The Impact of Universal Firearm Background Checks on Crime Rates And Death Rates

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Abstract

The purpose of this research project was to analyze the impact of closing the private sales loophole created by the Brady Handgun Prevention Act on crime rates and death rates. Five states have adopted a universal firearm background check regulation, which closes the private sales loophole, between the years of 2010 and 2014. A two stage least squares (2SLS) fixed effects analytical approach was then chosen in order to capture the impact of the gun law on 14 types of crime and death rates determined by the Uniform Crime Report and Center for Disease Control and Prevention. The two instrumental variables (IVs) chosen for the 2SLS models were the percentage of the population who participated in the Vietnam War and a binary variable representing the occurrence of a mass shooting. The Weak Instrument test and the Wu-Hausman test for endogeneity concluded that the 2SLS approach was inappropriate for this analysis with the two chosen IVs, therefore the fixed effects model results were emphasized. Adoption of universal firearm background check regulations were associated with statistically significant reductions in general violent crime, murder, robbery, firearm homicide, and homicide rates. The gun law had no impact on property crimes and suicide rates. These results may be explained because of the limited amount of property crime events that occur with firearms and the lack of dedication in determining mental illness status. This project demonstrates the potential benefits for a state that adopts the background check regulation and the improvements needed in order to maximize the reduction in crime and death rates.

Introduction

With the frequency of indiscriminate public mass shootings on the rise, the topic of gun control has become at the center of the U.S. political debate (Cohen et al., 2014). Many gun control advocates argue that universal firearm background checks are needed in order to deter crime and death rates. The concept of universal firearm background checks derives from the Brady Handgun Prevention Act of 1994, which requires background checks for all firearm exchanges conducted with licensed firearm dealers but excludes background checks for all other firearm transfers (Pub.L. 103–159, 107 Stat. 1536). The exclusion of background checks on private firearm transfers has become widely known as the "gun show loophole", because of the vast amount of transfers from unlicensed sellers that occur at gun shows ("Universal Background Checks", 2017). It would be more accurate to call the exclusion of background checks on private firearm transfers the "private sales loophole" because it excludes all firearm transfers that occur from a personal collection.

The goal of private sale background checks is to reduce the number of firearms issued to unqualified persons. In 2012, there were over 6 million gun transfers that occurred without background checks (Webster, 2013), meaning that there are potentially people with serious mental illnesses and criminal records who have access to guns through the secondary market. A universal background check regulation can close an estimated 40% of firearm transactions that occur without background checks (Ludwig and Cook, 1997). Failure to close the private sales loophole allows irresponsible individuals to obtain firearms through private sellers (U.S. Dep't of Justice, 2010). Studies analyzing the effectiveness of reducing guns to the general public are inconclusive but restricting firearms to unqualified people have been associated with reductions

in crime. The impact of closing the private sales loophole on crime and death rates is still unknown. The purpose of this study is to examine how the extension of the Brady Act to include private firearm sales is associated with changes in crime and death rates.

Literature Review

The Brady Act of 1994 implemented "a waiting period before the purchase of a handgun, and for the establishment of a national instant criminal background check system to be contacted by firearms dealers before the transfer of any firearm" (Pub.L. 103–159, 107 Stat. 1536). The key term in this definition is "firearms dealers", which is defined as a manufacturer with "the principal objective of livelihood and profit through the sale or distribution of the firearms" (18 USC 921). A gun show is an event where individuals and organizations rent out private venues to display and sell firearms (Carter, 2012). Not all people who participate in gun shows specialize in selling firearms. These people are not considered licensed dealers and are excused from conducting background checks. The exclusion of background checks for firearm transfers is not limited to just gun shows, but extends to any firearm transfer conducted with an unlicensed dealer. This exclusion is more accurately referred to as a "private sales loophole".

According to Giffords Law Center, there are two methods to implement universal background checks and close the private sales loophole. The first is to require background checks at the point of transfer. This method would require individuals to conduct firearm transfers through licensed dealers or law enforcement agencies ("Universal Background Checks", 2017). The second method is to require permits for private firearm transfers, where a background check is required before obtaining the permit ("Universal Background Checks", 2017). While the permit method indirectly closes the private sales loophole, it possesses a major

flaw. A person could obtain a permit, later become unqualified to possess a firearm, but still obtain a firearm because the permit is not updated ("Universal Background Checks", 2017). Requiring background checks at the point of transfer directly and more effectively closes the private sales loophole. Background checks are one of the few forms of gun control that have shown promise in reducing crime and death rates.

Only two approaches to reducing firearm related violence have sufficient scientific evidence behind them: uniformed police patrols and background checks (Sherman, 2001). Sherman points to a study by Wright et al. (1999) comparing future crime rates of convicted felons to future crime rates of people who were charged of a crime but not convicted of the felony in California. The felons, who were prohibited from buying guns, were less likely to be charged with a gun offense in the future compared to those who were not convicted of felonies. Another study by McDowall et al. (1995) found that homicide rates in Florida dropped after the implementation of waiting periods and background checks for handgun purchases. Many people argue that guns are a means of protection and increasing access to guns will deter crime. There however was no evidence that increases in the number of people with Right-to-Carry permits in Florida were associated with significant reductions in crime (Kovandzic and Marvell, 2003). These studies show promise that background check regulations can influence crime rates, although these results do not have external validity that can be applied to all states because they are only comparing crimes in a limited amount of cities.

Lott and Mustard (1997) provide a study the can be generalized to all states by conducting a county level cross sectional time series analysis. Data from 1977 to 1992 was used in order to determine the influence of Right-to-Carry (RTC) regulations on crimes rates. A state

that adopts a RTC law, which is also referred to as a shall-issue state, requires authorities to grant concealed handgun permits for all individuals who meet the requirements to own a firearm. This is compared to may-issue states where concealed handgun permits are granted at the authorities discretion even when the individual in question passes all requirements set by state law.

This study uses county-level data from the Uniform Crime Report (UCR) and County demographic data provided from the Census Bureau, which had information on population, race, and age. Economic data was also incorporated into the study to account for unemployment and income distribution. Previous research has associated these factors as determinants of crime and death rates. There were 4750 excess suicides during the time range of the Great Recession from 2007 to 2010 that were directly linked due to increasing unemployment rates (Reeves et al., 2014). Both unemployment rates and poverty rates are positively correlated with increases in violent and property crimes (Rafael and Winter-Ebmer, 1999). Higher education and income levels have been shown to lower criminal activity (Lochner and Moretti, 2001). Socioeconomic gaps between age, gender, and race exist in the United States that can lead certain demographic groups, notably young minority males, with a higher likelihood of committing crimes of various forms (Hagan, 1995). Caucasians and Hispanics experience lower firearm deaths rates than the national average while African-Americans experience significantly higher firearm deaths rates (Kalesan et al., 2014). It is therefore important to include these variables in a model predicting crime and death rates.

A two stage least squares regression was conducted using the variables previously mentioned to predict the change in crime rates associated with RTC laws. NRA membership as a percentage of a state's population and percentages of votes for the republican presidential

candidate were used as IVs for the RTC law variable. The results show that counties with RTC laws had lower rates of murder, rape, and aggravated assault compared to those counties that did not adopt the law. Counties with the RTC laws also experienced higher auto theft and larceny rates. The most significant influence in violent and property crime rates were associated with increases in arrest rates, which is consistent with Levitt's (2004) findings when determining major factors that explained the fall in crime during 1990s. Black males between the ages of 20 and 39 years had a large influence on violent crimes. States adopting the RTC laws were republican with high NRA members and rising crime rates. The study also shows that population density has a large influence on robbery, burglary, and auto theft.

Lott and Mustard conducted a thorough study in determining the influence of the RTC gun regulation on violent and property crimes. Many studies that analyze the effectiveness of gun control reference this study as a basis for selecting control variables. Lott and Mustard claimed that increasing gun ownership is associated with reductions in crime. The results, however, have been disputed because crime rates were already declining before the adoption of the RTC laws (Duggan, 2001). Criticism regarding the use of unsuitable instrumental variables determined the analysis biased (Ludwig, 1998) and the research results compromised (Kovandzic, 2003). Lott and Mustard therefore cannot attribute the reduction in crime rates solely to the RTC laws.

An analysis using state-level data is deemed unsuitable because of the heterogeneity that exists between state counties when implementing the RTC laws. It may be true that states can be heterogeneous when it comes to granting concealed handgun permits. However, regulations such as universal firearm background checks may not suffer from this heterogeneity due to the ease of

conducting a background check through the national instant criminal background check system. It only takes a few minutes to get the eligibility results through the background check system (Jones, 2013).

The results showing that RTC laws lower crime rates do not contradict the statement that universal background checks may also lower crime rates. The positive effect of well-behaved citizens acquiring guns may cancel out the negative effect of criminals acquiring guns (Moody and Marvell, 2005). RTC laws are meant to change general gun ownership levels of a population and universal firearm background checks specifically weed out unqualified persons from acquiring guns. A combination of these two gun regulations can have potential to further reduce crime rates. This study, however, failed to utilize death data provided by the Center for Disease Control and Prevention (CDC).

Ludwig and Cook (2000) performed a state-level time series analysis to measure the changes in suicide, firearm suicide, homicide, and firearm homicide rates resulting from the implementation of the Brady Act. The study incorporated the CDC WISQARS data from 1985 to 1997. A difference-in-difference regression was conducted including state fixed effects, year indicator variables, and other covariates used in the Mustard and Lott (1997) study. Checks for heteroskedasticity and autocorrelation were also made. The results show that firearm suicide rates for people 55 years of age or older were the only demographic that experienced a statistically significant reduction in death rates after the implementation of the Brady Act. The reduction in suicide rates associated with firearm background checks were replicated from other similar studies such as Anestis (2015).

Ludwig and Cook explain that the results may be insignificant because the Brady Act did not apply to the 40% of all firearm transfers that were conducted through the secondary market (Ludwig and Cook, 1997). A significant reduction in crime and death rates would rely on regulations that impact the whole firearm market. The limitation of this study derives from analyzing a law that only applies to a proportion of gun transfers.

Sen and Panjamapirom (2012) improved the Ludwig and Cook study by focusing on extensions of firearm background checks in the primary market. The study gathered state-level cross-sectional time series data from 1996 to 2005. The Brady Act requires all federally licensed dealers to conduct background checks for criminal history but individual states are free to adopt further requirements in order to pass the background check. These extensions include restraining orders, mental illness, fugitive status, and misdemeanor records. This study analyzed how the adoption of more restrictive background check requirements impacted firearm related homicide and suicide deaths.

Sen and Panjamapirom conducted a negative binomial regression for this analysis and included lagged death rates as independent variables in order to account for autocorrelation. The results showed that increases in the number of background check requirements were associated with fewer firearm related homicide and suicide deaths. Checking for restraining orders and fugitive status were associated with fewer firearm homicide deaths compared to states that only completed criminal history checks. Firearm suicide deaths were lower in states that checked for mental illness and fugitive status. States that adopted the background checks before the adoption of the Brady Act experienced lower firearm homicide and suicide deaths. A similar study by

Kalesan et al. (2016) using a Poisson regression, which strictly assumes that the mean of the dependent variables are equal to their variance (Wooldridge, 2008), concluded similar results.

This study gives evidence that background check policies can influence crime and death rates. A negative binomial regression works best when there is overdispersion in the outcome variable, meaning that the variance exceeds the mean (Wooldridge, 2008). This study, however, does not mention any details regarding the distribution of the dependent variables. Furthermore, there was no basis for why they chose to conduct a state-level cross-sectional analysis as opposed to choosing another unit of analysis. The lack of details regarding their analytical approach may compromise the results of this study.

Kleck, Kovandzic, and Bellows (2016) provided more of an explanation for using cross-sectional data. They conducted a 1990 city-level cross sectional analysis to examine the impact of gun control on violent crimes. The absence of yearly attainable gun ownership measures and macro-level determinants of crimes were the primary reasons for not using panel data. This study insisted that city-level data was best suited for their analysis because of uninterpretable aggregated county crime rates and the heterogeneity that exists within states. The study conducted an instrumental variable regression with the percentage of votes for the republican candidate in the 1992 presidential election and the 1990 Vietnam veteran rate per 100,000 persons as the instrumental variables for gun levels. The main variables of interest were the 19 firearm regulations that were in existence at the state and city level in 1989. The county level percentage of suicides that were committed with guns (PSG) was used as a proxy for gun ownership levels in order to isolate the influence of the gun law.

The first stage regression predicted gun levels with the gun control laws as the main independent variables. The regression results showed that of the 19 gun laws in question, seven had negative associations on gun levels and four had positive associations on gun levels. The second stage regression predicted violent crimes as a function of the gun law variables. The two most influential gun laws on homicide rates were state laws that forbade the purchase of guns to persons under the influence of alcohol and laws requiring a license to possess a gun at home. Gun licenses and permits require background checks for criminal history as well as alcohol related issues. Another similar study by Kovandzic et al. (2005) concluded that guns among convicted criminals were associated with increases in homicide rates. The results from these studies provided evidence that background checks for all firearm transfers may have a significant influence in reducing violent crime rates.

The authors argued that panel data is not suitable for a gun control analysis because of the absence of yearly attainable gun ownership measures and macro-level determinants of crimes. They insisted that there is no correlation over time between the percentage of suicides that were committed with guns (PSG) and surveys of gun measurements. This contradicts the findings of Ludwig and Cook (2003) with the justification that the correlation was due to cross-area covariation not correlated over time. Another study has determined that the magazine subscriptions per capita for *Guns and Ammo* (Duggan, 2001) is a suitable measure for gun ownership. If the implications of this study are correct that a gun level measure is needed for an analysis on gun control, a panel data analysis will have to ignore the variable, use PSG, or use the magazine subscription measure.

Macro-level determinants of crimes are also available for a panel data analysis. The American Community Survey and the U.S. population estimates contain information on race, age, poverty, income, and educational achievement. Most of these variables are available on a continuous yearly basis.

Past studies have shown that gun control has failed to reduce violent crime rates (Mustard and Lott, 1997) and firearm related death rates (Ludwig and Cook, 2001). However, other studies have shown that background checks can effectively lower violent crime rates (Kleck et. al., 2016) and firearm related death rates (Sen and Panjamapirom, 2012). None of these studies have analyzed the relationship between extending the Brady Act to include private firearm transfers. My study will focus on filling this gap by analyzing the effectiveness of extending the Brady Act and adopting universal firearm background check regulations.

Hypotheses

There is a clear research gap in determining the effectiveness of gun control on crime rates and death rates. This gap derives from the lack of studies that have analyzed gun regulations that limit the accessibility of guns in both the primary and secondary firearm markets, where the latter includes all firearm transfers conducted with unlicensed dealers. Individual states have taken the initiative to extend the Brady Act to include all firearm transfers in an effort to reduce crime and death rates. The consequences of adopting the background check laws have gone unchecked under economic analyses techniques; therefore any reductions in crime and death rates cannot be attributed to the firearm regulation. Considering these limitations, this research study will attempt to provide insight to the following hypothesis:

States that implement the universal firearm background check regulation will experience decreases in crime and death rates due to the law.

Implementing the gun law should have some impact on crime and death rates, which should reflect the intentions of the politicians advocating for the law. Crime and death rates should significantly decrease after being exposed to the new regulation. Determining this relationship can help prevent deaths and aid in responsible government spending. There also exists the issue as to why individual states adopt the law in the first place. This study will also attempt to answer the following question:

What are the main contributing factors that lead a state to implement the universal firearm background check regulation?

Finding the specific state qualities that most influence the adoption of the gun law can potentially assist policy makers at the federal or state level in determining the popularity of a proposed firearm regulation.

Data

This study analyzes the influence of universal firearm background checks on crime and death rates. The units of analysis are the states that make up the United States as well as the District of Columbia. The Giffords Law Center to Prevent Gun Violence website provided information regarding state-specific gun regulations along with their corresponding adoption dates, which were verified through a LexisNexis academic search. The twelve states that adopted a universal firearm background check regulation along with their respective adoption dates can be seen in Table 1. According to Giffords Law Center to Prevent Gun Violence, D.C. is practicing the gun law but the specific date cannot be determined. A geographical visual of the

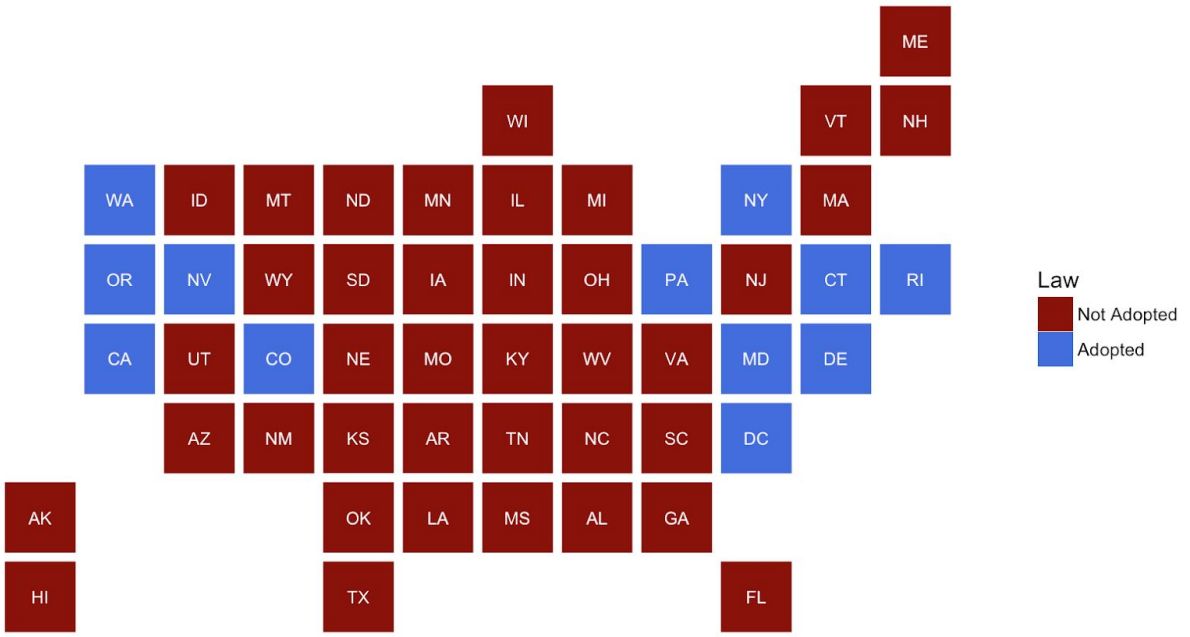
states that adopted the gun law on or before 2017 is shown in Figure 1. These states seem to be located on the east and west coats. Four states implemented universal firearm background checks in 2013. For this reason, state-level data for the years 2010 to 2014 is used in order to capture changes in crime and death rates associated with the implementations. This study lacks one notable factor, information on other state specific regulations were not obtained due to the lack of accessibility to receive reliable adoption dates for the laws.

