THE EFFECT OF CHILD ACCESS PREVENTION LAWS ON UNINTENTIONAL SHOOTINGS PERPETRATED BY CHILDREN

by

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ABSTRACT

SOFIA NUSSBAUM MUÑOZ. The Effect of Child Access Prevention Laws on Unintentional Shootings Perpetrated by Children (Under the direction of DR. LOUIS H. AMATO and DR. CAROL O. STIVENDER)

Holding gun owners responsible when a child accesses a firearm is one of the reasons Child Access Prevention Laws emerged. Previous studies have focused on fatal shootings in which the victim is a child without identifying the age of the perpetrator. This study will address the effectiveness of underage shootings from another perspective. With data retrieved from the *Gun Violence Archive* and *EveryTown for Gun Safety* from 2014-2018, I will analyze the relationship between CAP laws and unintentional shootings by a minor, no matter the age of the victim.

To deepen our analysis of the effects and effectiveness of these laws, I will also examine the effects of the charges associated with them. These are defined through three different categories: whether the child may or is likely to gain access to a carelessly stored gun, accesses a carelessly stored gun, or is intentionally given a gun by the owner.

Previous studies show there is a relationship between whether the gun owner is charged with a felony or misdemeanor and the decline in unintentional firearm deaths and firearm suicides among children and adolescents. In this research, we will address the effects of penalties under the three previously mentioned categories.

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CHAPTER 1: INTRODUCTION

Gun control is a topic that leaves no one indifferent. Unfortunately, the public, policymakers, and politicians have not been able to achieve a common ground regarding this matter. Efforts have been made (whether it has been enough is a matter for discussion) to get to a consensus that would benefit everyone, but currently, the number of accidents, injuries, and deaths caused by firearms reflects the ineffectiveness of those efforts. In fact, the *Centers for Disease Control and Prevention (CDC)* reported that in 2017, total gun deaths reached its peak since they have been collecting data: 39,773 deaths. In 2018 the number decreased slightly to 39,740 according to the CDC. The composition of gun-related deaths is the following: 61% suicides, 35.6% homicides, 2% unintentional shootings, and 1.4% police shootings. In the general public's eyes, there still is a long road ahead to reach the desired end goal: the protection and safety of human lives.

Throughout the history of the United States, there have been several attempts to regulate the possession and use of firearms in an effort to create a country in which everyone feels safe. Unfortunately, these attempts seem to be in vain when people witness events like Columbine, Sandy Hook, and even more recent cases like Parkland's Stoneman Douglas High School shooting. And then the cycle of doubts and questions resurface and once again the media and news ask: Have we done enough? How much more can we do to guarantee the safety of civilians?

For decades, many states have tried to cope with the imminent threat of a runaway situation by passing different laws to prevent these events. The reality of these incidents becomes even starker when children are the ones involved. This is one of the many reasons why different child access prevention laws have been implemented in many states across the country. But with the implementation and execution of these, some doubts emerge. How effective are they? What effect do these have on a potential decrease in the number of unintentional shootings perpetrated by children? Are the penalties associated to each one of them really important?

1.1 The Numbers

A quantitative analysis of the acts of violence involving firearms is crucial for a rational discussion of this extremely controversial topic. It is essential to use numbers that reflect the reality of what is being experienced by people throughout the country. It is unfortunate that discussions about deaths and life-threatening injuries are needed to demonstrate how important and sensitive an issue like gun control is. However, it seems that only by looking at the numbers, which are going to be exposed in the next few paragraphs, will people be able to realize how relevant this issue is.

From a worldwide perspective, *Giffords Law Center to Prevent Gun Violence* reports that the United States has the highest number of gun deaths among high-income nations per 100,000 people with a rate of 11.2 deaths. To put it in perspective, the second country on the list is Switzerland with 2.8 deaths per 100,000 people. The United States

accounts for thirty-five percent of all firearm suicides around the world (Naghavi, et al., 2018). According to Giffords: "Over one million Americans have been shot in the past decade, and gun violence rates are rising across the country". EveryTown adds that: "Every day, more than one-hundred people in the United States are killed with guns and two-hundred more are shot and wounded." While it is true that the history of the United States with firearms cannot easily be compared with other countries, it is relevant to highlight that countries like Australia and Japan, among others, have been able to address the issue over the last few years. Countries like these have implemented several laws during this time and as a result have improved their numbers.

Firearm-related deaths are the second leading cause of death among children under eighteen years old, second only to motor vehicle accidents. *Children's Defense Fund* reports that in 2017, 3,410 children in the U.S. were killed with a firearm. Texas was the state with the highest number of child deaths during that year: 346 children died in a gun related incident. *The State of America's Children* also reports that among OECD members in 2020: "The child and teen gun death rate in the U.S. was more than three times higher than that in Turkey, the country with the next highest rate; eleven times higher than in Israel; nineteen times higher than in Switzerland and eighty-five times higher than in the United Kingdom."

Finally, and as expected, there are economic implications when dealing with any type of violent act and gun related incidents are not exempt. Based on the study "The True Cost of Gun Violence in America" published by Follman et al., gun violence has an annual

cost that exceeds $229 billion dollars, with $8.6 billion in direct costs, and approximately $221 billion in the related indirect costs surrounding the impact these events have on victims and their families. This translates to an average cost of around seven hundred dollars a year made by each and every taxpayer in the country. EveryTown research argues that: “American taxpayers pay a daily average of $34.8 million for medical care, first responders, ambulances, police, and criminal justice services related to gun violence.” Based on Giffords numbers, for state-level costs: gun violence costs California eighteen billion dollars annually, sixteen billion for Texas and fourteen billion dollars for Florida.

1.2 Child Access Prevention Laws

Since 1989, many states have made efforts to protect the lives of children around the country. The *Regulating Guns in America Report (2008)* states that in 2005 almost two million children around the country lived in homes where they could easily access a loaded and/or unlocked firearm(s). A previous study from Okoro et al. (2002) argues that: “Nationally, 32.6% of adults reported that firearms were kept in or around their home. The prevalence of adults with household firearms ranged from 5.2% in the District of Columbia to 62.8% in Wyoming (median: 40.8%). The prevalence of adults with loaded household firearms ranged from 1.6% in Hawaii, Massachusetts, and New Jersey to 19.2% in Alabama”. With that premise, and the absence of a federal law that would directly hold adults who carelessly or intentionally allow children to access a gun responsible and

criminally liable, as of 2021, twenty-nine states have enacted a group of laws denominated Child Access Prevention (CAP) Laws.

