rates of suicides identified as involving handguns (ICD-10 code X72) in Minnesota and Wisconsin (1999-2019). Two-year moving average rates are represented by dashed lines.
SUPPLEMENTAL MATERIAL

Supplemental Figure 3. Donor weights for augmented synthetic controls of handgun and firearm suicide trends in Wisconsin.

Note: * denotes donor states that were excluded from the handgun suicide analysis due to suppressed data.