Table 1: States that adopted the universial firearm background check regulation

State	Year Adopted
Nevada	2017
Oregon	2015
Washington	2014
Colorado	2013
Connecticut	2013
Delaware	2013
New York	2013
Pennsylvania	1998
Maryland	1996
California	1990
Rhode Island	1990
District of Columbia	NA

Figure 1

Universal firearm background check law map



This study retrieved data from the Uniform Crime Report (UCR), the Web-based Injury Statistics Query and Reporting System (WISQARS), American Community Survey (ACS), and the U.S. Population Estimates. These datasets are utilized because they are reliable sources of data compiled by the U.S. government that contain information commonly used to analyze gun control. An additional dataset that contains information on public mass shootings was obtained from the Mother Jones website. This dataset includes seemingly indiscriminate events where greater than two individuals were killed and excludes events associated with common criminal activity. All five datasets provide continuous yearly data from 2010 to 2014.

The FBI compiles the Uniform Crime Report by collecting crime reports submitted by law enforcement agencies on a monthly basis ("Uniform Crime Reporting Handbook"). This report contains violent crimes composed of four offenses: murder and nonnegligent manslaughter, rape, robbery, and aggravated assault. Property crimes composed of an additional four offenses are also reported, which are: burglary, larceny-theft, motor vehicle theft, and arson. All previously mentioned crimes are reported in rates per 100,000 persons.

The WISQARS is an online database provided by the Center for Disease Control and Prevention, which is collected through death certificate information filed in state vital-statistics offices ("WISQAR Help Menu"). Homicide and suicide death rates per 100,000 persons are contained in the WISQARS dataset. The CDC dataset is distinct from the UCR dataset in that the former specifies homicide and suicide rates committed with firearms. Homicide rates reported by the CDC also include justifiable homicides while murder rates reported by the UCR do not. The data obtained from the CDC contains missing values because it suppresses all data counts with fewer than ten occurrences in order to keep confidentiality.

The U.S. Census Bureau produces the American Community Survey by mailing questionnaires to a random sample of addresses that adequately represents the population of the United States ("ACS Information Guide"). The ACS provided yearly estimates on topics including the population, the economy, and education. The social explorer website provided the population of different race categories with information obtained from the decennial census. These two datasets provide the percentages of the population who hold status in the following: veteran, unemployment, poverty, high school dropout, Hispanic, and African-American. Additional information regarding population density per square mile and per capita income was

also obtained. Together, these two datasets provide valuable information that controls for the differences in state characteristics.

Theory of Two Stage Least Squares (2SLS)

This study will incorporate a 2SLS analysis in order to capture the relationship between universal firearm background checks, crime rates, and deaths rates. All details on the theory of 2SLS were retrieved from the Wooldridge (2008) textbook. There are two potential issues with a standard OLS analysis that can make the estimates inconsistent: omitted variable bias and reverse causality. The former exists when variables in the regression are correlated with the error term and the latter occurs when the cause and effect relationship between variables cannot be determined. In the case of this study, the estimates of the independent variables (gun law, population, race, etc.) may be compromised if there are other variables that affect crime but are not included in the regression models. Furthermore, the extent to which how much crime plays a role in adopting the universal firearm background check law may be a problem. Rising crime can be a determining factor as to why states adopt the law. The OLS estimates are biased and inconsistent when the model suffers from OVB or reverse causality, which indicates that OLS may not be the most suitable method for reliable estimates. A 2SLS approach can produce consistent estimates assuming that the appropriate IVs are utilized.

Instrumental variables are often referred to as excluded and included instruments, where the former refers to the instruments excluded from the main regression model used for the control variables and the latter refers to the included control variables. Details on this process will be discussed later. There are two criteria that make an excluded IV appropriate for the included IV. The first criterion is called instrument exogeneity; the excluded IV must be

uncorrelated with the error term. Less formally, this means that the proposed excluded IV must have no influence in determining the dependent variable. One must make an assumption that is based on theoretical grounds to meet this requirement because it cannot be formally tested. The second criterion is called relevance; the excluded IV must be correlated with the included IV. Less formally, this means that the proposed excluded IV must have a significant impact in predicting the included IV. There are many tests that can determine the appropriateness of an IV that will be discussed later.

A 2SLS analysis can be completed once the appropriate IVs are determined that meet the instrument exogeneity and relevance requirements. As the name suggests, there are two steps in completing a two stage least squares analysis. The first-stage conducts an OLS regression predicting the main included IV of interest as a function of the excluded IV along with the other covariates. The second-stage then predicts the main dependent variable as a function of the predicted values obtained from the first stage regression. The 2SLS estimator is consistent because it "can be written in terms of population moments that can be estimated using a sample data (Wooldridge, 2008)." The equations for both stages are shown below where Y_i is the main dependent variable (crime and death rates), X_i is the included IV (gun law), Z_1 is the excluded IV, $Q_{1i}, ..., Q_{Ki}$ are the covariates, and u_i and e_i are the disturbance terms:

$$\text{First Stage: } X_i = \pi_0 + \pi_1 Z_1 + \delta_1 Q_{1i} + ... + \delta_K Q_{Ki} + e_i$$

$$\text{Second Stage: } Y_i = \beta_0 + \beta_1 \widehat{X}_i + \lambda_1 Q_{1i} + ... + \lambda_K Q_{Ki} + u_i$$

A critical concern when using 2SLS is to avoid using a weak instrument where the included IV and the excluded IV share a low correlation. 2SLS estimates have higher standard errors than regular OLS estimates. This is due to the R-squared between the included IV and the

excluded IV being included in the IV standard error formula. The IV and OLS standard error formulas for a covariate, $\widehat{\beta}_1$, are shown below. Where $\widehat{\sigma}^2$ is the estimator for the population variance, SST_x is the total sum of squares of x, and $R^2_{x,z}$ is the R-squared between x and z.

$$\text{IV: } \sqrt{\frac{\widehat{\sigma}^2}{SST_x \cdot R^2_{x,z}}} \quad \text{OLS: } \sqrt{\frac{\widehat{\sigma}^2}{SST_x}}$$

The IV standard errors are larger than the OLS standard errors because by definition, the R-squared is less than 1. The IV standard error can get incredibly high when there exists a low correlation between the included and excluded IVs. A high standard error may cause the IV confidence interval to include the OLS estimate, which would make the IV results useless. Furthermore, the probability limit of the IV estimates can be quite large when there exists a weak instrument, which would make the IV estimate highly bias. Stock and Watson (2007) propose to conduct an F-test to compare the sum of squared residuals for a model that includes the IV against a restricted model excluding the IV. Weak IVs result in F-tests lower than 10 in the case of multiple IVs and a t-stat smaller than the absolute value of 3.2 in the case of a single IV (Stock and Yogo, 2005).

One more notable feature of a 2SLS is that the R-squares are not interpretable and should not be compared to an OLS R-squared. By definition, the OLS R-squared will always be larger than the 2SLS R-squared because OLS minimizes the sum of squared residuals and picks the estimate where the independent variables appear least correlated with the errors. The R-squared only has meaning when the independent variables and the disturbance term are uncorrelated, which is not the case in a 2SLS regression. The goal of using 2SLS is not to provide the best R-squared but to provide the best estimates.

Wooldridge proposes to test for included IV endogeneity, instrument relevance, and overidentification. One way to test for endogeneity of the included IV is to conduct a Hausman test (Hausman, 1978). The Hausman test obtains the residuals from the first stage regression and includes them in the second stage regression. Endogeneity exists if the estimate for the residuals is statistically significantly different from zero. In the case of multiple instruments, the first stage regression is conducted for each proposed excluded IV to obtain the residuals then an F-test for joint significance is conducted. Instrumental relevance is tested by conducting an F-test comparing the the first stage model with and without the proposed instruments, where a low p-value signifies instrument relevance. Overidentification can be tested by checking if the 2SLS residuals are correlated with the instruments. This is done by running the 2SLS regression to obtain the error term then regressing the error term on all variables. Overidentification helps determine if at least one IV is appropriate. Additionally, Wooldridge proposes to adjust the standard errors of a fixed effects model for heteroskedasticity and serial correlation. This will ensure the most accurate significance power of the independent variables.

Analytical Approach

The most important and difficult process of conducting the 2SLS regression is determining suitable instrumental variables that meet the exogeneity and relevance requirements. The following two variables are used in this study as instrumental variables for the gun law regulation: Vietnam veterans and mass shootings. Sovey and Green (2010) classify seven categories for which the authors of numerous articles justify the use of their proposed IVs. This study can be classified in the theory, reference, and empirics categories. Empiric justifications for the proposed IVs are tested later.

A case can be made for using Vietnam veteran status as an IV for the implementation of a firearm background check regulation. Past studies, such as Kleck et al. (2016), used Vietnam veterans as an IV not for gun control but for gun ownership. A similar concept can be extended to justify the use of Vietnam veterans as an IV for gun control. The U.S. implemented a lottery draft for the Vietnam War, which essentially created a random variable ("Vietnam War Protests"). The veterans who fought in this war should have had no political, economical, or regional ties associated with them when entering the military. There is no reason to believe that being a veteran has a significant influence on crime rates, which meets the exogeneity requirement. As for relevance, there could exist a high correlation between being a veteran and the adoption of gun laws. Having veteran status has been shown to increase support for pro gun regulations (Langbein and Lotwis, 1986). A 1994 telephone survey concluded that 74 percent of veterans owned a gun in their lifetime and 50.5 percent of veterans owned a gun at the time of the survey (Ludwig and Cook, 1997). People who have guns in their households have a stronger opinion in protecting gun rights ("Continued Bipartisan Support for Expanded Background Checks on Gun Sales"). All of these studies suggest that veterans are more likely to own firearms and therefore oppose gun control policies. There should be a negative correlation between the adoption of a universal firearm background check regulation and Vietnam veteran populations.

Another case can be made for using mass shootings as an IV for the adoption of a firearm background check regulation. Although mass shooting deaths are counted in crime rates, there are no studies linking the occurrence of a public mass shooting as a determinant of crime rates. This may be sufficient enough to meet the exogeneity requirement. The demand for stricter gun control policies increases after the occurrence of a mass shooting, however, this demand falls

over time (Bradner and Agiesta, 2017). Nevertheless, the public uproar for gun control after a mass shooting has been shown to shift longer term blame to weak gun control laws (Haider-Markel and Mark, 2001). This blame promotes the implementation of firearm legislature (Rosenberg, 2014) because people are more inclined to advocate for stricter gun laws after a public mass shooting (Saad, 1999). Therefore, the relevance requirement should be met and a positive correlation between adopting the universal firearm background check regulation and mass shootings should exist.

The first-stage equation in this analysis, which includes the IVs, will predict the likelihood of a state adopting the universal background check law. The panel data structure will be utilized by including state fixed effect variables that represents all state specific factors. Year fixed effect dummy variables will also be included in order to account for factors that are associated with a single given year. Time varying state demographic and economic variables will be added as control variables. These variables include income, unemployment, education, poverty, race, and population measures. A fixed effect model captures all unobserved time invariant factors that affect the dependent variable, such as gender and age distributions. Political biases and other variables that stay relatively constant across states and time can be excluded from the regression model and avoid omitted variable bias.

In addition to the OLS estimate, a logistic regression will be conducted in order to account for the binary nature of the dependent law variable. As opposed to minimizing the sum of least squares, as in the case for an OLS regression, a logistic regression maximizes the likelihood of observing the event. This likelihood is kept between 0 and 1. The results from the

first stage model can help in determining what factors most influence the adoption of the gun law. In this case, i represents entities (states) and t represents time (years).

First Stage: $law_{it} = IV s_{it} + state\_characteristics_{it} + state\_fixed_i + year\_fixed_t + e_{it}$

The second-stage, which does not include the IVs, will then predict crime and death rates based on the predicted estimates determined from the first stage model. This model will address my main hypothesis determining how crime and death rates respond to the adoption of the universal firearm background check regulation. The estimate will now be consistent because the model uses the predicted values of the gun law variable as the main independent variable. As per convention from most other studies analyzing crime rates and death rates, the natural log of all 14 dependent variables will be used.

Second Stage: $crime_{it} = \widehat{law}_{it} + state\_characteristics_{it} + state\_fixed_i + year\_fixed_t + u_{it}$

Several tests will then be conducted in order to check for weak instruments, included IV endogeneity, and overidentification. Standard errors will also be adjusted for heteroskedasticity and serial correlation.

Limitations

There are many improvements that can be made to this study that could provide more beneficial results. The universal firearm background check regulation is the main variable of interest but information on other policies designed to reduce crime and death rates are not accounted for. This is due to the lack of accessibility to reliable adoption dates. Having access to more information on laws that aim to reduce crime and death rates would allow this study to isolate the effect of the background check regulation more accurately. The time frame of only five years (2010 – 2014) is relatively short and only includes one year after the gun law

implementation. Retrieving a wider time frame would be more favorable in order to examine the long-term influence of the gun law. There were also only five states that adopted the law during this time frame (four states in 2013 and one state in 2014) and the results will be solely based on these states. A greater quantity of states that adopt the law will allow for more accurate estimates. The Mother Jones mass shooting data was not government run, which indicate that errors could exist in the information provided. There is also no definitive way to check if an IV meets the exogeneity requirement. Acceptance of the proposed IV is based solely on the arguments presented by the author. Finally, OVB is hard to overcome. Although a fixed effects model takes into account all time invariant variables, the model can still exclude time varying characteristics. All of these limitations should be considered for when interpreting the results of this study.

Descriptive Statistics

Table 2 contains national-level descriptive statistics calculated by combining the data for years 2010 to 2014. Most variables contain 255 observation with the exception of firearm homicide, homicide, and firearm suicide rates, which is due to the the CDC suppressing data for confidentiality purposes. A table displaying states with missing data can be seen in the appendix (Table 10). Murder and arson have the lowest number of crime rates within the violent crime and property crime categories respectively. Small variations in crime rates across time may cause the 2SLS fixed effects models to dismiss the influence of gun control on crime rates. Firearms are twice as likely to contribute to suicides than homicides with rates of 3.88 and 7.63 per 100,000 persons respectively. On the other hand, general suicide levels occur about three times more than general homicide levels with rates of 14.31 and 5.22 per 100,000 persons respectively. The large

quantity of suicide levels compared to homicide levels may explain why previous studies have shown a statistical decrease in suicide deaths due to gun control; suicide rates may have more variation over time.

Table 2: Descriptive Statistics 2010 to 2014

	Mean	Standard Deviation	N
Violent and Property Crime Rate Per 100,000	3111.47	781.53	255
Violent Crime Rate Per 100,000	366.35	182.34	255
Murder Rate Per 100,000	4.36	2.63	255
Rape Rate Per 100,000	33.53	13.89	255
Robbery Rate Per 100,000	95.34	88.66	255
Aggravated Assault Rate Per 100,000	233.07	109.22	255
Property Crime Rate Per 100,000	2745.13	646.12	255
Burglary Rate Per 100,000	607.98	211.84	255
Larceny Rate Per 100,000	1931.14	435.74	255
Motor Vehicle Theft Rate Per 100,000	205.97	104.48	255
Arson Rate Per 100,000	16.55	6.20	255
Firearm Homicide Rate Per 100,000	3.88	2.00	203
Homicide Rate Per 100,000	5.22	2.62	237
Firearm Suicide Rate Per 100,000	7.63	3.15	250
Suicide Rate Per 100,000	14.31	3.94	255
Percent Veterans	9.46	1.71	255
Percent Vietnam Veterans	2.36	0.45	255
Population Density Per Sq. Mile	396.41	1434.99	255
Percent Unemployed	8.48	2.26	255
Per Capita Income	26127.26	4363.07	255
Percent Poverty For Population Under 18 Years	20.82	5.14	255
Percent Poverty For Population 18 to 64 Years	14.26	2.94	255
Percent High School Dropout For Population 16 to 18	4.67	1.52	255
Percent Hispanic or Latino	11.00	9.94	255
Percent Black	11.55	10.92	255

General violent and property crime rates have decreased over time (Figures 2 and Figure 3) and all subcategories of violent and property crime rates have been decreasing as well, with

the exception of rape. Both suicide and firearm suicide rates are increasing while homicide and firearm homicide rates are decreasing (Figure 4). It is important to note that the general decreasing nature of crime and death rates can be problematic when interpreting the results of this study. It is integral to control for this trend to accurately capture the relationship between crime rates, death rates, and gun control. The fixed effects model used for this study will account for all time-invariant factors that are associated with the dependent variables and includes time fixed effects that account for the time trend.