RAND Corporation, a research organization, states that: "CAP laws aim to reduce unintentional firearm injuries and deaths, suicides, and violent crime among youth chiefly by reducing children's access to stored guns…". In addition to what is proposed by RAND Corporation, and most studies that have been published since the creation of CAP laws, one of the objectives of this thesis is to analyze how the implementation of these laws affects unintentional shootings by minors. It is relevant to note the data I used for this research does not discriminate based on the age of the victim.

Michael Siegel, from Boston University School of Public Health[1], categorized eleven Child Access Prevention statutes under two different categories: Safety Locks and Storage Standards:

Table 1: CAP Laws Description[1]

Category	Coded Name	Description
Safety Locks	Lockd	All handguns must be sold with either an integrated or external lock. This applies to licensed dealers and may or may not apply to private sellers.

[1] Michael Siegel, MD, MPH, from Boston University School of Public Health, with funding from the Robert Wood Johnson Foundation, and using data derived from the Thomson Reuters Westlaw state legislative database.

Safety Locks	Lockp	All handguns must be sold with either an integrated or external lock. This applies to all dealers.
Safety Locks	Lockstandards	All handguns must be sold with either an integrated or external lock, which must meet state-specified standards or be otherwise approved by the state.
Storage	Locked	All firearms in a household must be stored securely (locked away) at all times.
Storage	Capliability	Owner of gun is criminally liable if a gun is not stored properly, regardless of whether a child actually gains access to the gun.
Storage	Capaccess	Owner of gun is criminally liable if a gun is not stored properly and a child gains access to the gun.
Storage	Capuses	Owner of gun is criminally liable if a gun is not stored properly, and the child uses or carries the gun.
Storage	Capunloaded	Owner of gun is criminally liable if a gun is not stored properly, regardless of whether a child actually gains access to the gun and regardless of whether that gun is loaded or unloaded.
Storage	Cap18	Owner of gun is criminally liable if child under age 18 has access to the gun.
Storage	Cap16	Owner of gun is criminally liable if child under age 16 has access to the gun.
Storage	Cap14	Owner of gun is criminally liable if child under age 14 has access to the gun.

EveryTown for Gun Safety defines three different criteria for criminal liability under CAP laws:

1) **Intention:** The least strict criminal liability criteria. Relies on those states where the gun owner is criminally liable only if he/she "recklessly, knowingly, or intentionally" hands a firearm to a child, implying that even if a gun is not properly stored and a child accesses it and causes an injury or death, the gun owner is not criminally liable for the events.
2) **Access:** Applies to those states in which, in addition to the criteria previously mentioned (intention), gun owners are criminally liable if the child gains access to a negligently stored gun.
3) **Likely:** Most strict criteria that applies in those states in which, in addition to the other two criteria (intention and access), gun owners are criminally liable if a child "may or is likely" to gain access to a negligently stored gun.

Since their inception, the creation and implementation of CAP laws have been controversial and not exempted from criticism. The National Rifle Association (NRA) claims they oppose them because: "they are unnecessary, ineffective, and endanger law-abiding gun owners." Arguing that according to the study done by Dr. John R. Lott, Jr., and John Whitley, *"Safe Storage Gun Laws: Accidental Deaths, Suicides, and Crime",* there is no evidence that CAP laws help decrease firearm accidental deaths and suicides

among adolescents. They claim that the only effects these laws seem to have is making it harder for law-abiding gun owners to protect themselves.[2]

[2] Mortensen, Catherine. *Child Access Prevention Laws Are Unnecessary*. 20 Sept. 2017, www.scsun-news.com/story/opinion/editorials/2017/09/20/child-access-prevention-laws-unnecessary/686319001/.

CHAPTER 2: LITERATURE REVIEW

Since the enactment of the first Child Access Prevention Laws, researchers have tried to test their effectiveness with the help of several studies. The only effective way policies can be proposed to help solve the issue is by understanding the impact and nature of these events. Additionally, previous research helps us understand the relationship between CAP laws and certain desired outcomes.

Still, there is a lack of focus on the main objective of these laws: keeping children away from guns. As I mentioned earlier, in this study the data is centered on the age of the shooter rather than the age of the victim. There is still space, and also a need, to continue studying the effects these laws have on protecting children today.

2.1 Gun Ownership and Severity of State Gun Laws

Reeping et al. (2019) did a cross-sectional time-series study of state gun laws and gun ownership to test the relationship between stricter or more permissive gun laws and mass shootings around the country. This study used state-level data from 1998-2015, retrieved from *Supplementary Homicide Reports from the Federal Bureau of Investigation's Uniform Crime Reporting System*, and defined a mass shooting as "an event in which four or more individuals were killed by another individual using a firearm". To measure gun ownership in the state, the authors decided to use the percentage of suicides committed with firearms as a proxy. Law severity was obtained using the annual

restrictiveness-permissiveness scale of gun laws from the *Traveler's Guide to the Firearm Laws of the Fifty States.* The study found that gun law permissiveness was associated with a higher rate of mass shootings, suggesting that having stricter gun laws would help reduce this type of fateful event. Additionally, their findings showed that a 10% increase in gun ownership in the state contributed to a 35.1% increase in the rate of mass shootings. Similarly, Simonetti et al. (2015), using a model controlling for socioeconomic demographics, concluded that stricter firearm legislation was associated with lower state-level hospital discharge rates for non-fatal injuries caused by a firearm.

2.2 Child Access Prevention Laws

With the analysis of the 1994 and 2000 National Health Interview Survey, Schuster et al. (2000) argued that further efforts needed to be made to prevent access to firearms among children. The authors reported that thirty-five percent of households with children have at least one gun at home. Among those households, forty-three percent said they had at least one unlocked gun at home, suggesting that around 1.4 million households with children had a negligently stored gun at home around the country.

Hemenway and Solnick (2015), studied the relationship between unintentional firearm deaths and the presence of children in these events. In addition, Shuster et al. (2000) argued that stricter laws need to be imposed to prevent children from accessing firearms. Results show that the majority of children are shot unintentionally by either another child or a self-inflicted injury. Fowler, Dahlberg, Haileyesus, Gutierrez, and Bacon (2017)

contributed to that statement and added that gun-related death rates among children are higher in Southern states and areas of the Midwest when compared with other parts of the country.

Hepburn, Azrael, Miller, and Hemenway (2006) used data from 1979-2000 to analyze the relationship between CAP laws and unintentional deaths with a firearm among two different age groups: children fourteen years old or younger and adults whose age ranged from fifty-five to seventy-four years. They concluded that the presence of CAP laws contributed to significantly fewer deaths among the fourteen years or younger group. The death rate was seventy-four percent of what it would have been compared to states that did not have CAP laws in place. The relationship with the effects among adult deaths was not clear.

