Using the Synthetic Control Method to Determine the Effects of the Death Penalty on State-Level Murder Rates

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Justice Policy Journal • Volume 17, Number 2 (Fall 2020)

Abstract

The purpose of the present study is to determine the effects of capital punishment on state-level murder rates. Using data for the period 1990-2014 and a synthetic control method, results of the present study suggest that the repeal of the death penalty in New Jersey resulted in an increase in murder rates when compared to a synthetic version of New Jersey. These results are similar to the results found in other studies on the death penalty, particularly Gius (2016). The present study is significant because it is the first study that uses the synthetic control method to determine the effects of the death penalty on murder rates.

Introduction

Over the past twenty years, the number of executions carried out each year in the United States has declined precipitously. In 2000, there 223 executions; in 2019, there were only 22 executions (Death Penalty Information Center, 2020). Even though executions are exceedingly rare, many believe that the death penalty may be an effective deterrent against murder. In fact, numerous studies have found that the death penalty may reduce the murder rate (Gius, 2016; Zimmerman, 2009;

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Shepherd, 2004; Zimmerman, 2004; Dezhbakhsh et al., 2003; Mocan & Gittings, 2003; Ehrlich, 1975). It is important to note, however, that many other studies have found that the death penalty has no effect on the murder rate (Donohue & Wolfers, 2009; Kovandzic et al., 2009; Grogger, 1990; Bailey & Peterson, 1989; Passell, 1975).

In order to offer additional evidence regarding the potential effectiveness of capital punishment, the present study will use the synthetic control method to determine if states with death penalties have lower murder rates than states without death penalties. No prior study has used the synthetic control method to study this important topic. Most other studies used fixed effects in order to determine the effectiveness of the death penalty. The results of this study suggest that the repeal of the death penalty in New Jersey resulted in an increase in murder rates. This evidence indicates that, even though it is rarely used, the death penalty may serve as an effective deterrent against murder.

Literature Review

There have been numerous studies on the effects of the death penalty on murder rates. One of the earliest studies was Ehrlich (1975). Ehrlich used national-level data and found that, over a thirty-year period, every execution resulted in seven or eight fewer murders. In order to test the robustness of his results, numerous other researchers attempted to duplicate his findings. Most found that capital punishment had no statistically significant effects on murder (Layson, 1985; Passell & Taylor, 1975; Bowers & Pierce, 1975).

Recent research has moved away from the use of national data and instead, state or county-level data are used much more frequently. Much of the recent research has found that capital punishment deters murder (Gius, 2016; Zimmerman, 2004; 2009, Mocan & Gittings, 2003; Dezhbakhsh et al., 2003). Other researchers, however, found that the death penalty is not significantly related to murder (Kovandzic et al., 2009; Donohue & Wolfers, 2009; Berk, 2005; Katz et al., 2003; Passell, 1975).

Most of these prior studies used varying measures of capital punishment in their estimating equations. For example, Mocan and Gittings (2003) used the number of executions divided by the number of people sentenced to death in the previous six years, while Passell (1975) used the four-year average of executions divided by current convictions. The problem with many of these measures of capital punishment is that there is a tremendous amount of uncertainty regarding when a death row inmate will be executed. Given that the average wait between sentencing and execution is over ten years and given that a convicted murderer is rarely executed in the same year that they are sentenced, executions per death sentences is an unrealistic estimate of the probability that a condemned person will be executed in a given year.

To correct the deficiencies of these prior studies, the present study will differ from prior research in two important ways. First, a large and recent data set will be used; the present study's data is for the period 1990-2014. Second, the synthetic control method will be used to determine the effects of the death penalty on state-level murder rates. This estimating methodology has never been used to examine the effects of death penalties on murder rates.

Empirical Technique

In order to determine if the death penalty is related to murder rates, a synthetic control method (SCM) is used in the present study. The synthetic control method (SCM) examines how a treatment (death penalty) can affect a particular outcome (murder rates). In an SCM, there is one individual or entity (state) that receives the treatment (treated group) and several entities that do not receive the treatment (control group). The SCM synthesizes a control group from a weighted sum of potential control entities. The outcome variable for the treated group is then compared to the outcome variable for the synthesized control group. If the outcome measure diverges in the treatment period, then the treatment is assumed to have caused the difference. If the outcome measures for the treated group and synthesized control group do not diverge, then it can be assumed that the treatment did not affect the outcome. Finally, the synthesized control group's outcome measure should match the treated unit's outcome measure during the pretreatment period.