Figure 2

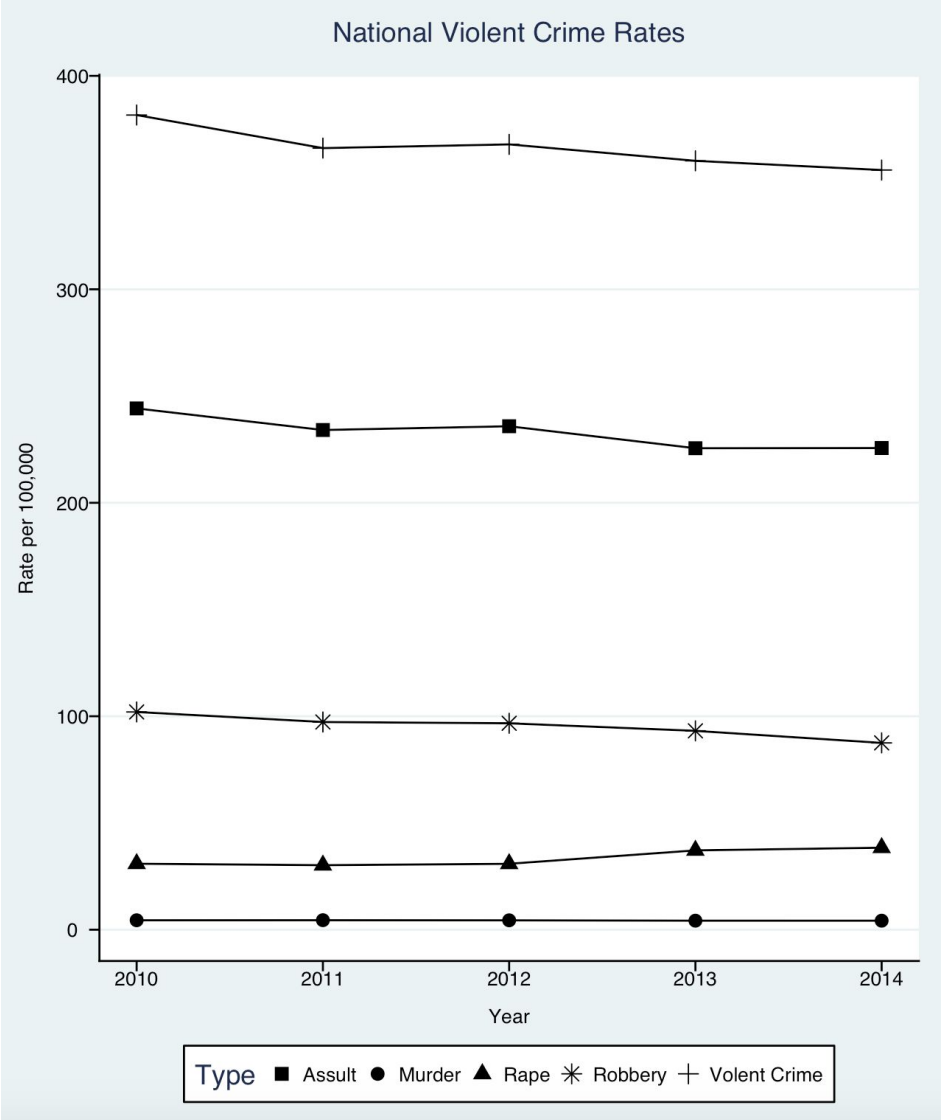


Figure 3

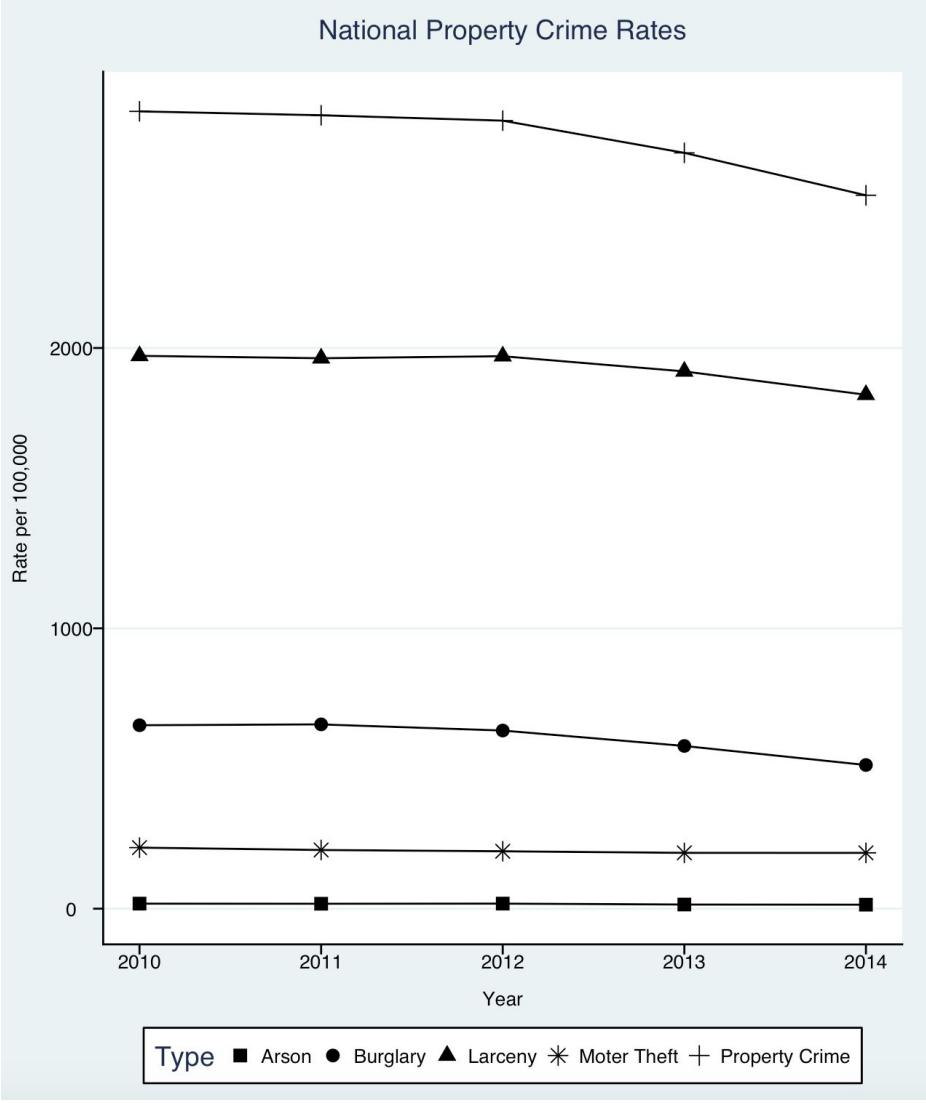
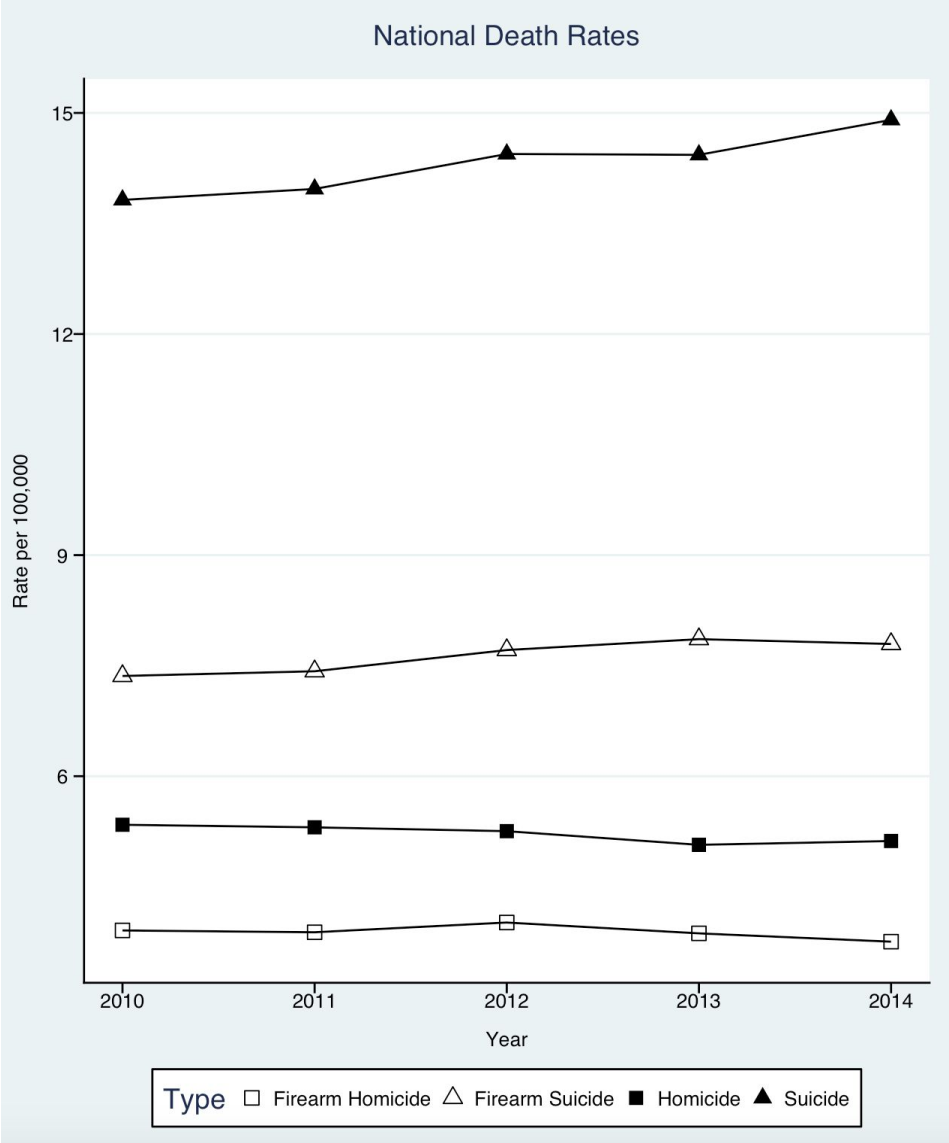

National Property Crime Rates
Rate per 100,000
2000
1000
0
2010
2011
2012
2013
2014
Year
Type
Arson
Burglary
Larceny
Moter Theft
Property Crime

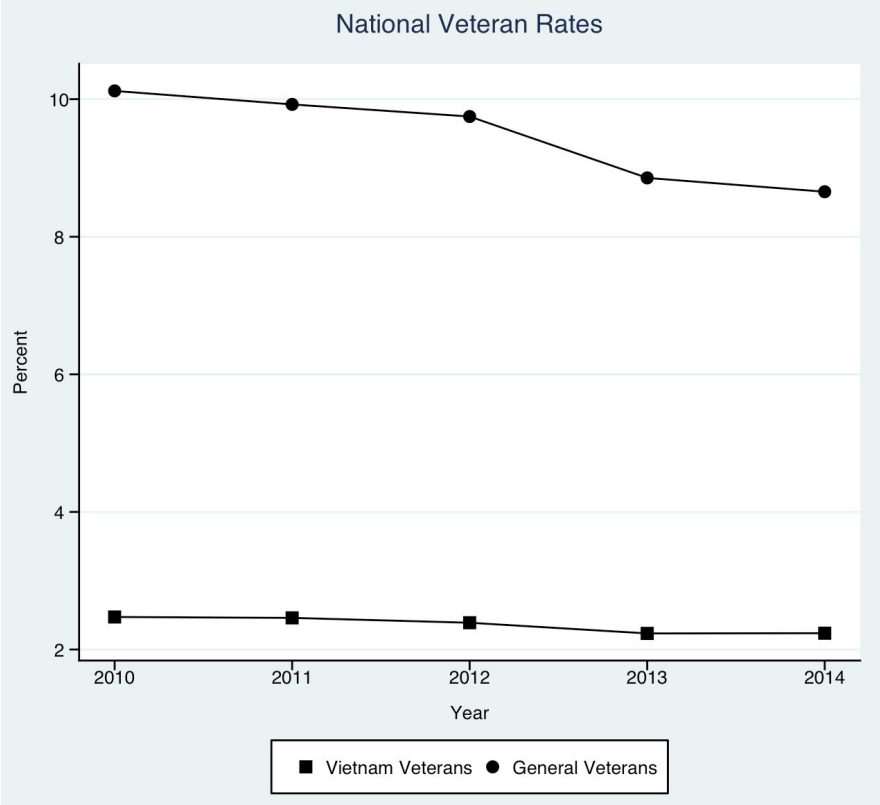
Figure 4



Veterans make about 9.5 percent of the civilian population while Vietnam Veterans only make up about 2.4 percent of the population (Table 2). These low percentages are important factors to take into consideration because they may not very much over time. Therefore, veteran status may have a lower influence on states adopting the universal firearm background check regulation because fixed effects models give little significance to time-invariant variables. Both veteran percentages, however, are falling over time and may therefore be time varying (Figure

5). According to the ACS, the African American population slightly exceeds the Hispanic population and both groups aggregate about 23 percent of the total U.S. population (Table 2). These groups are generally underprivileged and live in lower socioeconomic circumstances compared to other race categories, which is why they are included as covariates for this study. There is an average of about 396 people living within a square mile radius with 8.5 percent being unemployed and a national average income of about $26,127. The U.S. school dropout rate is at about 4.7 percent and poverty levels range from 14 to 20 percent.

Figure 5



Five states adopted the universal firearm background check law between the five-year time period of this study, four of which adopted the law in 2013. The adoption of the gun law in 2013 may be a consequence of the 2012 Connecticut Sandy Hook school shooting and Aurora

Colorado theater shooting where 27 and 12 people were killed, respectively. Between 2010 and 2014, there were a total of 20 mass shootings causing 152 fatalities and 144 injuries (Table 3). A geographical visual of states with mass shooting incidents is included in the appendix (Figure 13). There was a peak in both the number of mass shootings and total victims in 2012, which may indicate that states are more inclined to adopt firearm background check laws after these sorts of events (Figure 6). Six out of the thirteen states that had recorded mass shootings between 2010 and 2014 also adopted the gun law, three of which had the most number of mass shootings (Figure 7). Note that the figure displays states that adopted the gun law on or before 2014, in this case excluding Nevada and Oregon. This further suggests that mass shootings may be an indicator of the adoption of a universal firearm background check law. Of course, there are many other factors that can contribute to this trend, such as news coverage on gun related incidents and political party affiliation (Appendix Figure 14). Nevertheless, the data shows promise that mass shootings can serve as a predictor for the gun control law and can be utilized as an instrumental variable. The 25 states with the lowest number of veterans who participated in the Vietnam War contain seven out of the ten states that adopted the gun law on or before 2014 (Figure 8). This could imply an inverse relationship between the adoption of the gun law and Vietnam veterans, where having more veterans decreases the chances of adopting the gun law.

Table 3: Mass Shooting Statistics 2010 to 2014

	Count	Mean
Mass Shootings	20	1.0
Fatalities	152	7.6
Injuries	144	7.2

Figure 6

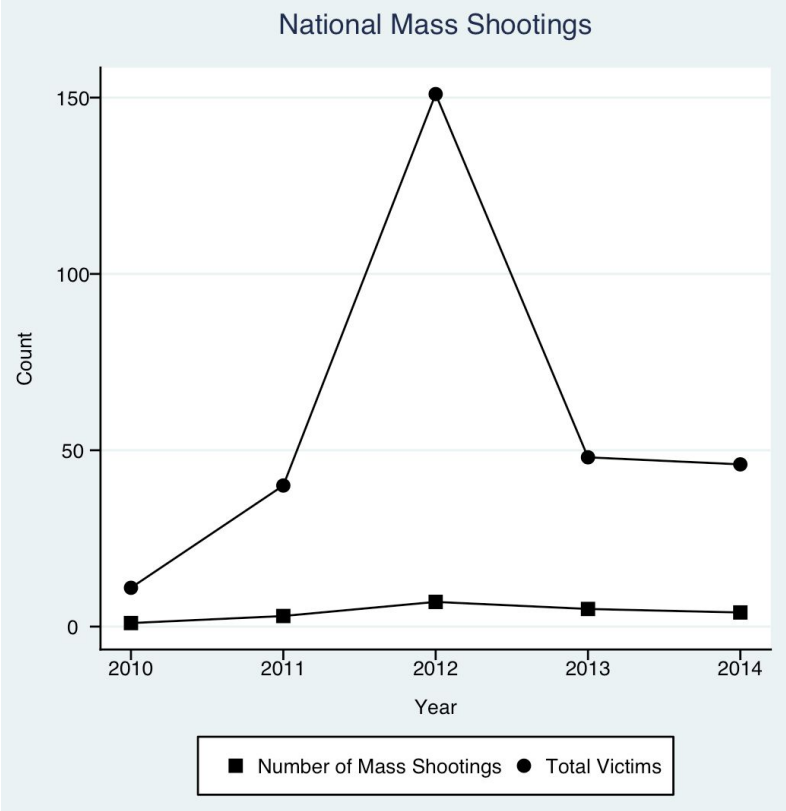

National Mass Shootings
150
100
50
0
Count
2010
2011
2012
2013
2014
Year
Number of Mass Shootings
Total Victims

Figure 7

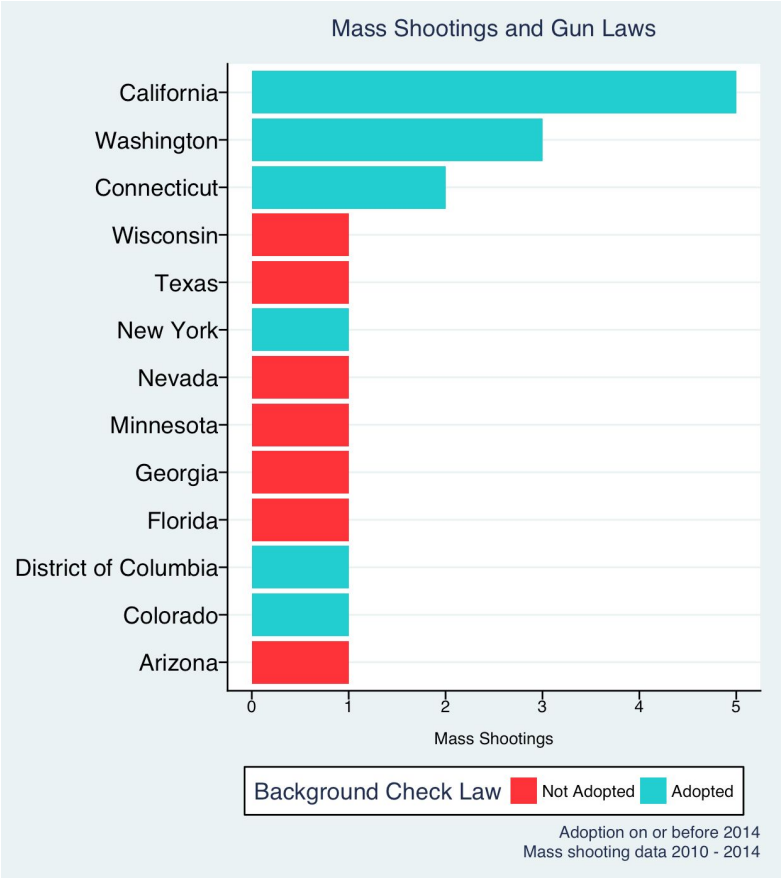
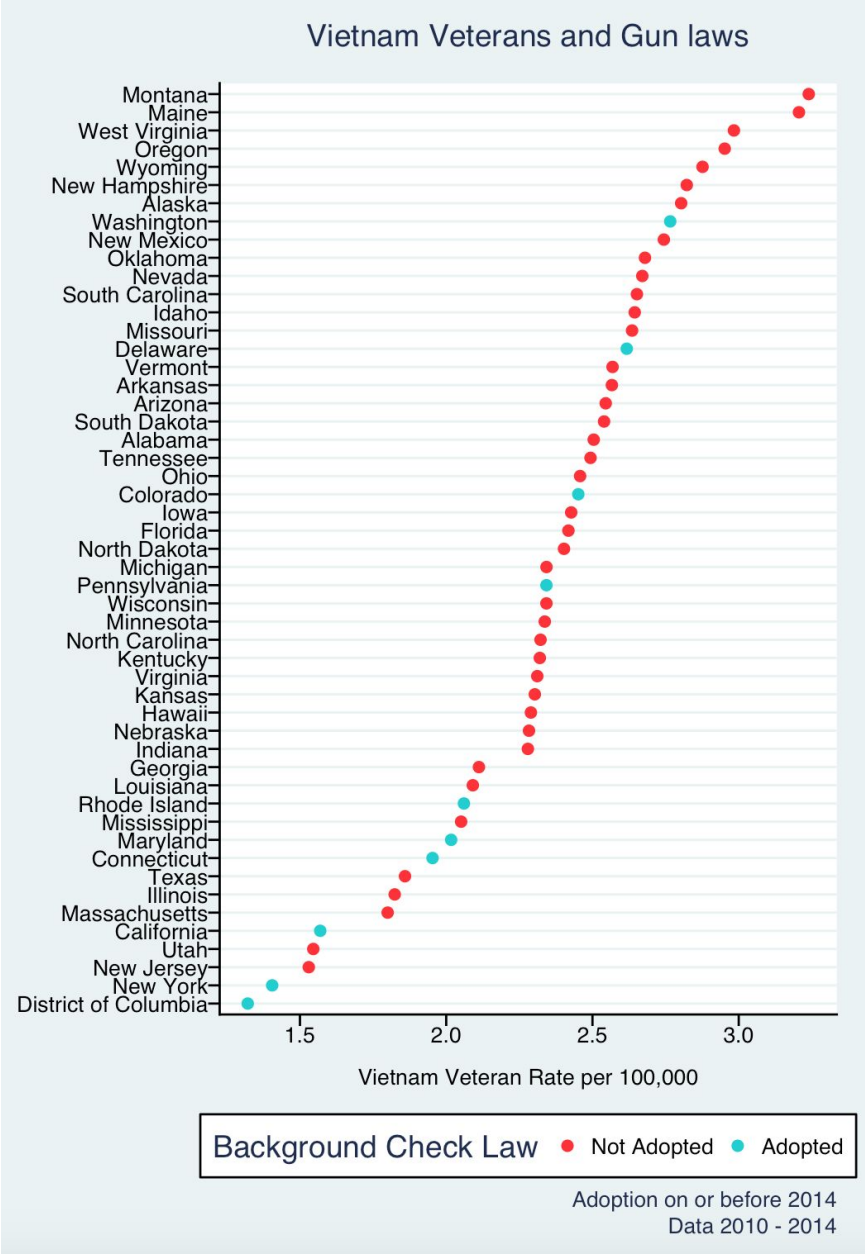

Mass Shootings and Gun Laws
California
Washington
Connecticut
Wisconsin
Texas
New York
Nevada
Minnesota
Georgia
Florida
District of Columbia
Colorado
Arizona
0
1
2
3
4
5
Mass Shootings
Background Check Law
Not Adopted
Adopted
Adoption on or before 2014
Mass shooting data 2010 - 2014

Figure 8



The appendix includes figures with the distribution of crime and death rates at the state level (Figures 15, 16, 17, 18) . It seems that states with the lowest firearm homicide and firearm suicide rates have adopted the gun law, which may indicate that the gun law may have an impact in reducing these crime rates. All other crime and death rate categories show no real trend regarding the gun law. In many situations, the District of Columbia has the highest crime and

death rates and may be considered an outlier. Geographical visuals displaying the distribution of mass shootings, violent crime rates, property crime rates, and CDC death rates can also be seen in the appendix (Figures 19, 20, 21, 22).