Hamilton, Miller, Cox, Lally, and Austin (2017), did a national cross-sectional study with data from the Healthcare Cost and Utilization Project-Kids Inpatient database from years between 2006-2009 and arrived at the same conclusions as Hepburn et al. (2006). In addition to the associated relationship between the reduction in self-inflicted firearm injuries and unintentional pediatric firearm injuries in states with CAP laws, Hamilton et al. found that weaker CAP laws (states in which the gun owner is criminally liable only if he/she "recklessly, knowingly, or intentionally" hands a firearm to a child), were associated with an increase in firearm injuries among pediatric patients.

Using data from the Compressed Mortality Files of the National Center for Health Statistics for the period 1979-1994, research published by Cummings, Grossman, Rivara,

and Koepsell (1997), concluded there was no evidence between CAP laws and the reduction of homicides among children under the age of fifteen, but unintentional shooting deaths decreased by twenty-three percent in the states in which CAP laws were enacted during that period.

In response to Cummings et al. (1997), Anderson and Sabia (2018) conducted a study using data collected from the FBI's Supplementary Homicide Reports from the time between 1985-2013, for all firearm homicides, limiting the age of the perpetrator to twelve to seventeen years old. They controlled for political affiliation and other socioeconomic demographics, like race and unemployment. Results showed that child access prevention laws are associated with a reduction in the rate of gun-carrying among high school students as well as homicides committed by children twelve to seventeen years old were reduced by nineteen percent when CAP laws were in place. In addition to that, the rate at which students reported being threatened or injured with a weapon on school property was reduced when child access prevention laws were in place. They further highlight that when the subject of interest (perpetrator) is an adult, there is no evidence that CAP laws help prevent firearm homicides.

Additional research by DeSimone and Markowitz (2013) reported the results from Poisson regressions studying the effect of CAP laws on non-fatal gun injuries to the *Southern Economic Journal.* With data from hospital discharges ranging from 1988-2001, they propose that the presence of child access prevention laws is correlated with the decline of self-inflicted and non-self-inflicted non-fatal firearm injuries among children

under eighteen years old. In contrast to Anderson and Sabia (2018), they suggest that unintentional gun-inflicted injuries among adults are also reduced with the presence of these laws. Additionally, another relevant result they reported is the effect of those laws that take into consideration the age of the child that accesses the firearm. They found laws that hold the owner of the gun criminally liable when a minor accesses a gun are related with larger coefficient magnitudes in those states in which the age cap is lower (fourteen or sixteen years old).

Simonetti et al. (2015) suggest that CAP laws are associated with a reduction in rates of both unintentional deaths and suicide. They emphasize that from 1979 until 2000, the period in which many states enacted these laws, country-level statistics saw a decline among unintentional firearm-related deaths among children. Also, states in which CAP laws were put in place saw a much greater decline than those that did not have statutes protecting children's access to firearms.

To analyze the effects of the impact of the penalties associated with CAP laws, Zeoli et al. (2019) conducted a study, hoping to better determine the relationship. Their results showed evidence that the variation in charges from each state impacts the effectiveness of child access prevention laws. Most importantly, they concluded that felony charges are related to a decline in unintentional firearm deaths among children and adolescents as opposed to misdemeanor charges. In contrast, there was no association found between CAP laws and firearm homicides and suicides. This finding supports the results proposed by Webster et al. (2004) there the authors found that whether the gun

owner is charged with a felony or misdemeanor under CAP laws had no significant effect on the reduction of firearm suicides among children between fourteen and seventeen years old.

CHAPTER 3: DATA, MODELS, AND METHODOLOGY

3.1 Data

This study was conducted using state-level data from 2014 until 2018. The data was employed in three different models. Table 2 contains the description and sources for each of the variables included in the research.

Table 2: Variable Description

Variable	Description
UnShoot [1] [2]	Number of unintentional shootings perpetrated by a child in the state
Population_mil [3]	State population in millions
MedHHInc [3]	Median household income
MedHHinc2 [3]	Median household income squared
White [4]	Percentage of white residents in the state
Black [4]	Percentage of black residents in the state
DemHS	Binary variable equal to 1 if Democrats had control over both chambers during that year
RepHS	Binary variable equal to 1 if Republicans had control over both chambers during that year
SplitHS	Binary variable equal to 1 if Democrats had control over one chamber and Republicans control over the other during that year
HSGradRates [5]	High school graduation rates

Ginix100 [6]	Estimated Gini coefficient (0 = perfect income equality)
Cap18 [7]	Binary variable equal to 1 if state has a provision for holding the owner of a gun criminally liable if a child under age 18 has access to the gun.
Capunloaded [7]	Binary variable equal to 1 if state has a provision for holding owner of a gun criminally liable regardless of whether the stored gun is loaded.
Lockstandards [7]	Binary variable equal to 1 if state has a provision that all handguns must be sold with either an integrated or external lock, which must meet state-specified standards or be otherwise approved by the state.
LAI_Penalty2 [1]	Binary variable equal to 1 if state has a provision in which the owner of a gun is charged with a felony or misdemeanor if child "may" or "is likely to" access carelessly stored gun.
AI_Penalty2 [1]	Binary variable equal to 1 if state has a provision in which the owner of a gun is charged with a felony or misdemeanor if child accesses a carelessly stored gun.
I_Penalty2 [1]	Binary variable equal to 1 if state has a provision in which the owner of a gun is charged with a felony or misdemeanor if the owner intentionally, knowingly or recklessly gives a gun to a child.
LAI_Felony [1]	Binary variable equal to 1 if state has a provision in which the owner of a gun is charged with a felony if child "may" or "is likely to" access carelessly stored gun.
LAI_Misdemeanor [1]	Binary variable equal to 1 if state has a provision in which the owner of a gun is charged with a misdemeanor if child "may" or "is likely to" access carelessly stored gun.
AI_Felony [1]	Binary variable equal to 1 if state has a provision in which the owner of a gun is charged with a felony if child accesses a carelessly stored gun.

AI_Misdemeanor [1]	Binary variable equal to 1 if state has a provision in which the owner of a gun is charged with a misdemeanor if child accesses a carelessly stored gun.
I_Felony [1]	Binary variable equal to 1 if state has a provision in which the owner of a gun is charged with a felony or if the owner intentionally, knowingly or recklessly gives a gun to a child.
I_Misdemeanor [1]	Binary variable equal to 1 if state has a provision in which the owner of a gun is charged with a misdemeanor if the owner intentionally, knowingly or recklessly gives a gun to a child.

