Firearm Violence in Relation to State Legislation:

Does stricter legislation result in lower rates of gun violence?

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Abstract

Every year, tens of thousands of U.S. civilians are affected by firearm violence yet gun control is still heavily debated. The relationship between gun ownership and violence is hotly disputed and highly politicized; much of this stems from the fact that the research is inconclusive on the direction and strength of this relationship. The research that has been done struggles to find clear evidence because the task of identifying precisely the nature of gun policies is a difficult one. This study seeks to help clarify the problem by examining correlations between legislation and gun violence. Found literature supports the finding that gun laws have significant, but varying, relationships with firearm incident rates. A policy change between 2013-2015, allows concealed carrying of long guns,and requires permits to purchase handguns. These were found to be positively correlated with an increase in gun violence. Allowing individuals to openly carry handguns and requiring permits to purchase long guns were correlated with decreases in gun violence. Future research is encouraged to examine the effects of gun control policies via time series analysis, and more closely investigate the relationship between laws and violence to ensure that legislation is effective.

Introduction

In 2014 over 33,000 deaths were attributed to gun violence ("All Injuries," 2016). Firearm violence is so prevalent in American society that it is sometimes referred to as an "epidemic" by both the media and medical professionals (Rigsby & Miller, 2016). Every year, the issue of gun violence grows increasingly contentious. Throughout the country laws are passed both for and against the ownership of these weapons, varying by state. Despite the evident concern that our nation has for firearms and subsequent violence, there appears to be little current research on the subject. One explanation for this dearth of information is the highly politicized nature of gun ownership.

In 1996 the Center for Disease Control (CDC), helped fund the publication of a highly controversial study that found that homicides in the home had a link to owning firearms (Kellermann, Rivara, Rushforth, Banton, Reay, Francisco, & Somes, 1993). This publication prompted the National Rifle Association (NRA) to accuse the CDC of having a political bias and using their influence to push for stricter gun control legislation (Rigsby & Miller, 2016). Thus, the 1996 House Omnibus Appropriations Bill cut funding for firearm research and stated that "None of the funds made available for injury prevention and control at the Centers for Disease Control and Prevention may be used to advocate or promote gun control" (Public Law 104–208, 1996). This effectively halted firearm related research for decades.

As a result, much of the information regarding firearms that the public can easily access comes from mainstream media outlets. Unfortunately, this information may not always be the most accurate, due to biases. In 2015, Eric Bolling of Fox News stated that "In countries where there are higher, more strict gun laws, there is more gun violence," which has been found to be untrue, as similar countries with stricter laws often report much lower rates of firearm incidents

(Greenberg, 2015). However, conservative media, is not the only platform for the spread of misinformation. In 2016 CBS News reported via Twitter that "It took 38 minutes and $1,030 for our @CBSNews producer to buy an AR-15 and walk out legally armed in Virginia," which they then had to issue a correction for as the firearm purchased was not in fact an AR-15 (CBS News, 2016). This rampant spread of false information would not be as troubling were it not for the fact that this information often informs the public's voting behavior. An uninformed public might vote for legislation that drastically decreases gun control, thinking that they are helping to reduce gun violence. Oppositely, they might vote for much tighter legislation that spends millions of tax dollars on something that does little for the overall goal of reducing violence. Ultimately, it is in the best interest of the public to identify which policies are effective and which are not. The premise of this study is to determine whether or not significant correlations can be found between a state's legislation and firearm violence. The following findings may help inform future policy decisions and encourage better understanding of the issue.