This study is particularly interested in the states that adopted the gun law in 2013: Colorado, Connecticut, Delaware, and New York. Washington was the only other state that adopted the gun law in addition to the states previously mentioned. Three out of the four states that adopted the gun law in 2013 experienced a decline in violent crime rates the following year (Figure 9). However, all of these states were experiencing declining violent crime rates already. Likewise, all states that adopted the gun law in 2013 experienced declining property crime rate trends (Figure 10). Suicide and firearm suicide rates increased in Colorado and Connecticut after 2013 (Figure 11). Delaware experienced increases in firearm homicide, homicide, and suicide levels after 2013. The increases in death rates may be a cause for concern when evaluating the positive impact of the gun law. These trends however may be due to other factors that exist within states that may have counteracted the impact of the gun law. Table 4 contains the crime and death rates for all five states that adopted the law between 2010 and 2014.

Figure 9

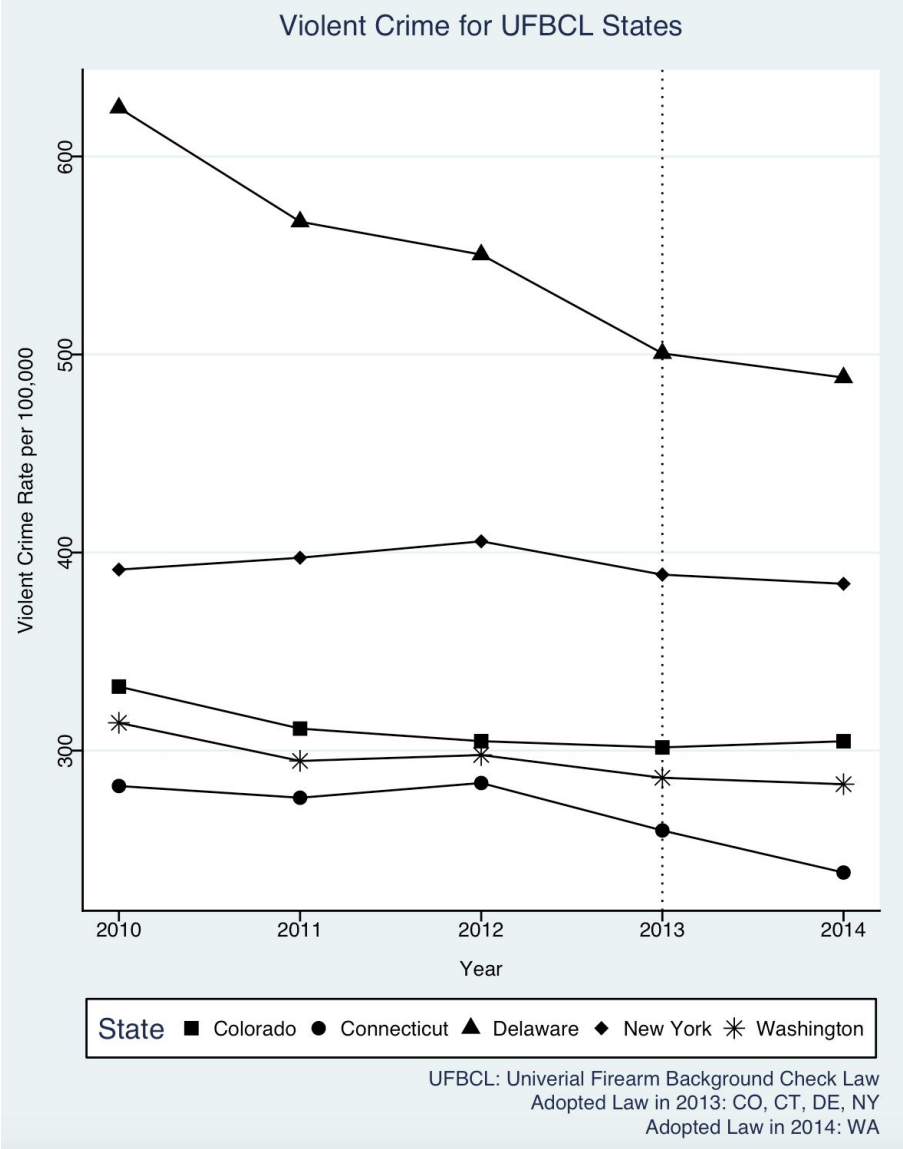

Violent Crime for UFBCL States
Violent Crime Rate per 100,000
300
400
500
600
2010
2011
2012
2013
2014
Year
State
Colorado
Connecticut
Delaware
New York
Washington
UFBCL: Univerial Firearm Background Check Law
Adopted Law in 2013: CO, CT, DE, NY
Adopted Law in 2014: WA

Figure 10

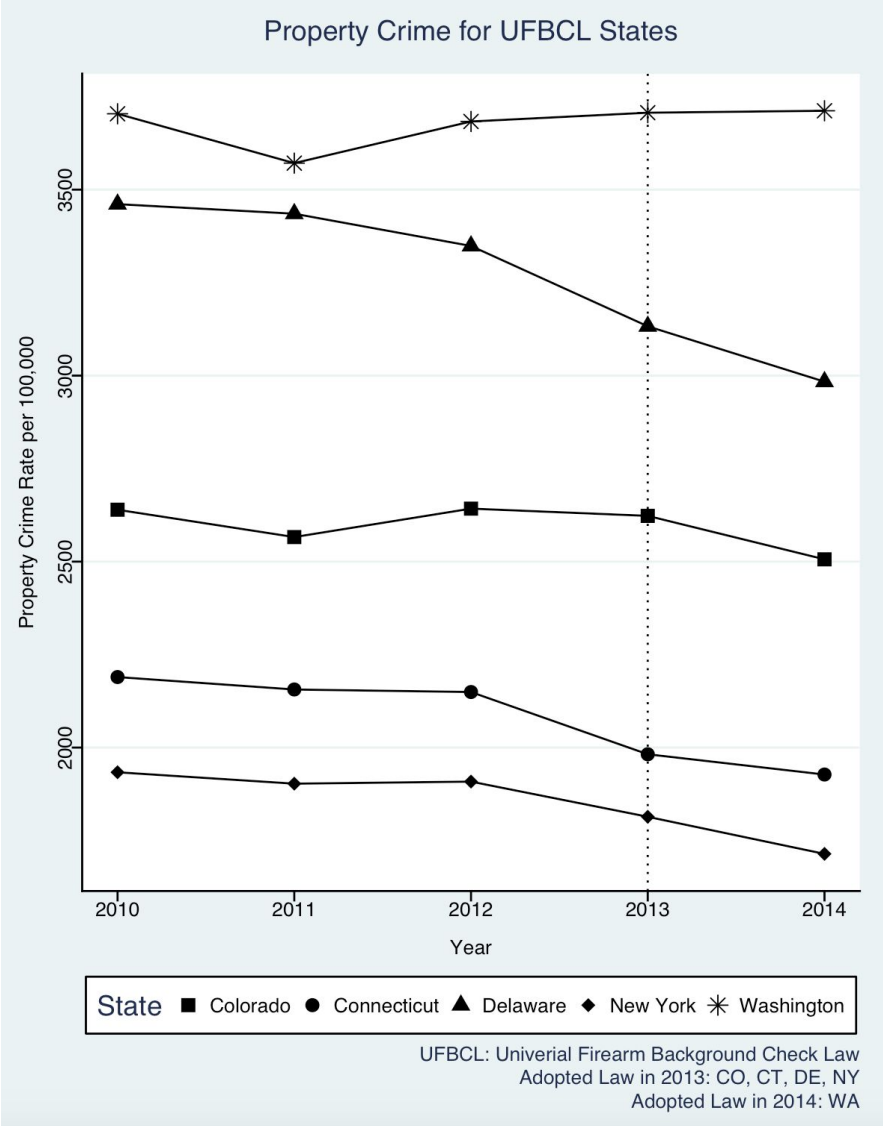

Property Crime for UFBCL States
Property Crime Rate per 100,000
2000
2500
3000
3500
2010
2011
2012
2013
2014
Year
State
Colorado
Connecticut
Delaware
New York
Washington
UFBCL: Univerial Firearm Background Check Law
Adopted Law in 2013: CO, CT, DE, NY
Adopted Law in 2014: WA

Figure 11

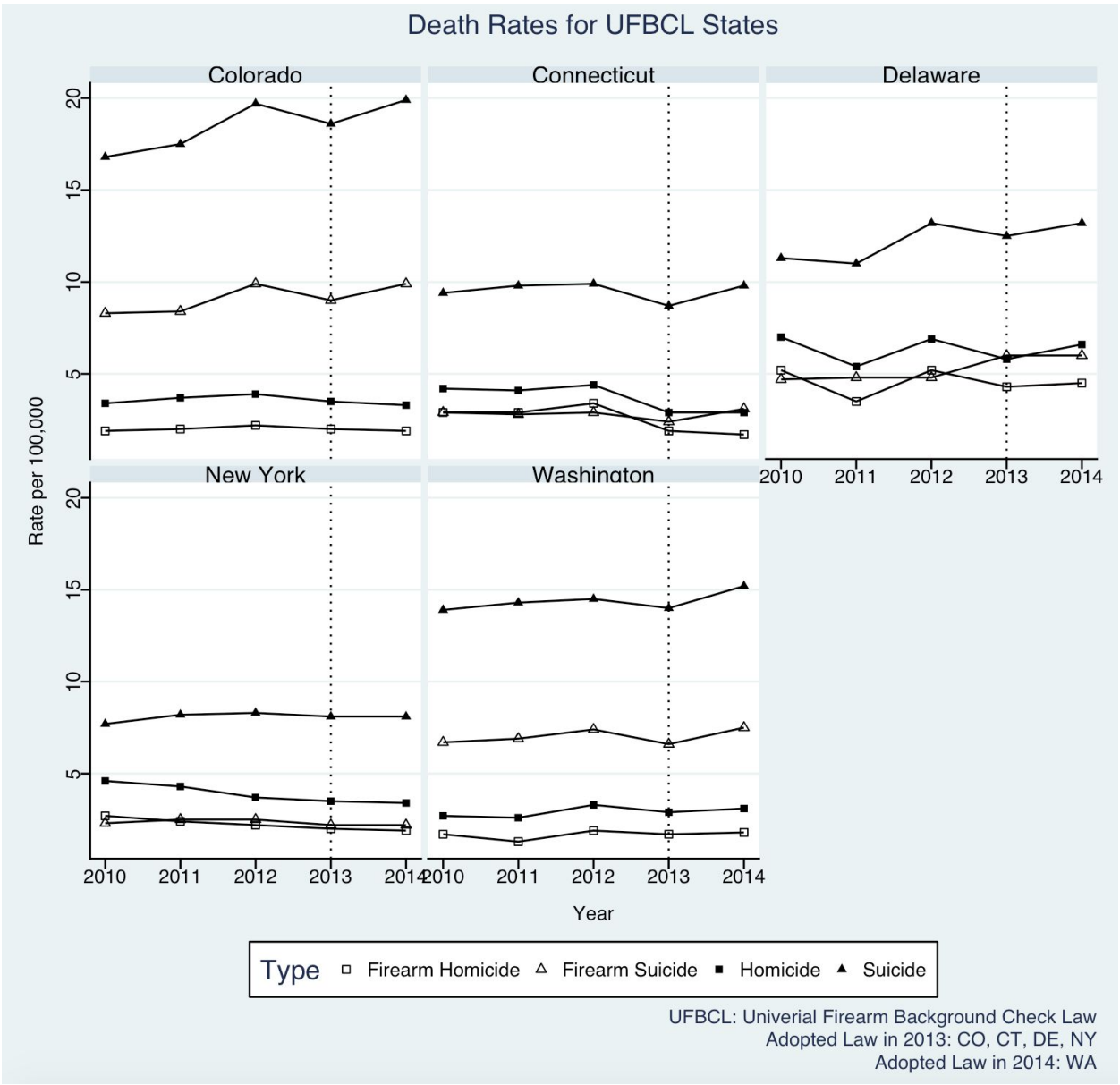

Death Rates for UFBCL States
Colorado
Connecticut
Delaware
New York
Washington
Rate per 100,000
5
10
15
20
2010
2011
2012
2013
2014
Year
Type
Firearm Homicide
Firearm Suicide
Homicide
Suicide
UFBCL: Univerial Firearm Background Check Law
Adopted Law in 2013: CO, CT, DE, NY
Adopted Law in 2014: WA

Table 4: Crime rates for states that adopted the universal background check law from 2010 to 2014

Year	State	Violent	Property	Firearm Homicide	Homicide	Firearm Suicide	Suicide
2010	Colorado	332.30	332.30	1.9	3.4	8.3	16.8
2011	Colorado	311.09	311.09	2.0	3.7	8.4	17.5
2012	Colorado	304.75	304.75	2.2	3.9	9.9	19.7
2013	Colorado	301.59	301.59	2.0	3.5	9.0	18.6
2014	Colorado	304.71	304.71	1.9	3.3	9.9	19.9
2010	Connecticut	282.11	282.11	2.9	4.2	2.9	9.4
2011	Connecticut	276.17	276.17	2.9	4.1	2.8	9.8
2012	Connecticut	283.62	283.62	3.4	4.4	2.9	9.9
2013	Connecticut	259.64	259.64	1.9	2.9	2.4	8.7
2014	Connecticut	238.41	238.41	1.7	2.9	3.1	9.8
2010	Delaware	624.54	624.54	5.2	7.0	4.7	11.3
2011	Delaware	567.06	567.06	3.5	5.4	4.8	11.0
2012	Delaware	550.44	550.44	5.2	6.9	4.8	13.2
2013	Delaware	500.57	500.57	4.3	5.8	6.0	12.5
2014	Delaware	488.34	488.34	4.5	6.6	6.0	13.2
2010	New York	391.37	391.37	2.7	4.6	2.3	7.7
2011	New York	397.38	397.38	2.4	4.3	2.5	8.2
2012	New York	405.66	405.66	2.2	3.7	2.5	8.3
2013	New York	388.83	388.83	2.0	3.5	2.2	8.1
2014	New York	384.20	384.20	1.9	3.4	2.2	8.1
2010	Washington	314.01	314.01	1.7	2.7	6.7	13.9
2011	Washington	294.77	294.77	1.3	2.6	6.9	14.3
2012	Washington	297.74	297.74	1.9	3.3	7.4	14.5
2013	Washington	286.26	286.26	1.7	2.9	6.6	14.0
2014	Washington	283.01	283.01	1.8	3.1	7.5	15.2

Regression Results

The universal firearm background check law (UFBCL) variable is negatively correlated with all crime and death rates with the exception of rape and robbery (Table 5). The gun law is most negatively correlated with firearm homicide and firearm suicide with correlations of -0.155

and -0.139 respectively. These initial statistics make sense since the gun law most directly impacts crime and death rates associated with firearms. The potential IVs, percent of the population who participated in the Vietnam War and whether or not a state had a mass shooting, need to have a significant correlation with the gun law variable. States with higher populations of Vietnam veterans are negatively correlated with the UFBCL and states with mass shootings are positively correlated with the UFBCL. These variables are slightly correlated but other tests can determine the validity of the IVs.

Table 5: Correlation between main variables. UFBCL: Universal Firearm Background Check Law

	UFBC	Vietnam Veterans	Mass Shooting
UFBCL	1.000		
Vietnam Veterans	-0.128	1.000	
Mass Shooting	0.108	-0.177	1.000
Violent Crime	-0.017	-0.241	0.07
Murder	-0.077	-0.302	0.024
Rape	0.028	0.224	-0.068
Robbery	0.013	-0.468	0.138
Aggravated Assault	-0.041	-0.043	0.013
Property Crime	-0.076	-0.007	0.076
Burglary	-0.126	0.144	0.014
Larceny	-0.043	-0.017	0.043
Motor Vehicle Theft	-0.034	-0.261	0.26
Arson	-0.102	0.436	-0.072
Firearm Homicide	-0.155	-0.102	-0.111
Homicide	-0.101	-0.199	-0.044
Firearm Suicide	-0.139	0.59	-0.144
Suicide	-0.080	0.643	-0.137

Table 6 displays the results for the 2SLS fixed effects models. The coefficients for the UFBCL variables are statistically insignificantly different from zero at the 10 percent

significance level. According to 2SLS, the null hypothesis that the gun law has no real impact on crime and death rates cannot be rejected. The gun law variable has a negative relationship, indicating decreases in crime and death rates, with eight out of the fourteen dependent variables: violent crime, murder, robbery, aggravated assault, motor vehicle theft, firearm homicide, homicide, and firearm suicide. The other six dependent variables have a positive relationship with the gun regulation, indicating that the UFBCL is associated with increases in rape, property crimes, burglary, larceny, arson, and suicide rates. The R-squares for the 2SLS fixed effect models are uninterpretable hence no emphasis will be placed on them. The reported R-squares were attained from the plm function in R and are low because the regression models include 54 dummy variables for states and years. These 2SLS model estimates may not be suitable because they may not pass the weak instrument, overidentification, and endogeneity tests.