Note. Superscripts denote the data source as follows:
(1) EveryTown for Gun Safety (Notanaccident index)
(2) The Gun Violence Archive
(3) U.S. Census Bureau's American Community Survey
(4) U.S. Dept. of Health and Human Services, CDC, and the National Center for Health Statistics.
(5) U.S. Department of Education, Office of Elementary and Secondary Education, Consolidated State Performance Report
(6) Federal Reserve Bank of St. Louis (FRED)
(7) Michael Siegel, MD, MPH, Boston University School of Public Health using data derived from the Thomson Reuters Westlaw state legislative database.

The three models have the same dependent variable: the number of unintentional shootings perpetrated by a child. The focus of this study is to contribute to the results of previous studies and understand the relationship between CAP laws and the number of unintentional shootings when the shooter is identified as a child.

Table 3 contains the summary statistics for all the variables included in the models. The dataset contains 250 observations.

Table 3: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
UnShoot	6.332	6.928	0	32
Population_mil	6.429	7.193	0.560	39.537
MedHHInc	57,853.92	9,859.02	39,680	83,242
White	70.496	15.733	21	95.204
Black	10.609	9.468	0.851	38.194
DemHS	0.308	0.463	0	1
RepHS	0.596	0.492	0	1
SplitHS	0.096	0.295	0	1
HSGradRates	83.942	4.853	68.50	91.40
Ginix100	46.464	1.894	40.81	51.57
Cap18	0.10	0.301	0	1
Capunloaded	0.06	0.238	0	1
Lockstandards	0.06	0.238	0	1
LAI_Penalty2	0.06	0.238	0	1
AI_Penalty2	0.22	0.415	0	1
I_Penalty2	0.276	0.488	0	1
LAI_Felony	0.04	0.196	0	1
LAI_Misdemeanor	0.02	0.140	0	1
AI_Felony	0.04	0.196	0	1
AI_Misdemeanor	0.18	0.385	0	1

I_Felony	0.14	0.348	0	1
I_Misdemeanor	0.136	0.136	0	1

Between 2014 and 2018, Texas was the state with the highest number of underage shootings with 140 shootings during those five years, and twenty-eight shootings per year on average. Following Texas, Florida had 99 shootings in total and 19.83 shootings per year. When adjusting for population, Alaska comes in with the highest number of underage shootings, averaging 3.85 shootings per year, followed by Louisiana with 3.47 shootings. Hawaii on the other hand, had zero shootings during the same period, followed by California with 0.22 shooting on average per year.

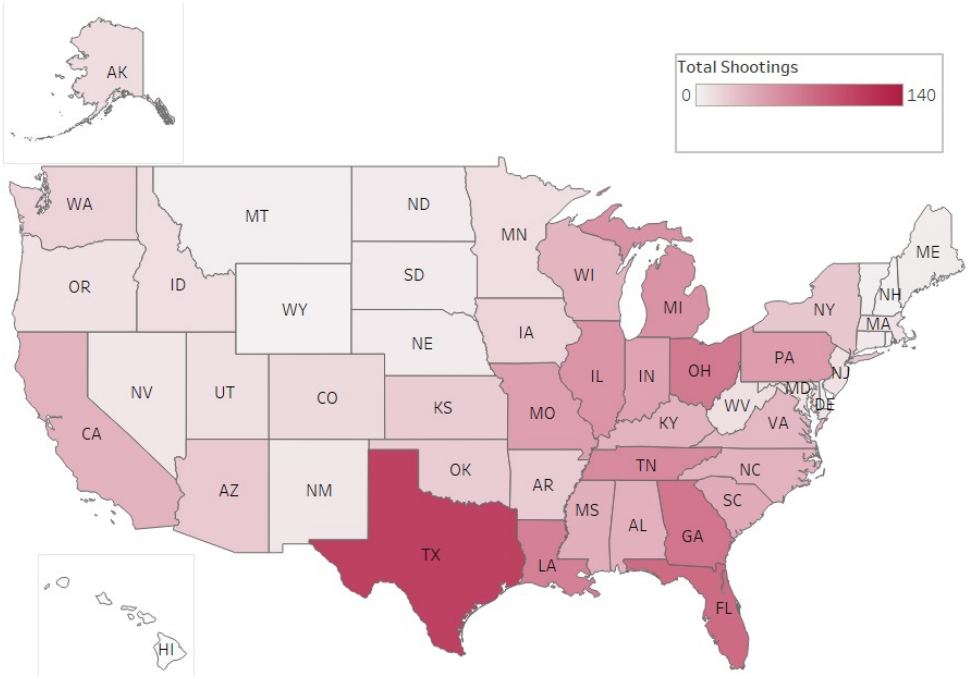

Figure 1 Total number of shootings per state

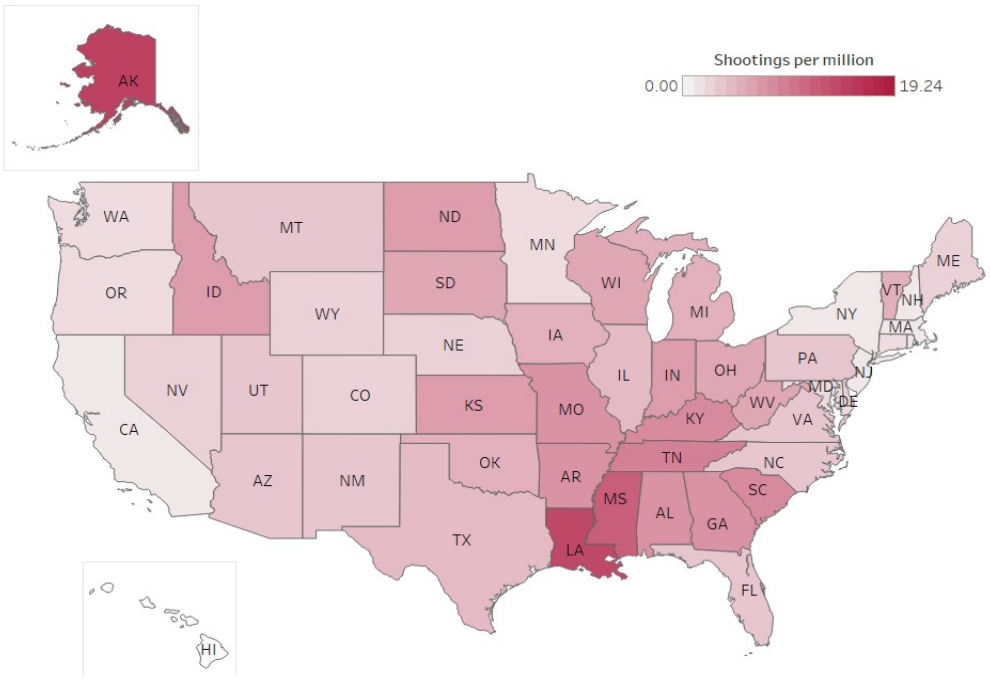

Figure 2 Total number of shootings per state adjusted per million in population.