Literature Review

Those who research the effect of legislation on firearm violence often obtain inconclusive or contradictory results. For example, in 1996 Australia ratified the National Firearms Agreement (NFA) in an effort to prevent mass shootings. The NFA severely limited gun ownership and allowed the Australian government to provide monetary compensation for guns that were handed in to law enforcement. The law was fiercely debated when it was passed, with one side believing that tighter policies would prevent gun violence, and the other vehemently disagreeing. Years later, researchers Baker and McPhedran compiled enough data on firearm related homicides and suicides to perform a time series analysis to determine whether the NFA was indeed effective (2007). The authors examined firearm violence rates from both pre and post ratification of the NFA and found

that the law had highly varying causational effects. While firearm related suicides decreased following implementation of the NFA, there were still significant numbers of suicides from other means[1]. In fact, they found that suicides actually increased immediately after the NFA became effective. Over a period of ten years, rates of suicide decreased; following a longstanding trend evident prior to the ratification of the NFA. Thus, they hypothesized that this reduction was due to societal changes rather than the effect of the NFA. As for homicides, the authors found that "gun buy-back and restrictive legislative changes" had "no influence on firearm homicide in Australia" (Baker & McPhedran, 2007). Despite extensive evaluation of statistics, they found little to suggest that the NFA was directly responsible for a decrease in violence.

This type of finding is far from uncommon. An article published in *Morbidity and Mortality Weekly Report: Recommendations and Reports* also had difficulty finding causational evidence that strict firearm legislation had any significant effect on gun violence (Hahn, Bilukha, Crosby, Fullilove, Liberman, Moscicki, & Briss, 2003). The authors assembled a body of 51 studies that looked at the relationship between firearm legislation and subsequent gun violence rates. These studies all concerned legislation that addressed violence. Therefore, only those laws pertaining to violent crime, suicide, and unintentional firearm injury were included. Based upon their in-depth examination of the aforementioned body of literature, the authors found that "Evidence was insufficient to determine the effectiveness of any of these laws" (Hahn et. al., 2003). They cited numerous reasons for this insufficiency, namely difficulty measuring both legislation and gun violence. Their study reiterated a need for more accurate reports of incidents, as well as a need for more research on the subject.

[1] Hanging, jumping, drowning, etc.

This need for more externally viable research is stressed by the findings of Janet Rosenbaum from the University of Maryland; who evaluated claims that less restrictive policies could prevent firearm violence. Following a failed assassination attempt of a politician in Arizona that resulted in the deaths and injuries of multiple civilians, concern about gun violence once again rose to the forefront of public conversation. Rosenbaum compared gun violence rates of Switzerland and Israel to that of the United States and found that the commonly held American belief that both countries had less gun violence because of loose legislation to be unfounded (2011). Switzerland and Israel were chosen for their supposedly casual approach to firearm legislation, wherein little to no laws are placed on gun ownership and the population are heavily armed. The author found that both countries, in fact, had fewer guns and tighter laws, and that "Switzerland's limited gun access does not prevent gun violence" (Rosenbaum, 2011). Rather, having such lethal weapons on hand was predictive of more violence and injury. Additionally, Israel's low rates of firearms in the population related to low rates of gun violence. In addition, by limiting Israeli soldier's access to firearms on weekends the Israel Defense Forces saw a 40% reduction in soldier's suicide rates. Rosenbaum postulates that this action may have directly led to the drop in suicide rates. Her research observes that although legislation appears to have no effect on violence rates, the increase of firearms is not a viable solution either.

Model

In order to understand the complex relationships between gun violence and existing political, social and political foundations; this paper utilizes a multiple regression framework. Which not only reveals the direction, but also the magnitude of the relationships between various explanatory variables and gun violence outcomes. As mentioned in the above literature review, multiple scientific studies have encountered confounding societal factors on their research. While

firearm violence might decrease after a shift in policy, the cause of this decrease may have little to do with the effects of the policy. Therefore, time series analyses are almost always required for this type of research. A model of this type would examine firearm violence rates before and after implementation of a policy; and account for race, income, education, and other confounding variables. However, in this instance that type of model was all but impossible to implement, as there are only a few gun violence tracking databases publicly available that contain the most up to date data (2010-2016 etc.). Additionally, firearm legislation varies greatly from state to state and is often written as an expansion upon previously existing bills. Thus, any research on the effect of a bill would require finding the original source of said bill, which is often quite difficult to uncover within each state. The final dataset allowed for limited, correlational statistical testing.