Table 6: 2SLS Regression

	Dependent Variables: Natural Log of Violent Crime Rates per 100,000 Persons				
	1	2	3	4	5
	Violent	Murder	Rape	Robbery	Assult
UFBCL	-0.312	-1.020	0.432	-0.603	-0.437
	(1.360)	(3.830)	(2.671)	(2.368)	(1.744)
% Unemployed	0.009	0.019	0.029	0.019	0.004
	(0.011)	(0.030)	(0.021)	(0.019)	(0.014)
Population Density	0.0002	-0.0002	0.00001	0.0002	0.001*
	(0.0002)	(0.001)	(0.0005)	(0.0004)	(0.0003)
Log of Per Capita Income	0.799	0.576	0.144	2.339*	0.722
	(0.746)	(2.099)	(1.464)	(1.298)	(0.956)
% Poverty < 18	-0.003	-0.025	0.005	-0.001	-0.002
	(0.013)	(0.037)	(0.026)	(0.023)	(0.017)
% Poverty 18 to 64	-0.007	-0.054	-0.046	-0.013	0.004
	(0.030)	(0.084)	(0.059)	(0.052)	(0.038)
% HS Dropout	-0.010	-0.034	-0.011	-0.010	-0.012
	(0.025)	(0.072)	(0.050)	(0.044)	(0.033)
% Hispanic	-0.034	-0.077	0.025	0.070	-0.064
	(0.118)	(0.332)	(0.231)	(0.205)	(0.151)
% Black	0.084	0.132	-0.284**	0.182*	0.112
	(0.057)	(0.159)	(0.111)	(0.098)	(0.072)
Weak instruments P-Value	0.951	0.951	0.951	0.951	0.951
Wu-Hausman P-Value	0.811	0.729	0.866	0.763	0.752
Sargan P-Value	0.626	0.043	0.656	0.145	0.719
Observations	255	255	255	255	255
R^2	0.049	0.058	0.085	0.085	0.043
Adjusted R^2	-0.264	-0.253	-0.217	-0.217	-0.273
F Statistic (df = 9; 191)	-6.274	-9.917	-1.185	-7.474	-9.136

Note: *p<0.1;* ***p<0.05;*** p<0.01

UFBCL: Universal Firearm Background Check Law

Table 6: 2SLS Regression (Continued)

	Dependent Variables: Natural Log of Property Crime Rates per 100,000 Persons				
	6	7	8	9	10
	Property	Burglary	Larceny	Moter Vehicle Theft	Arson
UFBCL	0.318	0.472	0.482	-0.342	6.145
	(1.335)	(2.063)	(1.690)	(2.280)	(19.935)
% Unemployed	0.002	0.004	-0.0001	-0.006	-0.049
	(0.011)	(0.016)	(0.013)	(0.018)	(0.158)
Population Density	0.0003	0.0002	0.0005	-0.0005	-0.003
	(0.0002)	(0.0004)	(0.0003)	(0.0004)	(0.004)
Log of Per Capita Income	0.780	0.967	0.512	2.479**	1.492
	(0.732)	(1.131)	(0.926)	(1.250)	(10.926)
% Poverty < 18	-0.008	-0.010	-0.009	-0.020	-0.077
	(0.013)	(0.020)	(0.016)	(0.022)	(0.192)
% Poverty 18 to 64	0.011	0.024	0.013	0.001	0.142
	(0.029)	(0.045)	(0.037)	(0.050)	(0.437)
% HS Dropout	-0.006	0.0003	-0.005	-0.020	0.063
	(0.025)	(0.039)	(0.032)	(0.043)	(0.372)
% Hispanic	0.027	0.034	0.003	0.116	-0.430
	(0.116)	(0.179)	(0.146)	(0.198)	(1.728)
% Black	0.055	0.103	0.046	0.049	0.039
	(0.055)	(0.086)	(0.070)	(0.095)	(0.828)
Weak instruments P-Value	0.951	0.951	0.951	0.951	0.951
Wu-Hausman P-Value	0.743	0.729	0.576	0.881	0.101
Sargan P-Value	0.457	0.904	0.536	0.312	0.821
Observations	255	255	255	255	255
R^2	0.037	0.007	0.036	0.092	0.015
Adjusted R^2	-0.281	-0.320	-0.282	-0.208	-0.310
F Statistic (df = 9; 191)	-8.985	-10.378	-14.546	-0.327	-19.574

Note: *p<0.1;* ***p<0.05;*** p<0.01

UFBCL: Universal Firearm Background Check Law

Table 6: 2SLS Regression (Continued)

	Dependent Variables: Natural Log of CDC Death Rates per 100,000 Persons			
	11	12	13	14
	Firearm Homicide	Homicide	Firearm Suicide	Suicide
UFBCL	-1.084	-4.456	-0.068	0.776
	(2.712)	(17.988)	(1.020)	(2.759)
% Unemployed	-0.006	0.062	0.016	0.006
	(0.071)	(0.298)	(0.019)	(0.022)
Population Density	-0.0003	0.0002	-0.002	0.0001
	(0.001)	(0.003)	(0.012)	(0.0005)
Log of Per Capita Income	0.016	5.919	0.508	-0.529
	(6.223)	(24.830)	(0.767)	(1.512)
% Poverty < 18	-0.021	0.014	0.009	-0.004
	(0.033)	(0.165)	(0.010)	(0.027)
% Poverty 18 to 64	-0.053	-0.117	0.002	0.027
	(0.084)	(0.476)	(0.029)	(0.061)
% HS Dropout	-0.037	-0.117	-0.011	0.014
	(0.084)	(0.450)	(0.021)	(0.052)
% Hispanic	-0.052	0.280	-0.061	-0.133
	(0.357)	(1.620)	(0.051)	(0.239)
% Black	0.118	0.484	0.011	-0.026
	(0.467)	(2.094)	(0.073)	(0.115)
Weak instruments P-Value	0.916	0.971	0.863	0.951
Wu-Hausman P-Value	0.511	0.079	0.933	0.525
Sargan P-Value	0.285	0.844	0.183	0.901
Observations	203	237	250	255
R^2	0.085	0.043	0.028	0.0001
Adjusted R^2	-0.249	-0.291	-0.294	-0.330

Note: *p<0.1;* ***p<0.05;*** p<0.01

UFBCL: Universal Firearm Background Check Law

The results for the three tests previously mentioned can be located at the bottom half of Table 6. The IVs pass the overidentification (Sargan) tests in all 14 regression models with the exception of the model that predicts murder rate. The null that both IVs are uncorrelated with the error terms of the dependent variables cannot be rejected at the 10 percent significance level, meaning that at least one of the IVs may be valid. The IVs, however, fail the weak instrument tests in all 14 regression models. This indicates that the two chosen IVs do not strongly predict the adoption of the firearm background check law at the 10 percent significance level. Lastly, the dependent variables fail the endogeneity (Wu-Hausman) tests in all regression models with the

exception of the model that predicts homicide rates. The null that the UFBCL variable is exogenous to crime and death rates cannot be rejected at the 10 percent significance level. Overall, the IV test results suggest that a 2SLS regression is inappropriate with the specified IVs, thus the regular fixed effects model estimates produce more consistent results.

The results for the 1st stage model predicting the passage of the gun law with the two IVs and other covariates are shown in Table 7. The 1st stage was conducted using a fixed effects model, linear probability model with no fixed effects, and logit model with no fixed effects. The fixed effect model indicates that all variables are statistically insignificant at the 10% significance level. The LPM model indicates that every one-person increase in population density per square mile decreases the likelihood of a state adopting the gun law by 0.00004 percentage points, ceteris paribus. The estimate for population density is statistically significant at the 1 percent significance level. Each passage of a year increases the likelihood of a state adopting the law by 0.025 percentage points. The estimate for year is statistically significant at the 5 percent significance level. The same model but in logit form produces large odd ratios and indicates that per capita income and year are statistically significant at the 5 percent significance level. The lack of states coded as adopting the gun law may explain the large odd ratios produced by the logit model. The results for both stages of the 2SLS model suggests that the fixed effects estimates are more appropriate to interpret the relationship between the gun law, crime rates, and death rates.

Table 7: 1st Stage Regression

	Dependent variable: UFBCL		
	Fixed Effects	LPM	Logit
% Vietnam Veteran	0.010	-0.003	3.402*
	(0.130)	(0.035)	(1.945)
Mass Shooting	-0.015	0.026	0.538
	(0.050)	(0.045)	(1.130)
% Unemployed	0.003	-0.001	-0.092
	(0.024)	(0.008)	(0.483)
Population Density	-0.0001	-0.00004***	-0.002
	(0.0005)	(0.00001)	(0.001)
Log of Per Capita Income	0.465	0.595***	36.283***
	(0.938)	(0.200)	(14.060)
% Poverty Under 18 Years	0.008	0.002	0.489
	(0.015)	(0.009)	(0.520)
% Poverty from 18 to 64 Years	-0.019	0.008	0.168
	(0.032)	(0.017)	(0.757)
% HS Dropout	-0.018	0.006	0.015
	(0.017)	(0.011)	(0.577)
% Hispanic	0.084	0.0001	0.072
	(0.080)	(0.002)	(0.066)
% Black	0.009	0.001	0.090
	(0.126)	(0.002)	(0.065)
Year		0.025**	1.478**
		(0.012)	(0.714)
Constant		-5.263**	-400.996***
		(2.124)	(153.359)
Observations	255	255	255
R^2	0.017	0.123	
Adjusted R^2	-0.314	0.084	
Log Likelihood			-19.761
Akaike Inf. Crit.			63.522
Residual Std. Error		0.177 (df = 243)	
F Statistic	0.335 (df = 10; 190)	3.113*** (df = 11; 243)	
Note:			*p<0.1;* ***p<0.05;*** p<0.01

UFBCL: Universal Firearm Background Check Law

The results for the fixed effects models are shown in Table 8. Five of the estimates for the UFBCL variable are statistically significant at the 5 percent significance level: violent crime, murder, robbery, firearm homicide, and homicide. All five of the statistically significant gun law variables share a negative relationship with the dependent variables, which indicates that the gun law is associated with decreases in crime and death rates. States that adopt the gun law

experience, on average, an approximately 100 times the corresponding gun law coefficient percent change in the corresponding dependent variable rate per 100,000 persons, ceteris paribus. For example, a state that adopts the gun law will experience, on average, an approximate 5.1 percent decrease in violent crime rates per 100,000 persons, all factors being equal. Of the statistically insignificant relationships, five shared a negative relationship (assault, burglary, motor vehicle theft, arson, and suicide) and four shared a positive relationship (rape, property crime, larceny, firearm suicide).

Many of the estimates for the Hispanic variables are statistically significant at the 10 percent significance level and share both positive and negative relationships with the dependent variables. All of the positive statistically significant relationships are associated with property crimes and the rest of the statistically significant estimates share a negative relationship with the dependent variables. A one percentage point increase in the hispanic population is associated with, on average, an approximate 5.5 percent decrease in violent crime rates per 100,000 persons, all factors being equal. This signifies that the Hispanic population is more inclined to commit lesser degree crimes that may not involve direct contact with their victims. The black population estimates for rape, robbery, assault, and burglary are statistically significant at the 5 percent significance level. The black population estimate shares a negative relationship with rape, meaning that states with increases in black populations are associated with reduced rape incidents. Increases in black populations, however, are associated with increases in robbery, assault, and burglary.

General increases in population densities share positive relations with violent crime, assault, property crime, and larceny at the 10 percent significance level. Population density

negatively impacts arson at the 1 percent significance level. This indicates that states with decreasing populations have more crimes involving fire. Contrary to what one might expect, it seems that increases in income, for statistically significant estimates, are associated with increases in crime and death rates. Increases in poverty and high school dropout levels, for statistically significant estimates, are associated with decreases in crime and death rates. These unexpected results should be taken with caution and could indicate errors with the fixed effects model approach.

Table 8: Fixed Effects Regression

	Dependent Variables: Natural Log of Violent Crime Rates per 100,000 Persons				
	1	2	3	4	5
	Violent	Murder	Rape	Robbery	Assult
UFBCL	-0.051**	-0.123**	0.034	-0.085**	-0.046
	(0.025)	(0.059)	(0.054)	(0.039)	(0.028)
% Unemployed	0.008	0.016	0.030*	0.017	0.003
	(0.008)	(0.019)	(0.018)	(0.013)	(0.009)
Population Density	0.0003*	-0.0001	-0.00003	0.0003	0.001***
	(0.0002)	(0.0004)	(0.0003)	(0.0002)	(0.0002)
Log of Per Capita Income	0.679**	0.162	0.328	2.099***	0.541
	(0.320)	(0.761)	(0.696)	(0.505)	(0.364)
% Poverty < 18	-0.005	-0.032***	0.009	-0.005	-0.005
	(0.005)	(0.012)	(0.011)	(0.008)	(0.006)
% Poverty 18 to 64	-0.002	-0.037	-0.054**	-0.003	0.012
	(0.011)	(0.026)	(0.024)	(0.017)	(0.012)
% HS Dropout	-0.005	-0.017	-0.018	-0.001	-0.005
	(0.006)	(0.014)	(0.013)	(0.009)	(0.007)
% Hispanic	-0.055**	-0.151**	0.058	0.027	-0.096***
	(0.028)	(0.065)	(0.060)	(0.043)	(0.031)
% Black	0.081*	0.121	-0.280***	0.176**	0.107**
	(0.043)	(0.102)	(0.094)	(0.068)	(0.049)
Observations	255	255	255	255	255
R^2	0.099	0.151	0.176	0.194	0.124
Adjusted R^2	-0.198	-0.129	-0.096	-0.071	-0.164
F Statistic (df = 9; 191)	2.338**	3.768***	4.518***	5.118***	3.017***

Note: *p<0.1;* ***p<0.05;*** p<0.01

UFBCL: Universal Firearm Background Check Law

Table 8: Fixed Effects Regression (Continued)

	Dependent Variables: Natural Log of Property Crime Rates per 100,000 Persons				
	6	7	8	9	10
	Property	Burglary	Larceny	Moter Vehicle Theft	Arson
UFBCL	0.013	-0.011	0.016	-0.032	-0.051
	(0.021)	(0.032)	(0.019)	(0.047)	(0.087)
% Unemployed	0.003	0.005	0.001	-0.007	-0.032
	(0.007)	(0.010)	(0.006)	(0.015)	(0.028)
Population Density	0.0003**	0.0002	0.0004***	-0.0005	-0.004***
	(0.0001)	(0.0002)	(0.0001)	(0.0003)	(0.001)
Log of Per Capita Income	0.921***	1.190***	0.727***	2.336***	4.353***
	(0.273)	(0.410)	(0.245)	(0.608)	(1.116)
% Poverty < 18	-0.006	-0.006	-0.005	-0.023**	-0.024
	(0.004)	(0.006)	(0.004)	(0.010)	(0.018)
% Poverty 18 to 64	0.005	0.015	0.004	0.007	0.022
	(0.009)	(0.014)	(0.008)	(0.021)	(0.038)
% HS Dropout	-0.011**	-0.008	-0.013***	-0.015	-0.048**
	(0.005)	(0.007)	(0.004)	(0.011)	(0.020)
% Hispanic	0.052**	0.074**	0.041*	0.091*	0.084
	(0.024)	(0.035)	(0.021)	(0.052)	(0.096)
% Black	0.059	0.109**	0.052	0.045	0.114
	(0.037)	(0.055)	(0.033)	(0.082)	(0.150)
Observations	255	255	255	255	255
R^2	0.166	0.115	0.233	0.172	0.538
Adjusted R^2	-0.109	-0.177	-0.020	-0.101	0.385
F Statistic (df = 9; 191)	4.221***	2.750***	6.447***	4.407***	24.672***

Note: *p<0.1;* ***p<0.05;*** p<0.01

UFBCL: Universal Firearm Background Check Law

Table 8: Fixed Effects Regression (Continued)

	Dependent Variables: Natural Log of CDC Death Rates per 100,000 Persons			
	11	12	13	14
	Firearm Homicide	Homicide	Firearm Suicide	Suicide
UFBCL	-0.124**	-0.125***	0.017	-0.006
	(0.050)	(0.045)	(0.040)	(0.028)
% Unemployed	-0.028	-0.005	0.015	0.008
	(0.018)	(0.015)	(0.013)	(0.009)
Population Density	-0.001	-0.0004	-0.003	0.0001
	(0.0003)	(0.0003)	(0.003)	(0.0002)
Log of Per Capita Income	-2.098**	0.081	0.462	-0.168
	(0.946)	(0.737)	(0.524)	(0.363)
% Poverty < 18	-0.027*	-0.021*	0.008	0.002
	(0.014)	(0.011)	(0.008)	(0.006)
% Poverty 18 to 64	-0.031	-0.009	0.004	0.011
	(0.031)	(0.021)	(0.018)	(0.012)
% HS Dropout	-0.009	-0.011	-0.009	-0.0005
	(0.015)	(0.012)	(0.010)	(0.007)
% Hispanic	-0.172***	-0.099*	-0.062	-0.068**
	(0.061)	(0.052)	(0.047)	(0.031)
% Black	-0.034	0.003	0.012	-0.016
	(0.102)	(0.087)	(0.070)	(0.049)
Observations	203	237	250	255
R^2	0.226	0.138	0.045	0.050
Adjusted R^2	-0.056	-0.163	-0.272	-0.264

Note: *p<0.1; **p<0.05;** p<0.01

UFBCL: Universal Firearm Background Check Law

The statistics for the UFBCL variables for the 14 regression models where the standard errors are adjusted for homoscedasticity and serial correlation are shown in Table 9. Wooldridge recommends adjusting the standard errors in order to more consistently capture the impact of the variable in question. Serial correlation may not be the biggest concern in this study since only five years of data was incorporated. It should be noted that the estimates for the variables remain the same but the standard errors change. All five of the UFBCL variables from the previous models remain statistically significant. The coefficients for violent crime and firearm homicide, however, drop from being significant at the 5 percent significance level to being significant at the 10 percent significance level. The coefficient for homicide also drops from being significant at

the 1 percent significance level to being significant at the 5 percent significance level. Overall, adjusting the standard errors for homoscedasticity and serial correlation have little impact on the original fixed effects model results. The results for the standard OLS models can be located in the appendix (Table 11).

Table 9: UFBCL model results adjusting for homoscedasticity and serial correlation

Model	UFBCL Estimate	Std. Error	t value	Pr(>|t|)	Significance
Violent	-0.051	0.028	-1.809	0.072	*
Murder	-0.123	0.048	-2.574	0.011	**
Rape	0.034	0.049	0.696	0.487	
Robbery	-0.085	0.039	-2.162	0.032	**
Assult	-0.046	0.032	-1.432	0.154	
Property	0.013	0.028	0.480	0.632	
Burglary	-0.011	0.040	-0.281	0.779	
Larceny	0.016	0.023	0.706	0.481	
Moter Vehicle Theft	-0.032	0.055	-0.581	0.562	
Arson	-0.051	0.051	-0.993	0.322	
Firearm Homicide	-0.124	0.071	-1.730	0.086	*
Homicide	-0.125	0.056	-2.231	0.027	**
Firearm Suicide	0.017	0.053	0.320	0.749	
Suicide	-0.006	0.020	-0.281	0.779	

Discussion and Findings

The purpose of this study was to determine how crime rates and death rates respond to the introduction of a gun control regulation. The specific gun control policy in question is the universal firearm background check (UFBC) regulation, which closes the private sales loophole created by the Brady Act. Many studies have made efforts to uncover this relationship by focusing on Right-to-Carry (RTC) laws, the Brady Act of 1994, and other gun related regulations. The results determined that states with RTC laws, which are pro-gun regulations,

have lower crime rates and gun control regulations such as the Brady Act have little influence in reducing crime and death rates. These efforts, however, are flawed in that their analytical approach used cross-sectional data that cannot imply changes in crime and death rates over time or analyzed gun regulations that apply to only a portion of the full firearm market. This study corrects for these problems by using state-level panel data to measure the impact of adopting the UFBC regulation on crime and death rates.