Table 4 shows the states that have at least one CAP law and the states that do not have any. Massachusetts is the only state that has the three CAP laws included. On average, Massachusetts experienced 2.2 underage shootings per year. In twenty-two states, gun owners are not criminally liable if a minor is “likely” or “may” access, gains access, or is intentionally given a gun. California and Massachusetts are the only two states where the gun owner risks being charged with a felony.

Table 4: States and the Presence of CAP Laws

At least one CAP law		No CAP laws	
California	Missouri	Alabama	New Mexico
Colorado	Nevada	Alaska	North Dakota
Connecticut	New Hampshire	Arizona	Ohio
Delaware	New Jersey	Arkansas	Oregon
Florida	New York	Idaho	South Carolina
Georgia	North Carolina	Kansas	South Dakota
Hawaii	Oklahoma	Louisiana	Vermont
Illinois	Pennsylvania	Maine	Washington
Indiana	Rhode Island	Michigan	West Virginia
Iowa	Tennessee	Montana	Wyoming
Kentucky	Texas	Nebraska	
Maryland	Utah		
Massachusetts	Virginia		
Minnesota	Wisconsin		
Mississippi			

Using historical state-level data retrieved from the *U.S. Dept. of Health and Human Services, CDC,* and *The National Center for Health Statistics* along with the year in which the first CAP law was enacted in the state, I looked at some of the states to analyze the change in the number of firearm deaths before and after this enactment.

Figure 3 shows the number of deaths with firearms in some states, along with the change after the enactment of the first CAP law. Among the states included, Utah was the state with the highest decrease in the number of deaths, noticing a decrease of 25.6%, followed by Kentucky with a 21.27% and Georgia with a 21.24% decrease. Virginia was the only state in which the number of deaths increased by 6.57%.

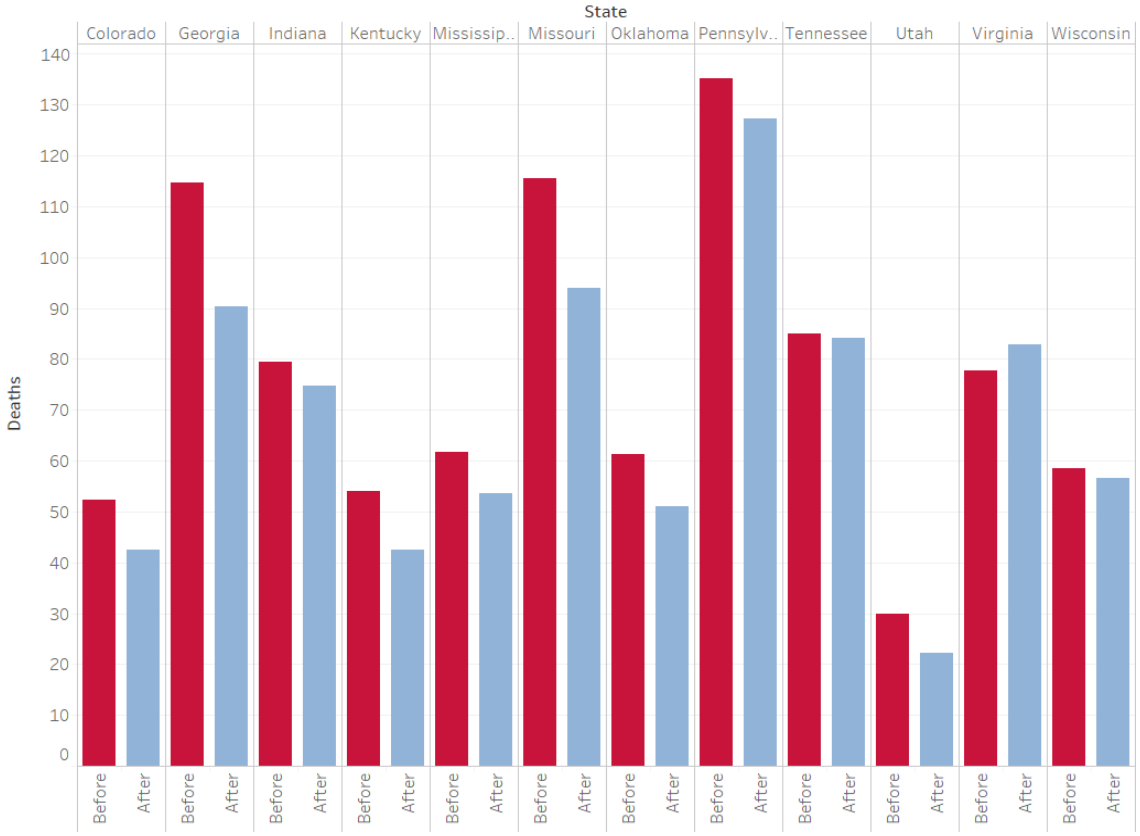

Figure 3. Average firearm deaths before-after first CAP law was enacted.

Figure 4 is adjusted for population. In this case, Utah was once again the state with the highest decrease finding the number of firearm deaths went down by 39.81%, this time. Following, Colorado saw a 34.5% decrease then Georgia with a 23.03% decrease. When adjusted for population, Virginia's numbers decreased by 4.56%, but for Pennsylvania, the number of deaths increased by 0.49% after the enactment of the first CAP law.