The advantages of using an SCM procedure over a fixed effects regression or a case study method are numerous. First, a weighted combination of control states provides a much better comparison to the treated state than a single control state (Abadie et al., 2010). Second, the relative contribution of each state in the synthetic control group can be ascertained (Abadie et al., 2010). Third, in an SCM procedure, it can be determined if there are differences with regards to the intervention variable and the other predictor variables between the treated state and the control group (Abadie et al., 2010). Due to these advantages, the SCM statistical procedure has been used in several studies examining the effects of public policies, laws, and exogenous shocks on various outcome measures (Kreif et al., 2016; Abadie et al., 2015; Abadie et al., 2010; Abadie & Gardeazabal, 2003)

For purposes of the present study, the “treatment” is when a state repeals its death penalty statute. There is only one state in the treatment group: New Jersey. The reason why New Jersey is the only state in the treatment group is because most states did not change their death penalty statutes during the period being examined. The few states that did repeal their death penalty statutes typically repealed them very late in the period being examined. In addition, although New York and New Mexico had repealed their death penalties during the period in question, they had missing observations and thus had to be excluded. Regarding the effective date of the repeal that will be used in the present study, New Jersey placed a moratorium on its death penalty in January of 2006, and then, in December of 2007, New Jersey formally repealed its death penalty statute. Hence, it is assumed that New Jersey changed its death penalty status in 2006.

One difference with the SCM analysis that is employed in the present study when compared to other studies that have used SCM is that the repeal of the death penalty is considered to be the treatment, and all states in the control group still have the death penalty. In most studies that use the SCM analysis, the passage of a law is the treatment, and all states in the control group do not have the law in question. This minor variation should have no effect on the validity of the results of the SCM analysis.

The outcome variable used in the present study is the murder rate (murders per 100,000 persons). The predictor variables used in this analysis were selected based upon their use in prior research (Gius, 2016; Zimmerman, 2009). These variables include the percentage of the state population that is Black, per capita real income, the percentage of the population that is college educated, unemployment rate, the percentages of the population aged 18 to 24 and 25 to 34, population density, per capita alcohol consumption, the ratio of gun-related suicides to total suicides, the percentage of the state’s population that lives in large cities, and an interaction variable between percent African-American and the death penalty dummy variable. The statistical software package R was used to conduct the SCM analysis (Abadie et al. 2011).

State-level data on murder rates were obtained from the *Supplementary Homicide Reports* (1990-2014), which were provided by the Bureau of Justice Statistics, U.S. Department of Justice. State-level data on total suicides and firearm-related suicides were obtained from the National Center for Injury Prevention and Control, the Centers for Disease Control (CDC). Per capita alcohol consumption data were obtained from the National Institute on Alcohol Abuse and Alcoholism. All other state-level data were obtained from relevant Census Bureau reports. Data used in the present study is for the years 1990-2014. Descriptive statistics are presented on Table 1.