The following model employs regressions to test the strength of correlations between variables when accounting for demographic controls. Therefore, this model shows how closely related firearm violence is to legislation. After the data had been synthesized into one cohesive set that included firearm incidents, legislative policies, and demographic information regression analysis was made possible. All regressions were performed using this model:

$$Gun\ Incident\ Rate = \alpha + \beta Gun\ Policy + \delta State\ Controls + \varepsilon$$

Where *Gun Incident Rate* = the number of firearm incidents per 100,000, as compared to incidents in states that did not have a certain variable, α = variable of interest, $\beta Gun\ Policy$ = legislative data by state, $\delta State\ Controls$ = state demographic information, and ε = second variable of interest. Each type of incident was regressed upon the legislative variables (see Table 2 in the Appendix).

Data

To compile a comprehensive dataset multiple sources were utilized. All statistical gun violence data was gathered from the Gun Violence Archive. This archive tracked firearm violence incidents in the U.S. over the past few years. All events were recorded by incident date, address of the event, and numbers of those injured or killed in the incident. This information was split into multiple types of data sets; for example, the archive contained reports highlighting accidental shootings, officer involved shootings, and teenager involved shootings. Although accidental shootings and officer involved shootings were so insignificant at the national level that legislation could not be correlated with them. The information was then merged into one complete data set that encompassed every firearm incident in the United States between 2012-2016.

Legislative data was then utilized to begin regressions. This data was found via researching specific policies by state. Four firearm related policies were targeted for the purposes of this research: change in policy between 2013-2015, concealed carry, open carry, and permit to purchase. It should be noted that these laws were divided into long gun and hand gun categories. Most states differentiated between the two types of firearms as long guns were often considered more lethal, and thus were more strongly regulated. There is no variable for handgun concealed carry, as each state allowed for this type of permit; thus no interstate correlations could be run. The Law Center to Prevent Gun Violence was a useful source of information regarding legislative trends over the years. In addition, the penal codes of every state were examined to find specific laws about firearms. This data was recorded in binary form[2] and merged with the incident information that had already been compiled (see Figure 2 in the Appendix).

[2] 1 if there was a law, 0 if there was no law or a law that permitted open carry, concealed carry, permit to purchase, etc.

Finally, demographic data obtained from the Integrated Public Use Microdata Series (IPUMS) provided background information for the incidents. This data was controlled for almost all variables related to gun violence so that the regressions would show reliable comparisons between states. The state codes (statefip) allowed demographic information from each state to be merged with individual incidents. This meant that family size (famsize), marital status (marst), race (race), citizenship status (citizen), income (inctot), employment status (empstat), migration status (migrate), fertility rate (feryr), and labor force participation rate (labforce) were all included in the regressions (see Table 1 in the Appendix).

Results

When controlling for many demographic variables, regression analyses displayed significant correlations in several categories. Correlations between the policy variables[3] and firearm violence incidents were highly varied, and yet nearly all remained significantly correlative with firearm violence. It was found that states that experienced a policy change between 2013-2015 had 0.33***[4][5] more incidents than states that did not have a policy change. States that allowed for open carry of handguns had a whopping 1.20*** less firearm related incidents than states that did not allow for open carry. States that allowed for open carry of long guns also saw less gun violence at 0.46*** fewer per 100,000 incidents. While these numbers may seem small, it is important to note that they remain significant at the 95% level. The previously mentioned correlations were supported both with and without the inclusion of other policy variables.

[3] Change in policy between 2013-2015, long gun open carry/concealed carry/permit to purchase, and hand gun open carry/permit to purchase.

[4] Per 100,000 incidents

[5] *** = Significant at the 95% level

However, not all the policies examined remained consistent when other legislation was accounted for. For example, states that allowed for concealed carry of long guns had 0.41*** less incidents than those that did not when other policy variables were not included, but 0.40*** more incidents when other policies were included. Similarly, states that had a law requiring permit to purchase both long and handguns had opposite effects when other policies were accounted for. Requiring a permit to purchase long guns saw a 0.22*** per 100,000 incident increase without other policies, but a 0.08*** increase when those other policies were included (see Table 2 in the Appendix).