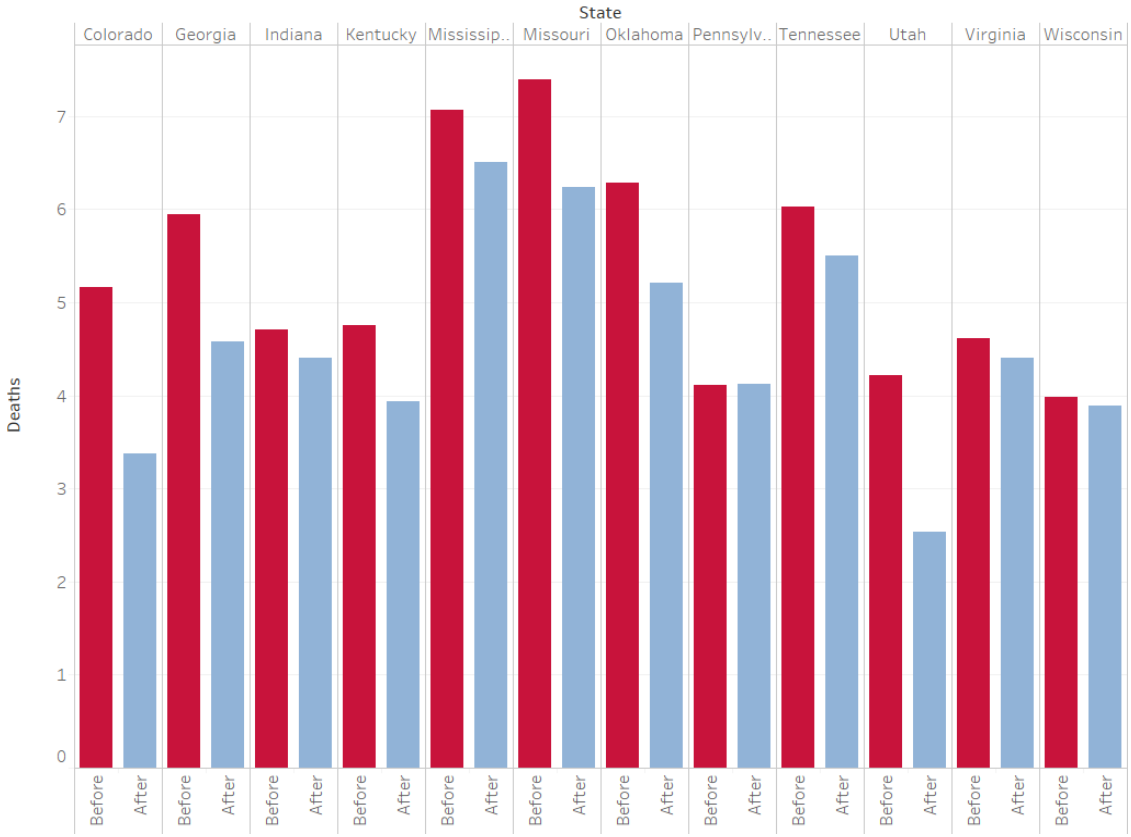

Figure 4. Average firearm deaths (per 100,000 people) before-after first CAP law was enacted.

3.2 Models

Throughout the years, and with the help of several studies, we have tried to understand the behavior people adopt with gun control laws. It is clear that it is a complex topic with several factors affecting behavior and, in turn the outcomes for which these laws were initially enacted. In this study the relationship between CAP laws and unintentional shootings perpetrated by children will be assessed using three different models:

Model 1:

$$UnShoot = \beta_0 + \beta_1(Cap18) + \beta_2(Capunloaded) + \beta_3(Lockstandards) + \theta\delta + \varepsilon$$

The purpose of this model is to identify the relationship between unintentional shootings perpetrated by children and the stricter laws under the following three different subcategories:

- Age restrictions: provision for holding the owner of a gun criminally liable if a child under age eighteen gains access to a gun.
- Load: provision for holding the owner of a gun criminally liable regardless of whether the stored gun is loaded or unloaded.
- Lock: provision that all handguns must be sold with either an integrated or external lock, which must meet state-specified standards or be otherwise approved by the state.

Model 2:

$$UnShoot = \beta_0 + \beta_1(LAI\_Penalty2) + \beta_2(AI\_Penalty2) + \beta_3(I\_Penalty2) + \theta\delta + \varepsilon$$

This model explains the relationship between the dependent variable, and the presence or absence of an associated penalty under the following three scenarios:

- I: Those states where the gun owner is criminally liable only if he/she "recklessly, knowingly, or intentionally" hands a firearm to a child, implying that even if a gun is not properly stored and a child accesses it and causes an injury or death, the gun owner is not criminally liable for the events.
- AI: States in which, in addition to I (intent), gun owners are criminally liable if the child gains access to a negligently stored gun.
- LAI: Most strict criteria that applies in those states in which, in addition to the other two criteria (AI and I), gun owners are criminally liable if a child "may or is likely" to gain access to a negligently stored gun.

  **Note: all three categories do not distinguish the type of penalty (i.e., felony or misdemeanor)*

Model 3:

$$\begin{aligned} UnShoot = {} & \beta_0 + \beta_1(LAI\_Felony) + \beta_2(AI\_Felony) + \beta_3(I\_Felony) \\ & + \beta_4(LAI\_Misdemeanor) + \beta_5(AI\_Misdemeanor) \\ & + \beta_6(I\_Misdemeanor) + \theta\delta + \varepsilon \end{aligned}$$

With this final model, I will try to see if the degree of effective criminal liability affects the behavior of gun owners when it comes to keeping children away and without access to firearms. The three scenarios described in model two apply to this model as well. The difference in this model is that the associated penalty is specified and classified as a felony or a misdemeanor.

All models include the same set of control variables (δ). I included population, race, median household income, income inequality, high school graduation rates, and the political majority as covariates for all three models.

3.3 Methodology

The data obtained from *EveryTown for Gun Safety* and the *Gun Violence Archive*, contained observations for states and years in which there were zero events of unintentional shootings perpetrated by children. The zeros in this particular case have a strong meaning: states have effectively prevented children from gaining access to firearms. The rightward skewness of the data (Figure 5) with those meaningful "zeros" observations would not be modeled properly using OLS. Therefore, a count data model is used.