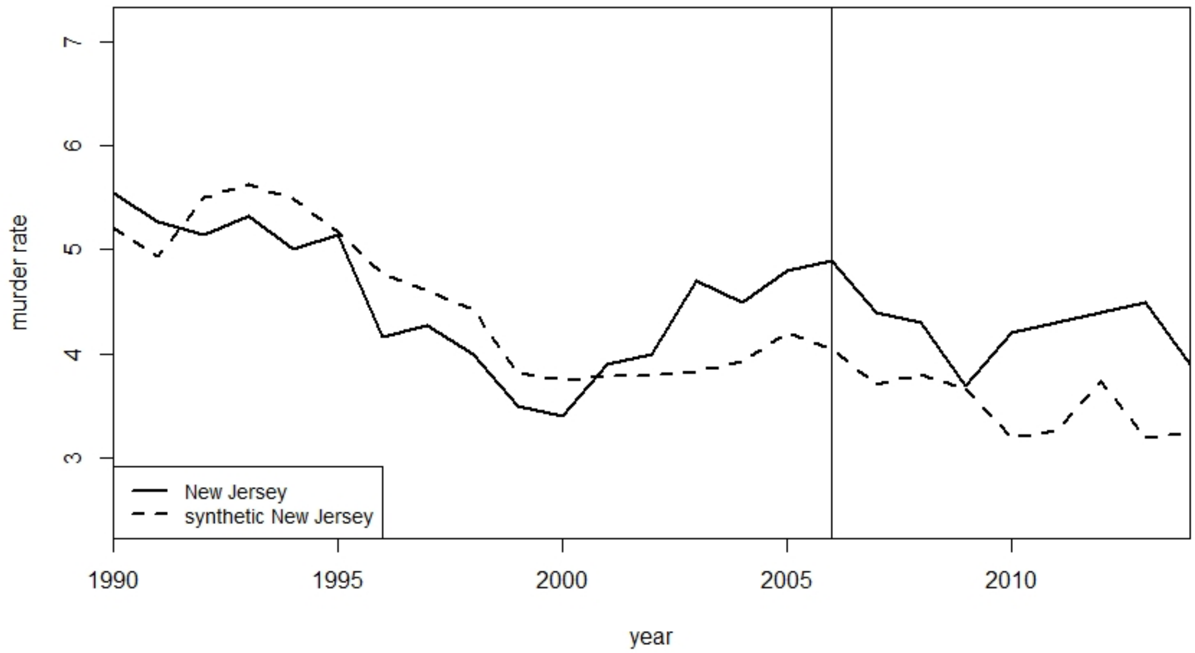
Table 1. Descriptive Statistics

Variable	Mean	Standard Deviation
Murder Rate	5.13	2.93
Percent Black	0.99	0.095
Per Capita Income	$30,655	$9,614
Percent College Educated	0.249	0.055
Unemployment Rate	0.057	0.019
Percent Aged 18 to 24	0.099	0.0098
Percent Aged 25 to 34	0.14	0.108
Population Density	183	252
Per Capita Alcohol Consumption	2.33	0.49
Ratio of Firearm Suicides to Total Suicides	0.56	0.13
Percent Population in Large Cities	0.137	0.136

Results

As noted previously, New Jersey was the only state in the treatment group. Given that states with missing observations had to be excluded from the analysis, only twenty-three states were in the potential control group. However, the SCM analysis found that the following three states should be in the final control group: Colorado (15.1%), South Carolina (30.3%), and Wyoming (54.5%). Numbers in parentheses are the weights given to the respective states (see Figure 1).

Figure 1. New Jersey SCM Results: Repeal of the Death Penalty Significantly Increased Murder Rate



Note: Vertical line denotes year death penalty was repealed.

An important aspect of the SCM analysis is that the outcome variable for the treated state should be similar to the outcome variable for the synthetic version of the treated state in the pre-treatment period. In order to test for the similarity in the outcome measure for the treated state and the synthetic state, two statistical tests were used. The first test used was the Mean Squared Prediction Error (MSPE) in the pre-treatment period. The larger the MSPE, the greater is the difference between the two outcomes. In the present study, the MSPE was 0.1328. Unfortunately, the MSPE is affected by the units of measurement and the scale of the outcome measure; hence, the relative significance of the MSPE is ambiguous.

The other statistical test that was used was a hypothesis test for the difference between the means of the actual outcome measure and the synthetic outcome measure. In the pre-treatment period, this test should be statistically insignificant, thus indicating that there is no statistical difference between the actual outcome measure and the synthetic outcome measure. In the present study, the pre-treatment test statistic was -0.05, which is statistically insignificant, thus indicating that the actual outcome does not measure differ from the synthetic outcome measure.

To determine if the repeal of the death penalty significantly affected murder rates in the post-treatment period, a hypothesis test for the difference between the means of the actual outcome measure and the synthetic outcome measure was used. In the post-treatment period, if the law had a significant effect on the murder rates, then the t test should be statistically significant. The post-treatment test statistic was 4.75, which suggests that the repeal of the death penalty in New Jersey resulted in an increase in the murder rate when compared to the synthetic version of New Jersey. The SCM analysis is presented in Figure 1. The vertical line on the chart denotes the year when the death penalty was repealed.

In order to test the robustness of the synthetic control model in this scenario, two placebo tests were conducted (Abadie et al., 2011). In the first test, the SCM is applied to a control state which is similar to the treated state but which did not repeal its death penalty. Results indicate that the outcome trajectories for New Jersey and its synthetic counterpart are similar. These results are available upon request.

Another method that was used to test the robustness of the SCM results was a permutation test (Abadie et al., 2011). In this test, the control states are subjected to the same synthetic control method as was the treated state. Then, the gaps between the synthetic outcomes and the actual outcomes for the control states and the treated state are plotted in order to determine if the synthetic control unit is different from the other control units. Ideally, there should be small gaps prior to the treatment and large gaps afterwards. Results suggest that the outcome measures track similarly pre-treatment, but after 2005, there is much more of a divergence. This indicates that the change in murder rates cannot be attributed to the repeal of the death penalty in the synthetic control states (Abadie et al., 2011). These results are also available upon request.

Conclusions

The purpose of the present study was to ascertain the effects of the death penalty on state-level murder rates. Although the death penalty has rarely been used over the past twenty years, recent studies have found that the death penalty may deter crime (Gius, 2016; Zimmerman, 2009; Zimmerman, 2004; Mocan & Gittings, 2003; Dezhbakhsh et al., 2003). To confirm these findings, the present study used a synthetic control method and examined the impact of the repeal of the death penalty in New Jersey on murder rates. The results of the present study suggest that the repeal of the death penalty in New Jersey resulted in an increase in the murder rate. These findings corroborate the results found in other studies on the death penalty, particularly Gius (2016) and Zimmerman (2009).

The results of the present study are significant and noteworthy because this is the first study that uses a synthetic control method in order to determine if capital punishment is statistically related to murder rates. Even though the number of executions carried out each year may be relatively small when compared to the total number of murders committed, the very existence of the death penalty may be a significant deterrent for would-be murderers. Future research should examine other states that have repealed death penalties, and larger data sets should be used in order to capture additional post-repeal years.

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