In addition to the policy findings other significant correlations between the demographic variables and violence rates were found. Differences in marital status were found to be significantly correlative with both increases and decreases of firearm violence. States that had more marriages had 14.45*** fewer firearm incidents than those that had more single citizens while states that had more divorcees had 23.44*** more incidents than those with a majority of single citizens. States with more citizens born abroad than non citizens saw a 130 more incidents per 100,000. Demographic controls such as employment status and high income were correlative with increased firearm violence (see Table 3).

Conclusion

The findings of this study indicate that policies do have an effect on gun violence. However, the causal influence of those laws is still unclear. There is enough evidence to suggest that policies have at least some impact on violence, when taking such strong correlations into considerations. Yet while these correlations are significant, they are often contradictory and do not indicate that legislation reduces firearm violence. It is difficult to speculate on why a particular policy may not have a clear correlation with gun violence. By way of illustration, increases in gun violence rates correlative with changes in policy. Yet there is no way to confirm this hypothesis

without time series analyses. Therefore future research is encouraged to investigate the relationship between gun laws and gun violence. When doing so, it is important to consider societal shifts. As seen in Australia, the effectiveness of a law has much to do with the social climate of the time. This is substantiated by findings that demographic characteristics were more important in explaining variations in gun violence rates than any of the various gun policies. In future work, I plan to better identify the timing of gun policy legislation and utilize time-series analyses to examine the causal relationships between gun policy and gun violence.

Appendix

Variable Code		Definition
incidentid		Incident ID #
state		State that incident occurred in.
cityorcounty		City or county incident occurred in.
killed		# of people killed (between 0-50).
injured		# of people injured (between 0-53).
edate		Date that incident occurred.
accidental		
	0	Incident was not accidental
	1	Incident was an accident
changepolicy20132015		
	0	No known policy change between 2013 and 2015
	1	Known policy change between 2013 and 2015
LG_Concealed_Carry		
	0	State does not permit long gun concealed carry.
	1	State permits long gun concealed carry.
HG_Concealed_Carry		
	0	State does not permit hand gun concealed carry.
	1	State permits hand gun concealed carry.
LG_Open_Carry		
	0	State does not permit long gun open carry.
	1	State permits long gun open carry.
HG_Open_Carry		
	0	State does not permit hand gun open carry.
	1	State permits hand gun open carry.
LG_Permit_to_Purchase		
	0	No permit necessary to purchase long gun.
	1	Permit necessary to purchase long gun.
HG_Permit_to_Purchase		

	0	No permit necessary to purchase hand gun.
	1	Permit necessary to purchase hand gun.
statefip		States and territories (numbering through 56).
injuredrate		# injured per 100,000 people.
famsize		Mean family size by state.
marst		Mean marital status by state.
feryr		Mean children born within the past year by state.
race		Mean race by state.
citizen		Mean citizenship status by state.
empstat		Mean employment status by state.
incss		Mean income generated from Social Security by state.
incwelfr		Mean income generated from welfare by state.
migrate1		Mean migration rate every year by state.
race1		Mean white by state.
race2		Mean black/ negro by state.
race3		Mean American Indian or Alaskan Native by state.
race4		Mean Chinese by state.
race5		Mean Japanese by state.
race6		Mean other Asian or Pacific Islander by state.
race7		Mean other race by state.
race8		Mean two major races by state.
race9		Mean three or more major races by state.
yearseduc		Mean years of education.
marriage1		Mean married, spouse present by state.
marriage2		Mean married, spouse absent by state.
marriage3		Mean separated by state.
marriage4		Mean divorced by state.
marriage5		Mean widowed by state.
marriage6		Mean never married/ single by state.
feryr1		Mean no fertility data available by state.
feryr2		Mean no children born within the past year by state.
feryr3		Mean children were born within the past year by state.