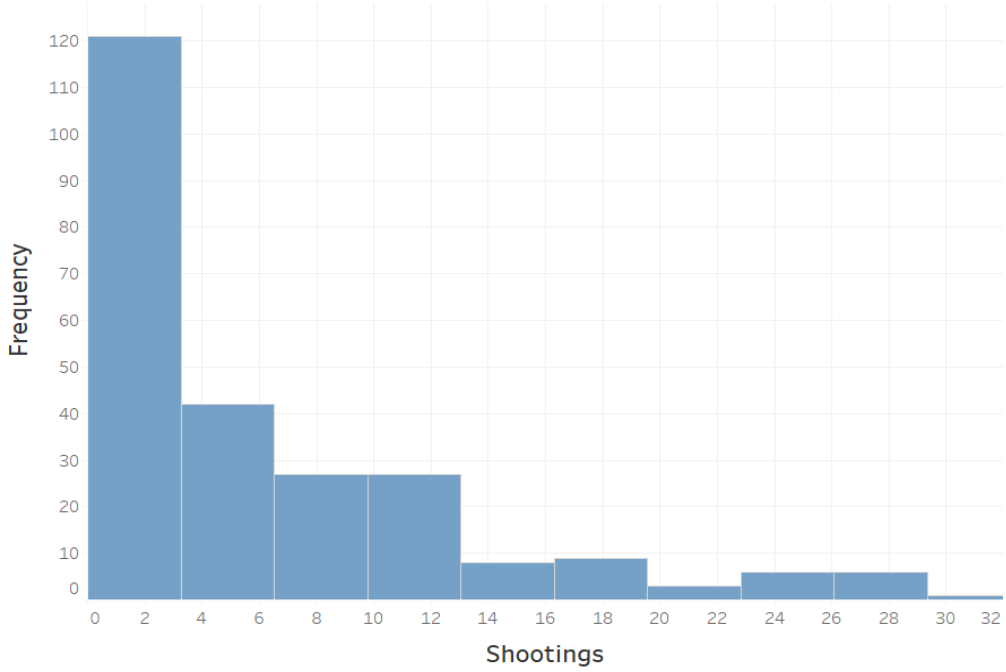

Figure 5. Histogram of the number of shootings perpetrated by children in the US.

A standard model used for count data is the Poisson regression model. This is a type of generalized linear regression using the Poisson distribution. We can use the Poisson distribution when an event is being counted in whole numbers, the average frequency of the events during the time period is known, and the occurrences are independent of each other.

We can calculate the probability of any given number of observed occurrences using the Poisson distribution:

$$\Pr(Y) = \frac{\lambda^y e^{-y}}{y!}$$

Where y is the number of times an event occurs, and lambda is the average rate of occurrences of an event.

One of the main assumptions of the model is that the average rate of occurrences of an event is equal to the variance:

$$\mathrm{E}(X) = Var(Y) = \lambda$$

Skewness is another characteristic of this distribution. Poisson distributed data is skewed to the right, and as the average occurrence of an event (lambda) increases, the data approaches a normal distribution.

After running a goodness of fit test to see if the data in the models is Poisson distributed, the results showed that in all three cases we rejected the null hypothesis of Poisson distribution.

Table 5: Overdispersion Tests for Poisson Regression

	Model 1	Model 2	Model 3
Deviance goodness-of-fit:	522.521	571.153	566.474
Prob > χ^2 (238)	0.0000	0.0000	0.0000
Pearson goodness-of-fit:	514.234	558.757	554.297
Prob > χ2 (238)	0.0000	0.0000	0.0000

Table 6 shows the statistics for the dependent variable of all three models. The variance is significantly larger than the mean, violating the assumption of mean being equal to the variance for a Poisson distribution. There is a clear overdispersion of the data:

$$\mathrm{E}(X) < Var(Y)$$

Table 6: Number of Unintentional Shootings Perpetrated by a Child in the State Statistics

Variable	N	Mean	Variance	Std. Dev.
UnShoot	250	6.332	47.998	6.928

The negative binomial regression model is an alternative approach for count data when the data suffers from overdispersion. The negative binomial regression model is a generalized version of the Poisson regression model that relaxes the assumption of the relationship between the mean and variance and includes an extra parameter to control for the overdispersion of the data.

Another alternative to treat overdispersion is the use of robust standard errors for the Poisson regression. Deciding between one regression model or the other is going to depend on how different the results are from model to model. We can also compare the correlations between y and $\hat{y}$ to see which model fits the data better to help determine which model we should use.

After running the negative binomial regressions and compare the results with the Poisson regression with robust standard errors, we find that results are very close. We also

see that the standards errors of both regressions are similar and qualitative results are identical. since pseudo-R^2 cannot be compared across models, we compared the correlations between y and $\hat{y}$. For the three models, the correlation between y and $\hat{y}$ is slightly better for the Poisson regressions.

Most of the studies included in the literature review, as well as other general research about shootings, use Poisson regressions for their analysis. Cummings et al. (1997) used a Poisson (MLE) model to estimate the incidence of unintentional shootings ratio for their research. DeSimone and Markowitz (2013) used a Poisson quasi-maximum likelihood estimator (QMLE) since their data suffered from overdispersion as well and did not follow a Poisson distribution.

In this study, the Poisson quasi-maximum likelihood estimator cannot be implemented because invariant variables are dropped and almost all the variables of interest for the three models do not change during the years included in the sample. Based on this previous literature and the results obtained with both models, I decided to use a Poisson regression with robust standard errors for all three models.

CHAPTER 4: RESULTS

Table 7 contains the marginal effects for our three models.

Table 7: Poisson Regression Marginal Effects

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3
Population_mil	0.5923*** (0.0679)	0.530*** (0.0785)	0.5541*** (0.0823)
Black	0.3162*** (0.0447)	0.2921*** (0.0475)	0.2845*** (0.0465)
White	0.1498*** (0.0387)	0.112*** (0.0413)	0.1112** (0.0439)
MedHHInc	0.00116*** (0.00351)	0.001*** (0.0004)	0.000878** (0.0004)
MedHHinc2	-1.01e-08*** (3.03e-09)	-9.00e-09*** (3.25e-09)	-7.97e-09** (3.34e-09)
HSGradRates	0.0259 (0.0648)	0.0655 (0.0675)	0.0642 (0.0826)
Ginix100	0.6389** (0.2731)	0.3160 (0.2573)	0.3243 (0.2724)
1.DemHS	-2.4125*** (0.7905)	-3.3017*** (0.839)	-3.1653*** (0.8283)
1.SplitHS	-0.0726 (1.0443)	-1.2494 (0.9952)	-1.4777 (1.0038)
1.cap18	-2.1280*** (0.5453)		

1.capunloaded	1.3347		
	(2.6724)		
1.lockstandards	-4.481***		
	(0.7254)		
1.LAI_Penalty2		-2.836**	
		(1.2323)	
1.AI_Penalty2		0.0348	
		(0.9198)	
1.I_Penalty2		1.4863**	
		(0.7243)	
1.LAI_Felony			-3.699***
			(1.142)
1.AI_Felony			-0.2933
			(1.1571)
1.I_Felony			1.5838*
			(0.9266)
1.LAI_Misdemeanor			-0.2548
			(1.9823)
1.AI_Misdemeanor			0.0359
			(1.039)
1.I_Misdemeanor			1.5965
			(0.9874)
Observations	250	250	250
Pseudo-R^2	0.4746	0.4545	0.4564

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The purpose of model one was to estimate the effects of the three most restrictive laws of each subcategory on the number of unintentional shootings perpetrated by minors. The Pseudo-R^2 of the model is 0.4746, which means that 47.46% of the variation of shootings is explained by the variables included in the model. In terms of significance population, the percentage of black and white residents in the state, median household income, median household income squared, as well as Democrats' control over both chambers, are significant at the 1% level. Gini index for inequality was significant at the 5% level while, high school graduation rates were not significant. In the case of our variables of interest, *Cap18* and *Lockstandards* were significant at the 1% level, while *Capunloaded* was not significant.