The 2SLS fixed effects approach was deemed inapplicable for this analysis according to the endogeneity Wu-Hausman tests and weak instruments tests. The two proposed instrumental variables may not very enough over time thus the fixed effects model drowns out their impact on adopting the gun law. Furthermore, using IVs reduces the statistical significance of the regression models because the predicted values of the gun law variables are being used. The results for the first stage regression lacks the statistical power to answer the secondary question to this study that tried to determine the state characteristics that persuaded a state to adopt the gun law. Another study using a standard logit model might uncover more promising results to determine these factors. The lack of utilizing appropriate IVs suggests that the estimates for the standard fixed effects models compute more consistent results.

The results obtained from the fixed effect models have strong implications on the subject of gun control. The main hypothesis that states that adopt the universal firearm background check law experience decreases in crime and death rates was proven to be true, especially in life threatening situations. Adopting the universal background check law is associated with reductions in general violent crimes, murder, robbery, firearm homicide, and homicide rates by 5.1, 12.3, 8.5, 12.4, and 12.5 percent respectively. People may be more inclined to use firearms

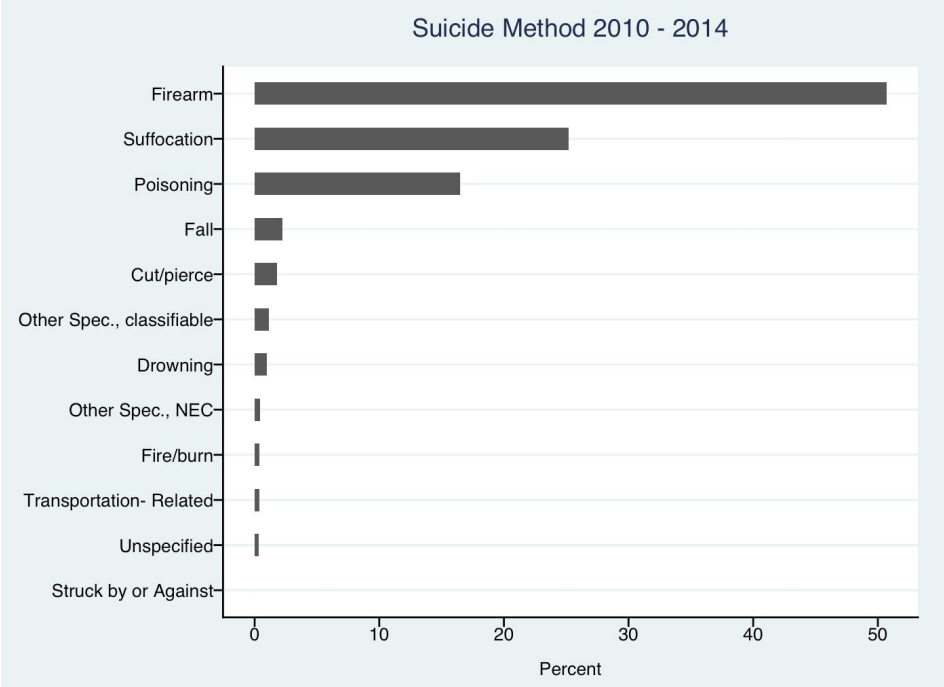
in life threatening situations, which may explain why four of the statistically significant categories involve death. Background checks therefore identify potentially harmful individuals and prevents these individuals from committing crimes. Robbery differs from the other four categories in that it does not involve death but it does involve direct contact with an individual. The criminals involved in robberies may obtain firearms through the secondary market, which they then use to intimidate their victims. Some skeptics of gun control argue that potential offenders will deviate to other forms of weapons to commit the same crimes in the absence of firearms. Although the situation in this argument can occur, the absence of firearm access has still proven to substantially reduce crime in situations where the offender is in direct contact with their victims. It seems that blocking access to firearms is enough of an incentive to deter the offender from committing the crime altogether. Any policy that aims to reduce crime and deaths rates should consider universal firearm background checks as a viable option.

The previously mentioned results were promising from a gun control perspective but other results from this study do not align with the gun control narrative. The impact of the gun control regulation was inconclusive for nine of the dependent variable categories. Two of which were in the violent crime category, five in the property crime category, and two involved suicides. Restricting gun access does not significantly deter actions of rape and aggravated assault. Offenders of these crimes may not rely on firearms as the main method of intimidation; in fact less than twenty-three percent of aggravated assaults involved firearms in 2014 (FBI, Uniform Crime Report). The same explanation may extent to all property crimes as well; the offender's intentions may not be to eliminate their victims but to cause harm or obtain something

from them. Firearms may attract unwanted attention to individuals with the desire to commit a property crime.

Suicides differ from the previously mentioned categories in that they involve death but were not impacted by the gun law. One would expect the gun law to significantly reduce suicides levels since fifty percent of them were committed using firearms from 2010 to 2014 (Figure 12). The implications of these results may reveal a gap in the structure of the universal firearm background check regulations; additional requirements may be needed in order to detect factors that lead to suicide. These supplementary requirements can then significantly impact suicide levels by preventing gun access to unstable persons.

Figure 12



These statistically insignificant results however contradict pro-gun claims that gun control increases crime because it prevents people from adequately protecting themselves. If these claims were accurate then the results from this analysis would include statistically

significant positive relationships between the gun law variables and the dependent variables, none of which share this relationship. The gun law at worse has no impact on certain types of crime rates and death rates but at the least prevents other types of crime rates and deaths rates. UFBC regulations differ from other gun control regulations in that they only target crime-prone individuals and allow gun access to law-abiding citizens. This specific gun law will actually enhance protection because offenders will have to divert to other forms of weapons where potential victims are better suited to protect themselves against. Even after considering the inconclusive results, policy makers may still want to consider implementing UFBC regulations in order to reduce crime and death rates.

Over recent years, public mass shootings have lead the debate regarding gun reform with events such as the 2018 Parkland Florida shooting where 17 people were killed (Levenson, 2018). Gun control advocates commonly mention universal firearm background checks and increasing age restrictions as promising deterrents against mass shootings that occur at schools and other public areas. The argument here is that the background checks will determine unstable individuals and block them from firearm access, which will then prevent catastrophic mass shootings. This study, however, may not contain results that can apply to this argument. Mass shootings are situations where greater than two to three people are killed, not including the offender (Follman et al., 2018). These situations differ from standard crime and death rates because a greater quantity of victims are involved in each incident and the determinants of mass shootings may differ from the determinants of standard crime related incidents. As the laws formally stand, it seems that background checks are not capable to significantly deter mass shootings. The offenders of mass shootings legally obtained their firearms in greater than three

quarters of all mass shootings (Follman et al., 2018). Thus, the requirements to own a gun should be revised and include factors that signify mass shooting incidents. A formal study specifically analyzing the impact of gun control on mass shootings can more accurately depict the extent of the relationship.

As previously stated with the situation regarding suicide levels, a major flaw with the current UFBC system is that it may not be extensive enough to detect mental health issues that may persuade individuals to commit suicides and participate in a mass shootings. Many mass shootings have occurred where offenders legally obtained their firearms, even after participating in a background check. These sorts of situations might compromise the impact of background checks on reducing death rates. Closing this gap will be difficult because policy makers will have to determine a subjective definition of what makes a person mentally unstable to own a firearm.

The results from this study do not contradict any results from previous studies mentioned in the lit review section. Lott and Mustard (1997) determined that states that implemented RTC laws, which allowed for greater gun access to the general public, were associated with lower rates of murder, rape, and aggravated assault with a minimal impact on property crimes. The purpose of RTC laws is to deter crime by allowing law-abiding citizens access to protection against criminals. The adoption of universal firearm background check laws can only amplify these results by limiting the access of guns to criminals and therefore giving law-abiding citizens an upper hand when confronted by criminals. It is within reason to believe that an interaction between the RTC law and the UFBC law will have a greater impact on reducing crime rates.

Ludwig and Cook (2000) determined that the Brady Act, which implemented background checks on firearm transfers conducted with licensed firearm dealers, had no impact on homicide

rates and minimal impact on suicides rates. The results from this study conclude the opposite, where the gun law variable had a significant impact on homicide rates and no impact on suicide rates. A universal background check regulation closes the private sales loophole and blocks criminals from committing homicides. The lack of dedication to mental illness detection explains why background checks had no impact on suicide levels. The studies conducted by Sen and Panjamapirom (2012) and Kleck et al. (2016) also align with the results of this study; regulations that involve background checks have a significant impact on crime and death rates.

Some results regarding state characteristics were questionable; increases in income, poverty, and high school dropout levels had opposite impacts on crime and death rates from what is expected. These findings parallel results from previous studies. Stack (1984) found that increases in the gini inequality index, which measures income distribution, was associated with increases in property crime rates. When inequality increases, poverty and school dropout rates may increase as well. This could signify that increases in the factors that create inequality, such as poverty and school dropout rates may also be associated with reductions in crime. Ramos (2014) using a fixed effects model, found that increases in poverty levels were associated with decreases in violent crimes and increases in GDP per capita were associated with increases in violent crimes. Ramos explains that according to criminal opportunity theory, offenders of crime have incentives to target higher rewarding areas with higher income and less poverty. The results from the fixed effects models may not be misleading considering this explanation and the fact that other covariates behaved in the expected manner.

The results of this study should be taken with caution considering the limitations involved with the analytical approach. The impact of other regulations aiming to deter crime and

death rates were not accounted for in this analysis. There is a possibility that the true impact of the UFBCL variable is minimal and it is taking credit for other policies. Because the fixed effects model accounts for any time invariant variables, policies adopted outside this studies time period were taking into account. However, any policy implementations between 2010 and 2014 were not accounted for. The time frame of five years is also small and the results from this study do not depict any long-term reductions in crime and death rates. There could be an initial response to the gun law but this response could deteriorate as time passes. The decreasing crime and death rate trend is also a factor to consider. While this study did make efforts to account for time trends, it is unlikely that omitted variable bias is absent in the models. Therefore the coefficients for the gun law variables may not accurately represent the true impact of background checks on crime and death rates because the coefficients may be biased.

The ramifications of adopting a universal firearm background check regulation is a topic worth discussing. The United States has a history of casting certain groups of people into underprivileged living standards that leads to a path of drugs, crime, and unexpected death. These groups are usually based on race with African-American and Hispanic communities being the most vulnerable to poverty and crime. Universal firearm background checks will then disproportionally limit the accessibility of firearms to these groups of people. The law itself is not innately discriminative but the socio-economic factors that people experience are, which will in turn cause the gun law to be discriminatory against them. These laws usually prevent "felons, persons convicted of domestic violence crimes, and persons dangerously mentally ill" from acquiring firearms (Rev. Code Wash. § 9.41.113). Once an individual is determined to be a felon or domestic abuser, the individual will hold that status for life and will never be able to own a

firearm past that point. At this time there is no length of good behavior that the law outlines in which an individual can obtain back firearm access. Since African-Americans and Hispanics are more susceptible to hold a status that the gun law deems irresponsible to hold a firearm, people who belong to these two groups will disproportionately have firearm access denied to them. Their access to firearms will be denied even after consistent years of being a law-abiding citizen.

The lifetime denial of firearm access transitions into the topic of second amendment rights of U.S. citizens. Universal firearm background check laws leave room for subjective opinions on who is rightfully responsible to own a firearm, especially in the mental illness category. A critique against background checks questions the ability to determine the definition for what a "dangerously mentally ill" person signifies. Should veterans with PTSD, individuals with high levels of anxiety, or individuals who visit a therapist be trusted with a firearm? The loose definition of a mentally ill person may unjustifiably strip U.S. citizens' rights to self-protection or recreational use of firearms. The benefits of adopting the gun law may open doors to negative externalities that violate individual rights for which the U.S. was built upon. This may not be a great concern considering the positive impact of adopting a UFBC regulation in reducing crime and death rates, but it is an opinion that many citizens hold and is worth noting. Background checks are a stepping-stone to reducing crime and death rates but efforts to address the underlying problems of poverty, education, and mental illness may yield long-term results.

Conclusion

This study explores the topic of gun control, specifically the impact of universal firearm background checks on crime and death rates. This analysis contributes to the ongoing gun

control debate by analyzing the benefits of background checks while incorporating a fixed effects model using recent state-level panel data. The results suggest that adopting the background check law is associated with reductions in general violent crime, murder, robbery, firearm homicide, and general homicide levels. Firearm background checks laws, however, have no impact on property crimes and suicide levels. These insignificant results can be explained by the lack of property crime events that involve firearms and the mental illness detection gap that exists in the gun law. The main limitations of this analysis involve using a short time frame of five years, already decreasing crime rates, and the absence of accounting for other policy methods. Nevertheless, the results for this study have strong implications on policy targeted to deter crime and death rates. A discussion outlining race discrimination and the infringement of U.S. citizens' rights as potential negative externalities of adopting the universal firearm background check law is also reviewed. Overall, this study concludes that firearm background checks have a positive impact on society by reducing crime rates and death rates, but modifications are needed in order to provide efficient and fair results.

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Appendix

Table 10: CDC missing data

State	Missing values
Alaska	3
District of Columbia	5
Hawaii	6
Idaho	4
Maine	5
Montana	5
New Hampshire	8
North Dakota	10
Rhode Island	6
South Dakota	6
Vermont	10
Wyoming	7

Table 11: OLS Regression

	Dependent Variables: Natural Log of Violent Crime Rates per 100,000 Persons				
	1	2	3	4	5
	Violent	Murder	Rape	Robbery	Assult
UFBCL	-0.033	-0.202*	0.119	-0.026	-0.045
	(0.104)	(0.105)	(0.115)	(0.138)	(0.133)
% Unemployed	0.030**	0.018	-0.008	0.159***	0.002
	(0.013)	(0.014)	(0.015)	(0.018)	(0.017)
Population Density	0.0001***	0.00001	0.0001***	0.00005	0.0001**
	(0.00002)	(0.00002)	(0.00003)	(0.00003)	(0.00003)
Log of Per Capita Income	0.034	0.213	-0.894**	0.635	-0.037
	(0.327)	(0.330)	(0.362)	(0.436)	(0.420)
% Poverty < 18	0.063***	0.056***	0.023	0.147***	0.049**
	(0.015)	(0.015)	(0.017)	(0.020)	(0.020)
% Poverty 18 to 64	-0.118***	-0.065**	-0.067**	-0.271***	-0.088**
	(0.027)	(0.027)	(0.030)	(0.035)	(0.034)
% HS Dropout	0.117***	0.093***	0.108***	0.049**	0.140***
	(0.017)	(0.017)	(0.019)	(0.023)	(0.022)
% Hispanic	0.007***	0.005**	-0.006**	0.010***	0.008**
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
% Black	0.005*	0.024***	-0.019***	0.017***	0.005
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Year	0.070***	0.060***	0.102***	0.149***	0.049**
	(0.019)	(0.020)	(0.021)	(0.026)	(0.025)
Constant	-135.681***	-122.451***	-191.449***	-303.038***	-93.693*
	(38.474)	(38.911)	(42.674)	(51.287)	(49.485)
Observations	255	255	255	255	255
R^2	0.580	0.725	0.313	0.761	0.408
Adjusted R^2	0.562	0.714	0.285	0.751	0.384
Residual Std. Error (df = 244)	0.286	0.290	0.318	0.382	0.368
F Statistic (df = 10; 244)	33.633***	64.345***	11.115***	77.684***	16.811***

Note: *p<0.1;* ***p<0.05;*** p<0.01

UFBCL: Universal Firearm Background Check Law

Table 11: OLS Regression (Continued)

	Dependent Variables: Natural Log of Property Crime Rates per 100,000 Persons				
	6	7	8	9	10
	Property	Burglary	Larceny	Moter Vehicle Theft	Arson
UFBCL	-0.001	-0.058	0.027	-0.132	-0.148
	(0.064)	(0.082)	(0.065)	(0.137)	(0.145)
% Unemployed	0.012	0.036***	-0.002	0.060***	0.019
	(0.008)	(0.011)	(0.008)	(0.018)	(0.019)
Population Density	0.0001***	0.00001	0.0001***	0.0001***	-0.0002***
	(0.00001)	(0.00002)	(0.00002)	(0.00003)	(0.00003)
Log of Per Capita Income	-0.692***	-0.981***	-0.594***	-0.600	0.343
	(0.203)	(0.258)	(0.206)	(0.430)	(0.455)
% Poverty < 18	0.015	0.051***	0.006	0.002	0.057***
	(0.009)	(0.012)	(0.010)	(0.020)	(0.021)
% Poverty 18 to 64	-0.042**	-0.076***	-0.029*	-0.055	-0.080**
	(0.017)	(0.021)	(0.017)	(0.035)	(0.037)
% HS Dropout	0.038***	0.023*	0.035***	0.109***	0.069***
	(0.011)	(0.013)	(0.011)	(0.022)	(0.024)
% Hispanic	0.004***	0.003*	0.003**	0.015***	-0.006*
	(0.001)	(0.002)	(0.001)	(0.003)	(0.003)
% Black	0.003*	0.005**	0.003*	0.001	-0.011***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)
Year	0.003	-0.005	-0.003	0.074***	-0.019
	(0.012)	(0.015)	(0.012)	(0.025)	(0.027)
Constant	9.078	25.074	19.458	-138.130***	37.398
	(23.898)	(30.338)	(24.220)	(50.649)	(53.630)
Observations	255	255	255	255	255
R^2	0.433	0.601	0.322	0.425	0.396
Adjusted R^2	0.410	0.585	0.294	0.402	0.371
Residual Std. Error (df = 244)	0.178	0.226	0.180	0.377	0.399
F Statistic (df = 10; 244)	18.640***	36.825***	11.601***	18.054***	16.010***

Note: *p<0.1;* ***p<0.05;*** p<0.01

UFBCL: Universal Firearm Background Check Law

Table 11: OLS Regression (Continued)

	Dependent Variables: Natural Log of CDC Death Rates per 100,000 Persons			
	11	12	13	14
	Firearm Homicide	Homicide	Firearm Suicide	Suicide
UFBCL	-0.236**	-0.169*	-0.032	0.021
	(0.110)	(0.097)	(0.100)	(0.060)
% Unemployed	0.034**	0.010	0.020	-0.003
	(0.017)	(0.014)	(0.014)	(0.008)
Population Density	-0.00001	-0.00003	-0.001***	0.00003*
	(0.00003)	(0.00002)	(0.0001)	(0.00001)
Log of Per Capita Income	-0.438	0.213	-0.864***	-0.987***
	(0.378)	(0.314)	(0.324)	(0.190)
% Poverty < 18	0.127***	0.091***	-0.029*	-0.029***
	(0.020)	(0.015)	(0.015)	(0.009)
% Poverty 18 to 64	-0.180***	-0.098***	0.021	0.024
	(0.035)	(0.027)	(0.026)	(0.015)
% HS Dropout	0.046**	0.067***	0.072***	0.075***
	(0.022)	(0.017)	(0.017)	(0.010)
% Hispanic	-0.003	0.0003	-0.005**	-0.002*
	(0.003)	(0.002)	(0.002)	(0.001)
% Black	0.023***	0.022***	-0.001	-0.013***
	(0.003)	(0.003)	(0.003)	(0.002)
Year	0.072***	0.048**	0.064***	0.048***
	(0.024)	(0.019)	(0.019)	(0.011)
Constant	-139.764***	-97.865**	-117.651***	-82.924***
	(48.348)	(38.532)	(37.896)	(22.369)
Observations	203	237	250	255
R^2	0.724	0.736	0.725	0.674
Adjusted R^2	0.709	0.725	0.713	0.661
Residual Std. Error	0.296 (df = 192)	0.265 (df = 226)	0.276 (df = 239)	0.167 (df = 244)