feryr4		Mean suppressed children born within the past year by state.
citizen1		Mean citizenship status not available by state.
citizen2		Mean born abroad of American parents by state.
citizen3		Mean naturalized citizen by state.
citizen4		Mean non citizens by state.
empstat1		Mean employment status not available by state.
empstat2		Mena employed by state.
empstat3		Mean unemployed by state.
empstat4		Mean not in labor force by state.
labforce1		Mean labor force data not available by state.
labforce2		Mean not in the labor force by state.
labforce3		Mean in the labor force by state.
migrate11		Mean migration rate data by year not available by state.
migrate12		Mean still living in the same house by state.
migrate13		Mean moved within state by state.
migrate14		Mean moved between states by state.
migrate15		Mean abroad one year ago by state.
officer		
	0	No officer killed during incident.
	1	One or more officers killed during incident.
pop2013		United States population in 2013.
pop2010		United States population in 2010.
pop2000		United States population in 2000.
event		
statecount		# of incidents by state.
peckilledstate		Percentage of people killed by firearms by state.
inctot		Mean income by state.
Republican_Leaning		Whether state was republican leaning during 2013.
	0	Left lean or no clear lean.
	1	Republican leaning.
number_of_state_policies		# of policies variables present in each state during 2013 (between 1-4)
percapincident		# of incidents per 100,000 people.

quintileincident	Quintile of incidents per 100,000 people.
statecountrate	# of incidents by 100,000 people in each state.
killedrate	# Killed per 100,000 people.
officerrate	# of officers involved per 100,000 citizens.
accidentalrate	# of accidental incidents per 100,000 citizens.

Table 1: All variable codes included in the data set.

Policy Variables on Firearm Violence Rates							
Change of Policy between 2013-2015	0.35***						0.33***
Concealed Carry: Long Gun		-0.42***					0.41***
Open Carry: Long Gun			-0.06**				-0.46***
Open Carry: Hand Gun				-0.12***			-1.20***
Permit to Purchase: Long Gun					0.22***		-0.08***
Permit to Purchase: Handgun						-0.19***	0.34***
R-Squared	0.03	0.06	0.00	0.01	0.01	0.01	0.96
N	3900	3900	3900	3900	3900	3900	3900
* p<0.10, ** p<0.05, *** p<0.01							

Table 2: Regression outputs; each column is a separate regression. The outcome is the State Gun Incident Rate (as a number affected per 100k). The primary treatment variable is indicated in the left column.[6]

[6] All regression models include demographic control variables for other factors that may affect gun violence rates including state averages for the following characteristics: family size, fertility rate, population, political leaning, education, income, race, citizenship, labor force participation rate, migration status.

Demographic Variables on Firearm Violence Rates	
Married w/ Spouse v. Never Married (Single)	-14.45***
Married w/o Spouse v. Never Married (Single)	-56.54***
Separated v. Never Married (Single)	-29.84***
Divorced v. Never Married (Single)	23.44***
Widowed v. Never Married (Single)	6.09***
Fertility Data Unavailable v. Suppressed Children Born	-7.30***
No Children Born v. Suppressed Children Born	-17.10***
Healthy Children Born v. Suppressed Children Born	149.84***
Japanese-American v. Mixed Nationality Americans	-39.94**
Status Unavailable v. Non Citizens	24.56***
Americans born Abroad v. Non Citizens	130.29***
Naturalized Citizens v. Non Citizens	8.98***
Republican Majority	0.23***
Education Level	-2.56***
Income	0.00010***
Employment Status Unavailable v. Not in Labor Force	-29.79***
Employed v. Not in Labor Force	26.63***
R-Squared	0.96
N	3900
* p<0.10, ** p<0.05, *** p<0.01	

Table 3: Regression outputs for demographic controls testing significance of policies. Again the outcome is the state gun incident rate and the primary treatment variable is indicated in the left column. The primary treatment variable was recorded in binary form; for example, one if the state had a higher average of married couples than single individuals and so on.