Note: *p<0.1; **p<0.05;** p<0.01

UFBCL: Universal Firearm Background Check Law

Figure 13

States with a mass shooting 2010 - 2014

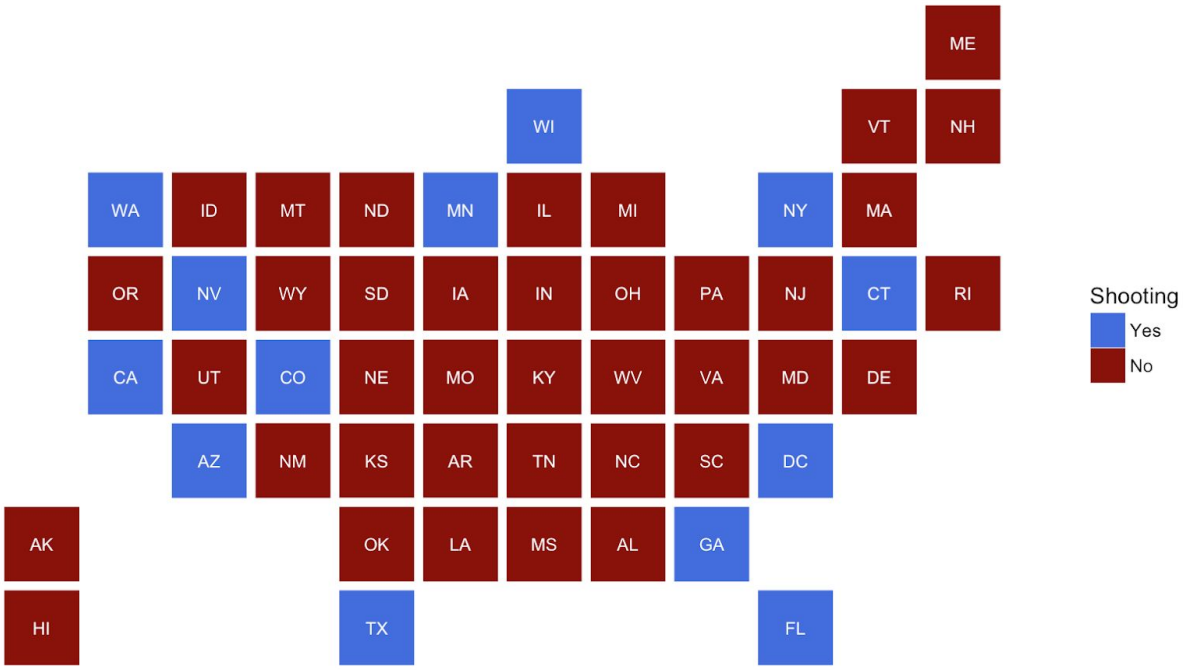


Figure 14

2012 US Election

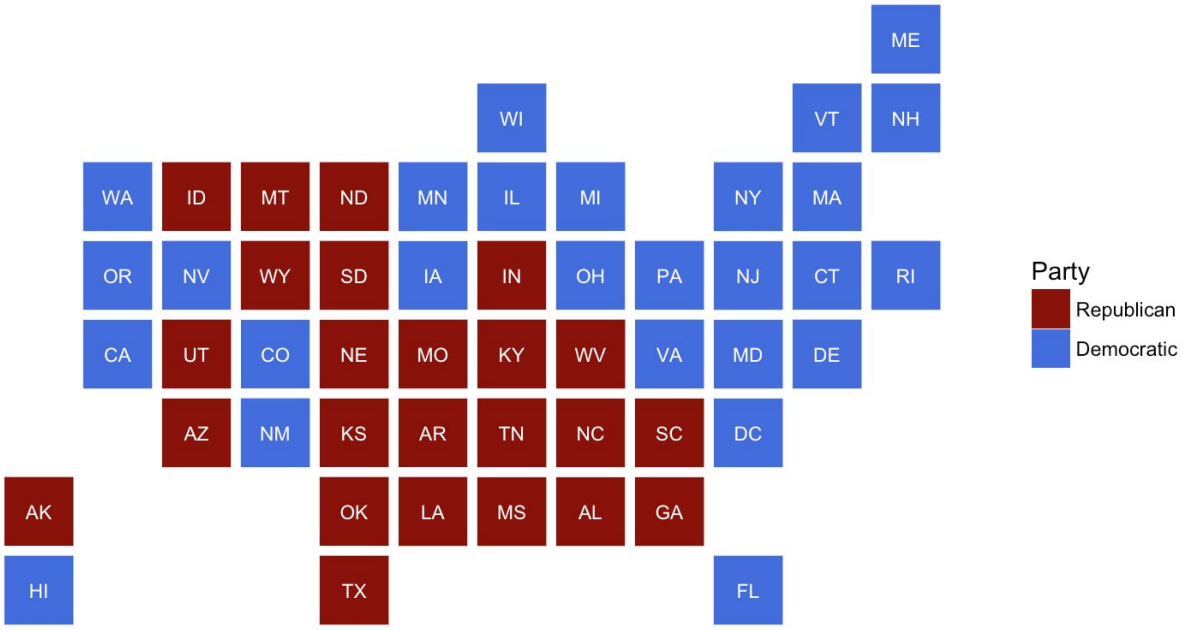


Figure 15

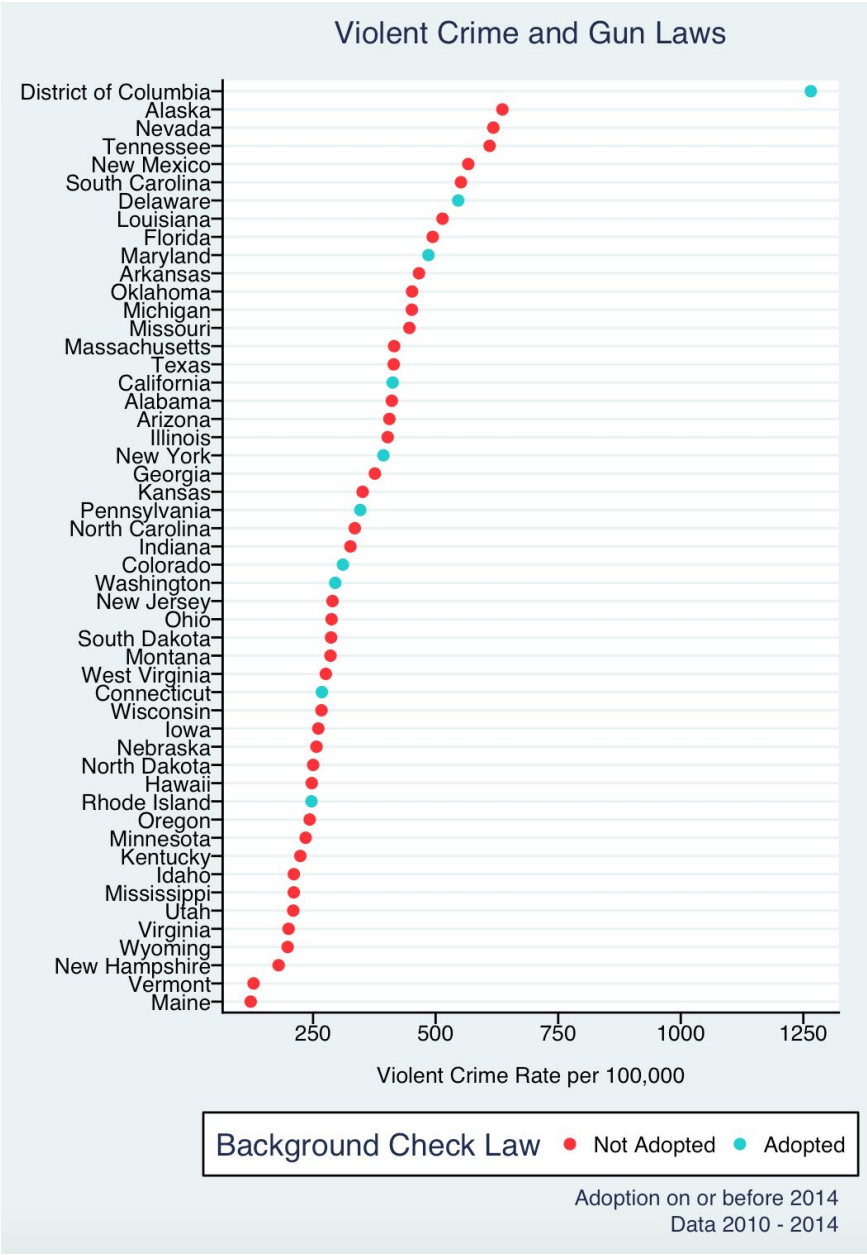

Violent Crime and Gun Laws
District of Columbia
Alaska
Nevada
Tennessee
New Mexico
South Carolina
Delaware
Louisiana
Florida
Maryland
Arkansas
Oklahoma
Michigan
Missouri
Massachusetts
Texas
California
Alabama
Arizona
Illinois
New York
Georgia
Kansas
Pennsylvania
North Carolina
Indiana
Colorado
Washington
New Jersey
Ohio
South Dakota
Montana
West Virginia
Connecticut
Wisconsin
Iowa
Nebraska
North Dakota
Hawaii
Rhode Island
Oregon
Minnesota
Kentucky
Idaho
Mississippi
Utah
Virginia
Wyoming
New Hampshire
Vermont
Maine
250
500
750
1000
1250
Violent Crime Rate per 100,000
Background Check Law
Not Adopted
Adopted
Adoption on or before 2014
Data 2010 - 2014

Figure 16

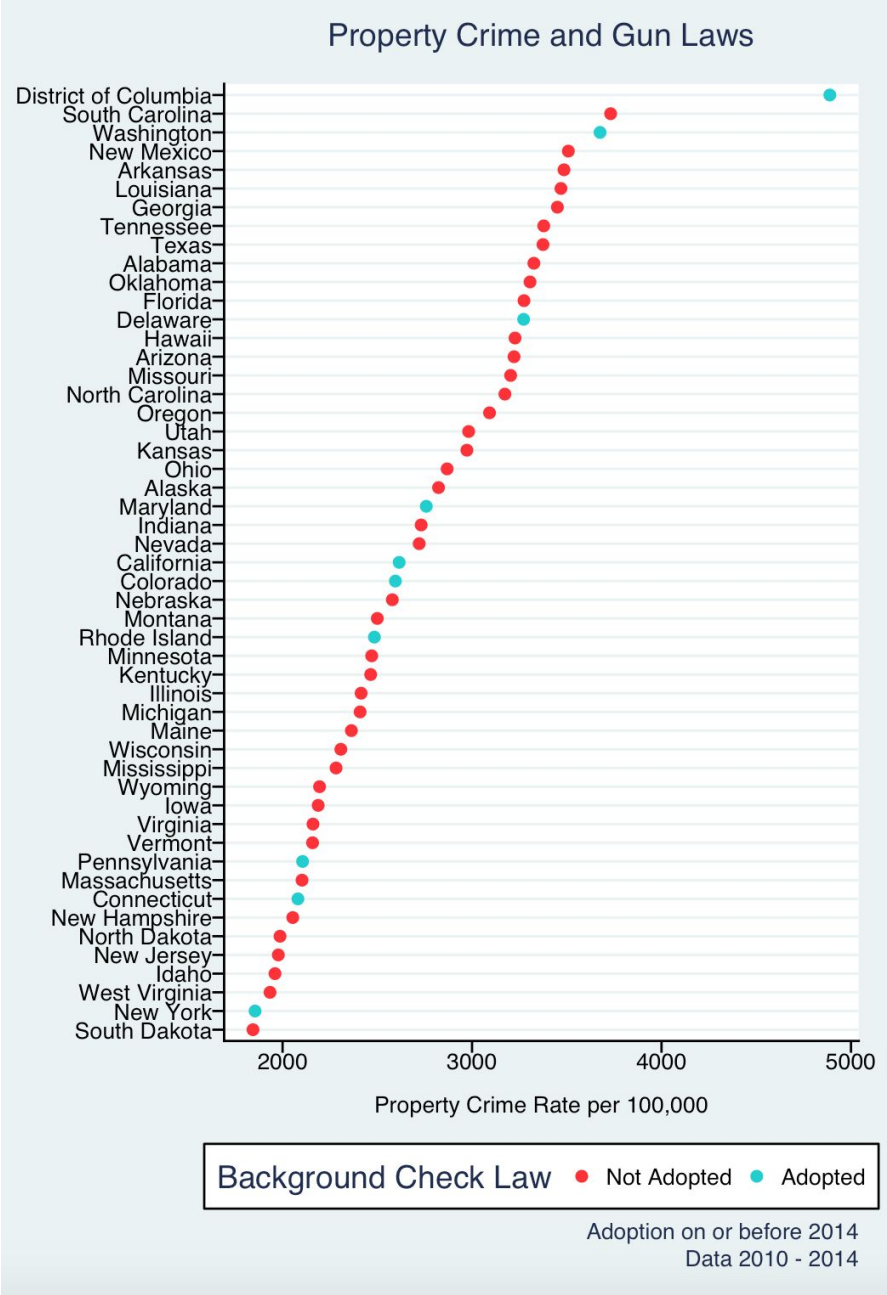

Property Crime and Gun Laws
District of Columbia
South Carolina
Washington
New Mexico
Arkansas
Louisiana
Georgia
Tennessee
Texas
Alabama
Oklahoma
Florida
Delaware
Hawaii
Arizona
Missouri
North Carolina
Oregon
Utah
Kansas
Ohio
Alaska
Maryland
Indiana
Nevada
California
Colorado
Nebraska
Montana
Rhode Island
Minnesota
Kentucky
Illinois
Michigan
Maine
Wisconsin
Mississippi
Wyoming
Iowa
Virginia
Vermont
Pennsylvania
Massachusetts
Connecticut
New Hampshire
North Dakota
New Jersey
Idaho
West Virginia
New York
South Dakota
2000
3000
4000
5000
Property Crime Rate per 100,000
Background Check Law
Not Adopted
Adopted
Adoption on or before 2014
Data 2010 - 2014

Figure 17

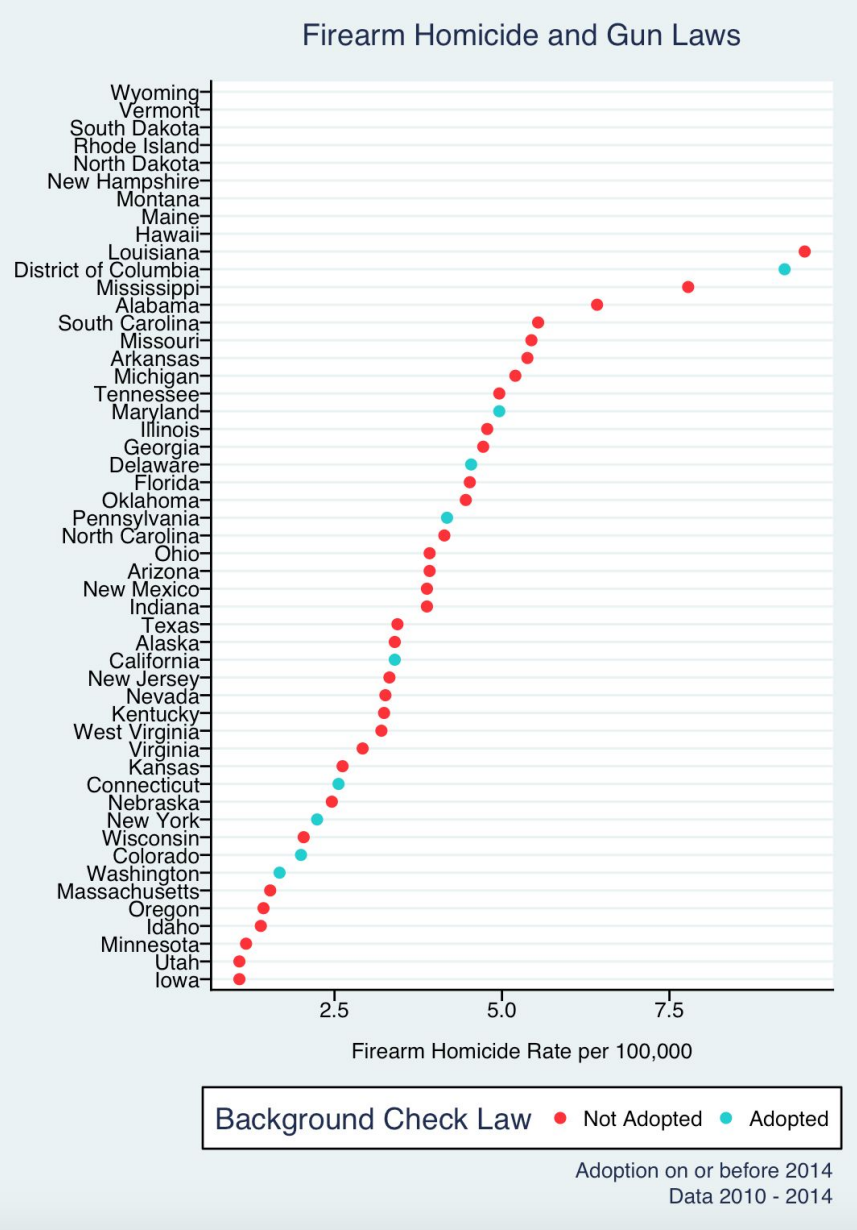

Firearm Homicide and Gun Laws
Wyoming
Vermont
South Dakota
Rhode Island
North Dakota
New Hampshire
Montana
Maine
Hawaii
Louisiana
District of Columbia
Mississippi
Alabama
South Carolina
Missouri
Arkansas
Michigan
Tennessee
Maryland
Illinois
Georgia
Delaware
Florida
Oklahoma
Pennsylvania
North Carolina
Ohio
Arizona
New Mexico
Indiana
Texas
Alaska
California
New Jersey
Nevada
Kentucky
West Virginia
Virginia
Kansas
Connecticut
Nebraska
New York
Wisconsin
Colorado
Washington
Massachusetts
Oregon
Idaho
Minnesota
Utah
Iowa
2.5
5.0
7.5
Firearm Homicide Rate per 100,000
Background Check Law
Not Adopted
Adopted
Adoption on or before 2014
Data 2010 - 2014

Figure 18

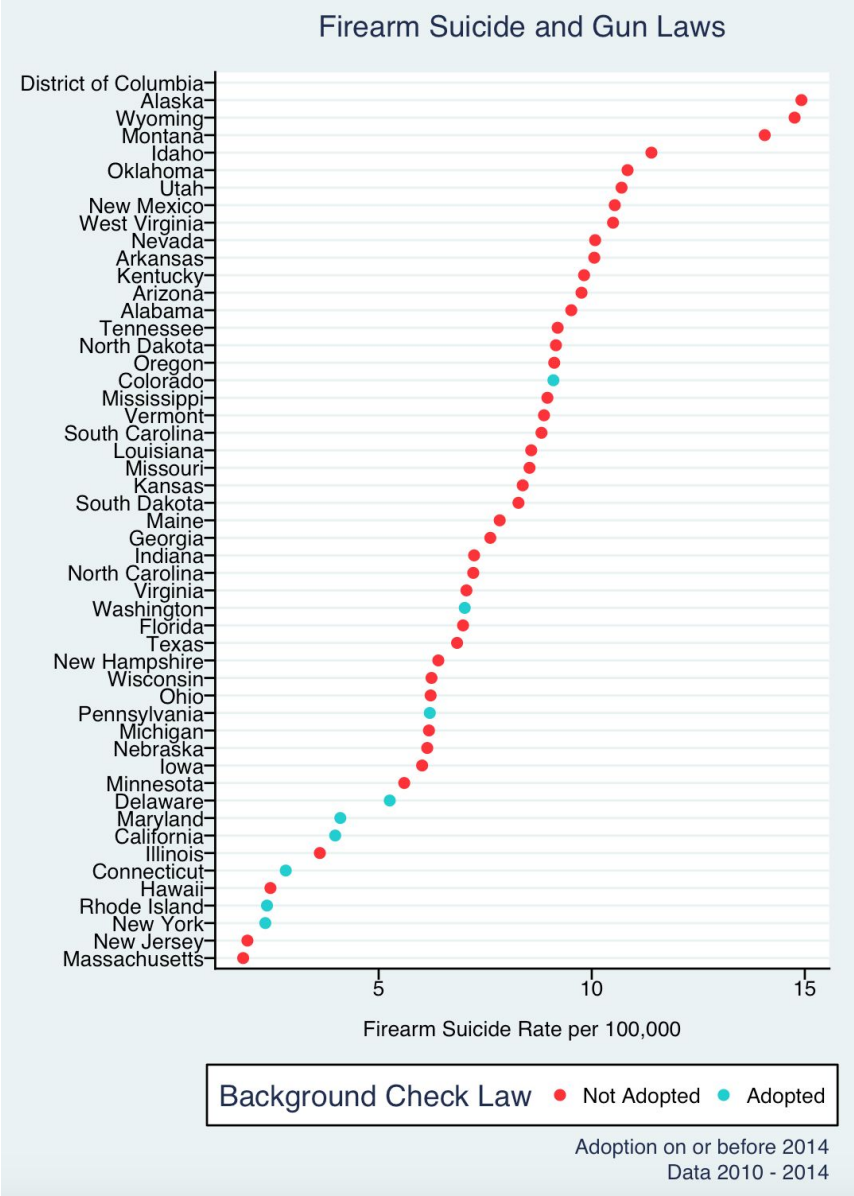

Firearm Suicide and Gun Laws
District of Columbia
Alaska
Wyoming
Montana
Idaho
Oklahoma
Utah
New Mexico
West Virginia
Nevada
Arkansas
Kentucky
Arizona
Alabama
Tennessee
North Dakota
Oregon
Colorado
Mississippi
Vermont
South Carolina
Louisiana
Missouri
Kansas
South Dakota
Maine
Georgia
Indiana
North Carolina
Virginia
Washington
Florida
Texas
New Hampshire
Wisconsin
Ohio
Pennsylvania
Michigan
Nebraska
Iowa
Minnesota
Delaware
Maryland
California
Illinois
Connecticut
Hawaii
Rhode Island
New York
New Jersey
Massachusetts
5
10
15
Firearm Suicide Rate per 100,000
Background Check Law
Not Adopted
Adopted
Adoption on or before 2014
Data 2010 - 2014

Figure 19

Violent Crime 2010 - 2014 Excluding D.C.

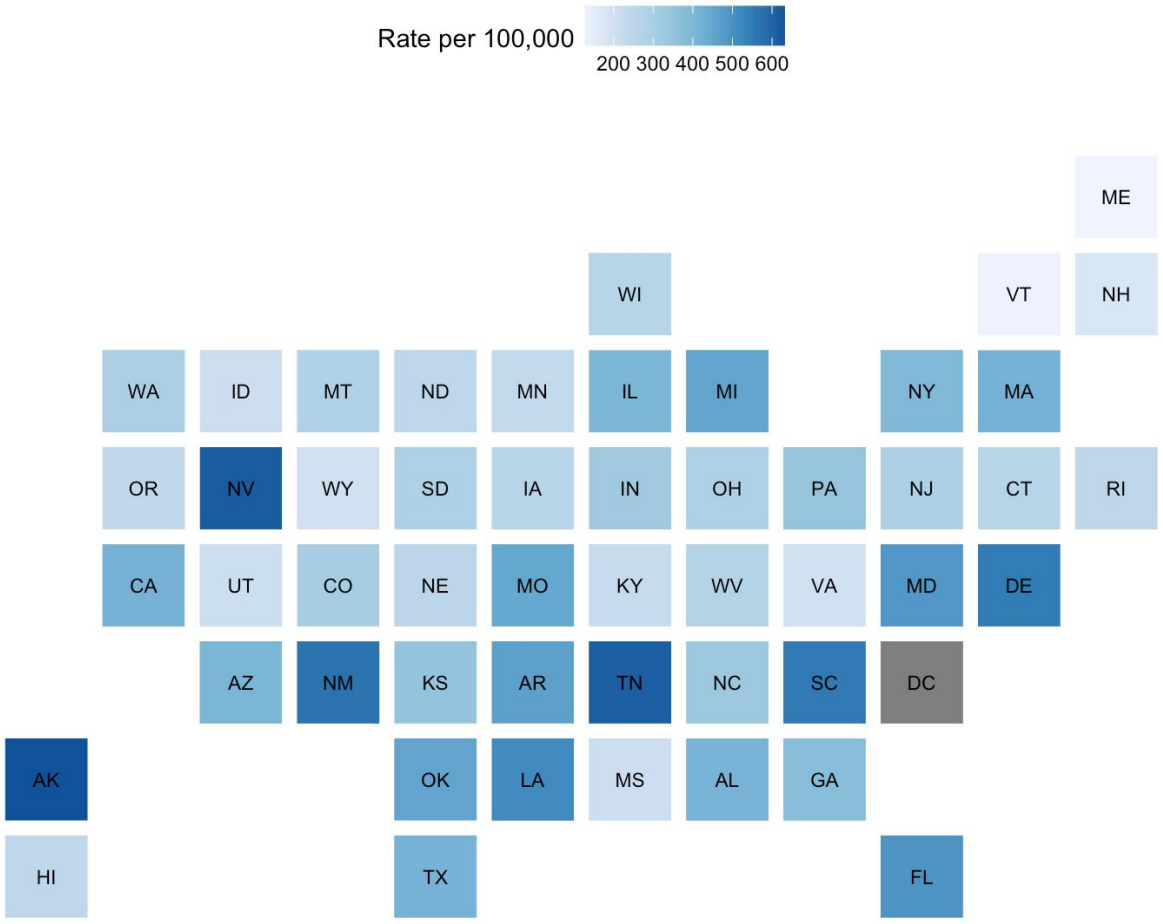


Figure 20

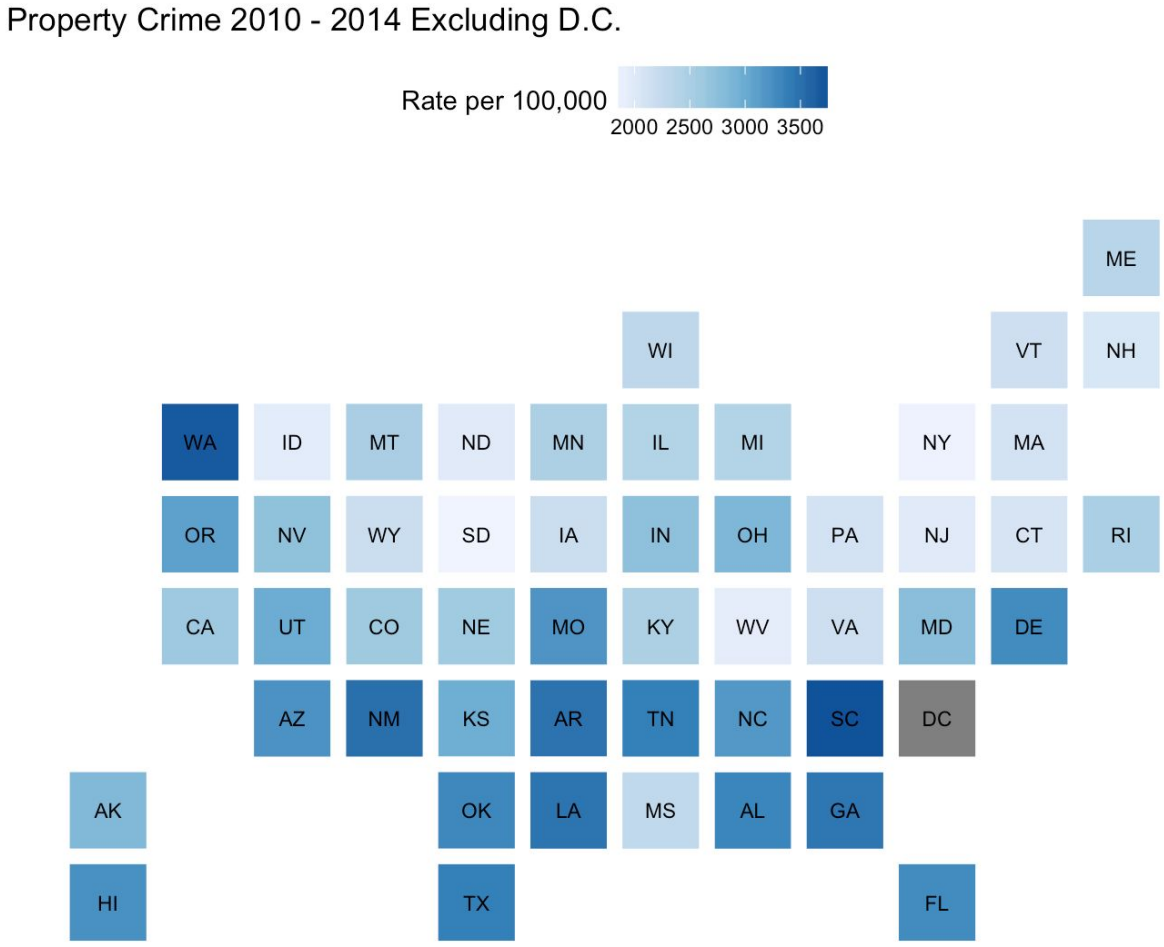

Property Crime 2010 - 2014 Excluding D.C.
Rate per 100,000
2000 2500 3000 3500
ME
WI
VT
NH
WA
ID
MT
ND
MN
IL
MI
NY
MA
OR
NV
WY
SD
IA
IN
OH
PA
NJ
CT
RI
CA
UT
CO
NE
MO
KY
WV
VA
MD
DE
AZ
NM
KS
AR
TN
NC
SC
DC
AK
OK
LA
MS
AL
GA
HI
TX
FL

Figure 21

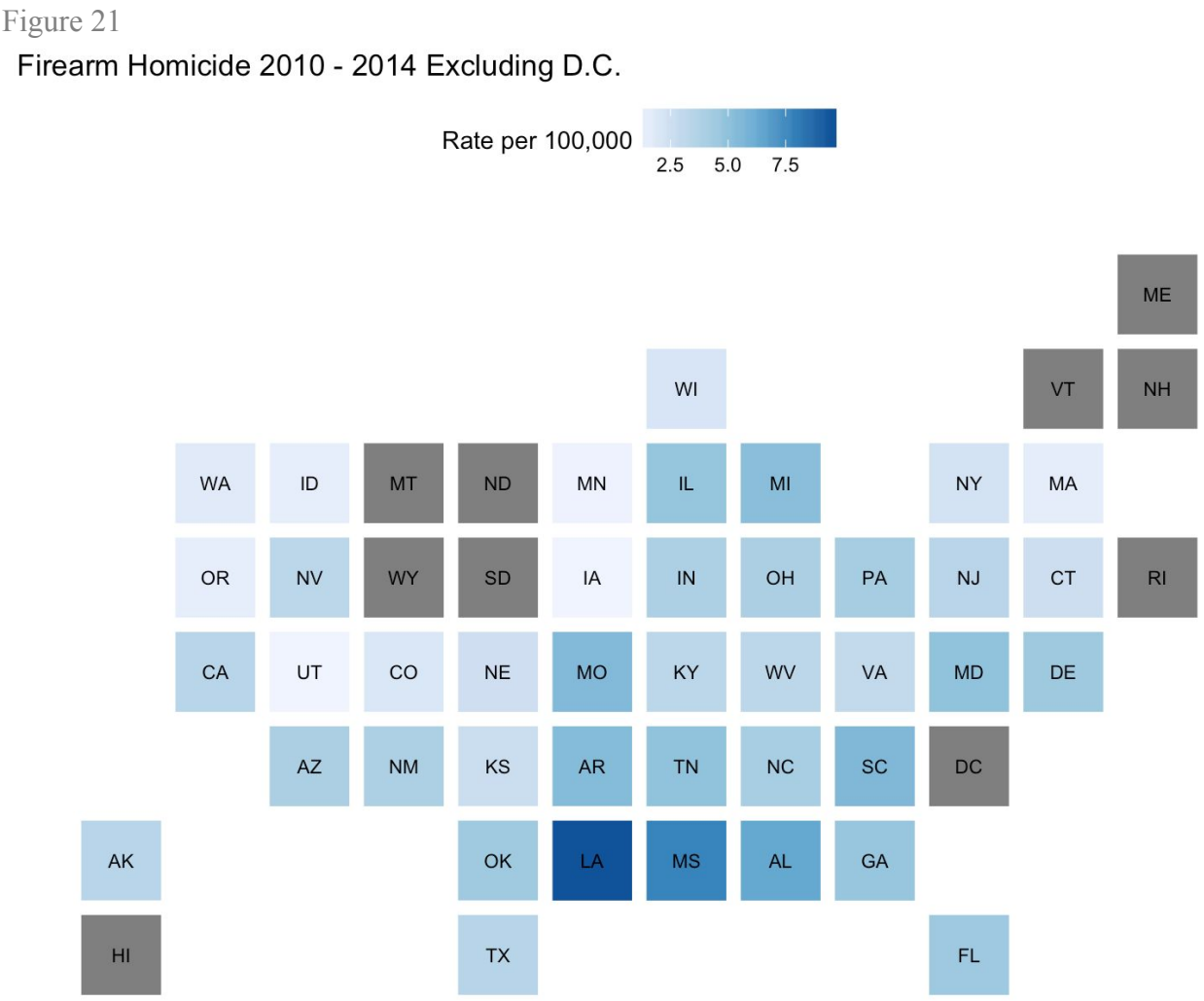
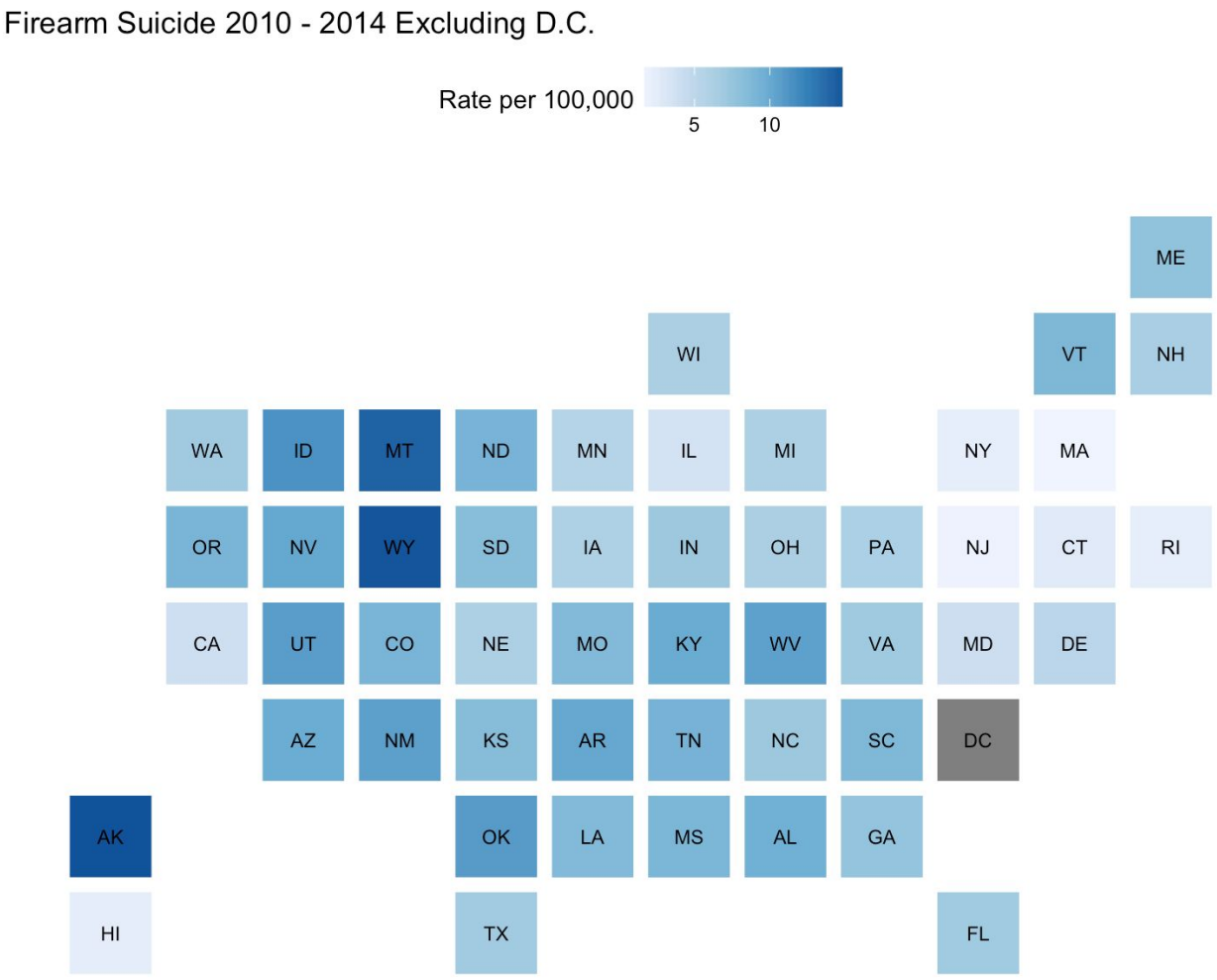

Firearm Homicide 2010 - 2014 Excluding D.C.
Rate per 100,000
2.5
5.0
7.5
ME
WI
VT
NH
WA
ID
MT
ND
MN
IL
MI
NY
MA
OR
NV
WY
SD
IA
IN
OH
PA
NJ
CT
RI
CA
UT
CO
NE
MO
KY
WV
VA
MD
DE
AZ
NM
KS
AR
TN
NC
SC
DC
AK
OK
LA
MS
AL
GA
HI
TX
FL

Figure 22


Firearm Suicide 2010 - 2014 Excluding D.C.
Rate per 100,000
5
10
ME
WI
VT
NH
WA
ID
MT
ND
MN
IL
MI
NY
MA
OR
NV
WY
SD
IA
IN
OH
PA
NJ
CT
RI
CA
UT
CO
NE
MO
KY
WV
VA
MD
DE
AZ
NM
KS
AR
TN
NC
SC
DC
AK
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FL