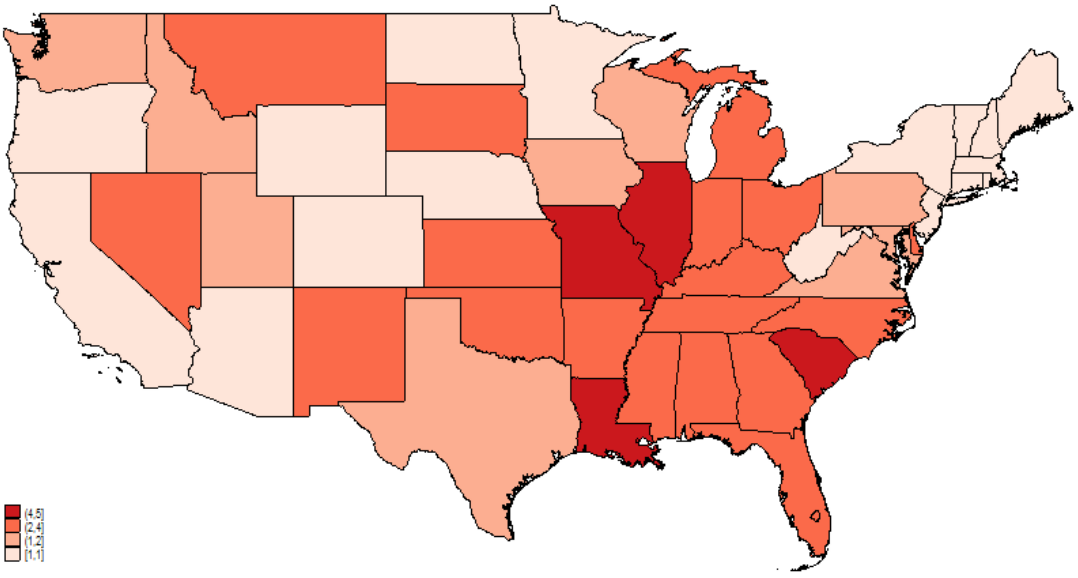

Figure 1: Firearm related incidents per capita by state (quintiles)

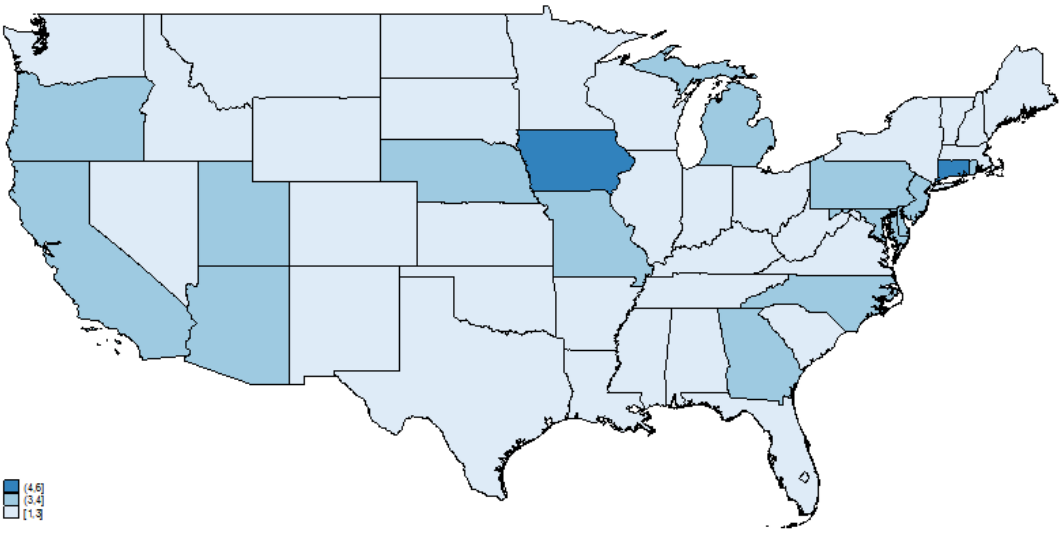

Figure 2: Amount of policies per state.

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