With model two, I estimated the effects of penalties on the number of unintentional shootings perpetrated by minors. The Pseudo-R^2 of the model is 0.4545, which means that 45.45% of the variation of shootings is explained by the variables included in the model. In terms of the significance, population, the percentage of black and white residents in the state, median household income, median household income squared, as well as Democrat's control over both chambers, were significant at the 1% level. Gini index for inequality and high school graduation rates were not significant. In the case of our variables of interest, *LAI_Penalty2* and I_*Penalty2* were significant at the 5% level while *AI_Penalty2* was not.

Finally, in model three I estimated the effect of being charged with a felony or a misdemeanor would have on the number of unintentional shootings perpetrated by minors. The Pseudo-R^2 of the model is 0.4564, which means that 45.64% of the variation of

shootings is explained by the variables included in the model. In terms of the significance, population, the percentage of black and white residents in the state, as well as Democrat's control over both chambers, were significant at the 1% level. Median household income and median household income squared were significant at the 5% level, while the Gini index for inequality and high school graduation rates were not. In the case of our variables of interest, only *LAI_Felony* was significant at the 5% level, and *I_Felony* at the 10%. *AI_Felony* and all the Misdemeanor variables were not significant.

Based on the data, we can say that states with a provision for holding the owner of a gun criminally liable if a child under age 18 has access to the gun have, on average, 2.128 shootings less than a state that does not have that provision. In the case of locks requirements, states with a provision in which they require that all handguns must be sold with either an integrated or external lock have, on average, 4.148 shootings less than a state that does not have that provision. These results support previous literature.

The effects of penalties on unintentional shootings are interesting. A state that has a provision in which the owner is charged with a felony or misdemeanor if the child "may" or "is likely to" access a carelessly stored gun has, on average, 2.836 shootings fewer than a state that does not charge the gun owner with a felony or misdemeanor. This is the stricter statute among the three included in the model since the child does not necessarily need to access the gun for the gun owner to be charged. In the case of the *I_Penalty2* variable, if a state has a provision in which the owner of a gun risks being charged if he/she intentionally gives a gun to a child, there is on average 1.486 more shootings that a state that does not

have that provision. This statute is the less strict of the ones included and all of the states that have this provision do not have any of the CAP laws included in model one.

The impact of the severity of the potential charges had similar results. A state that has a provision in which the owner of a gun risks being charged with a felony if the child "may" or "is likely to" access a carelessly stored gun, has on average 3.7 shootings less than a state that does not charge the gun owner with a felony. In the case of *I_Felony*, if the state has a provision in which the owner of a gun risks being charged with a felony if he/she intentionally gives a gun to a child, there is on average 1.584 more shootings than states that do not charge the gun owner with a felony.

These results are similar to the ones obtained by Antunes and Hunt (1973). In their paper, "The impact of Certainty and Severity of Punishment on Levels of Crime in American States: An Extended Analysis", they found that the effects of certainty and severity of punishments are greater in the case of rational crimes than in emotional crimes. When an adult consciously gives a gun to a child, there is no rationality behind that act. Here is an emotional intention associated with that action. The risk of being criminally liable, charged with a felony, and potentially going to prison, is not something that is going to prevent them from doing it. In the case where there is no intention but just negligence, the effect of penalties is the opposite as reflected in the results of model two and model three, as we see unintentional shootings decrease when the gun owner risks being charged.

For the control variables included in each model, we found that the greater the population of the state, the higher is the number of unintentional shootings perpetrated by

children. For every additional million in population, shootings increase by 0.55 shootings on average among the three models.

A one percentage point increase in black or white population increases the number of shootings by 0.89 and only 0.12 respectively. Kalesan et al. (2016) obtained similar results when analyzing the relationship between race and pediatric firearm-related hospitalizations. Black children were four times more likely to be hospitalized because of a firearm-related injury than white children Black children had the highest hospitalization rate, 72.33 per 100,000, while the rate for white children was 17.37 per 100,000.

Based on Gallup's gun ownership polls for 2020, there are significant differences between gun ownership and political affiliation. Fifty percent of Republicans own guns, while only eighteen percent of Democrats said they own one. This could explain the results we obtained across the three models. Democrats holding control of both chambers is associated with 2.96 shooting less on average compared to if Republicans had control. In terms of legislation, Democrats are generally more in favor of gun control policies than Republicans, supporting the results obtained from our regression.

I included median household income and its squared term to test for a non-linear relationship with the number of shootings. In all three models, both variables are statistically significant. As median household income increases, the number of shootings increases at a decreasing rate until income is between about $55,000 to $57,000, where shootings start to decrease at an increasing rate.

There are many factors that determine a household's income, such as education, parent's education, ability, experience, etc. Therefore, explaining these findings is not an easy task. People with above average incomes have a higher opportunity cost of being convicted of a crime, which will make them less likely to facilitate a scenario where a child will gain access to a gun. The lower the income of a person, the less they have at risk (Becker, 1968).

Lastly, income inequality is only significant in the first model. Regression results show that as the Gini index of the state increases by one, the number of shootings increases by 0.689 shootings. This suggests that the greater the income inequality, the higher the number of shooting in the state. Rowhani-Rahbar et al. (2019) found that a greater Gini Index is associated with greater firearm homicide rates. Kwon and Cabrera (2019) conducted a study to analyze the relationship between mass shootings and income inequality. Their results are similar to the results of model one, since they found that growing levels of income inequality are associated with a greater probability of mass shootings.

CHAPTER 5: CONCLUSIONS

5.1 Main Findings

The possession of firearms is a right granted to citizens by the second amendment: "A well-regulated Militia, being necessary to the security of a free State, the right of the people to keep and bear Arms, shall not be infringed." A text written over two hundred years ago, continues to condition our way of life. Yet, every time some unfortunate event occurs, criticism, doubts, and questions resurface among the public. Do we live in the same world as 1791? How long can a right be protected? Even when it violates the rights of others? This is why throughout the history of the United States there have been several attempts to regulate the possession and use of firearms, aiming to create a country in which everyone feels safe.

Have these attempts of regulating guns been effective? This paper suggests that some laws have been effective in reducing unintentional shootings perpetrated by children while some have not had the expected results. Our results are similar and support the ones obtained by previous literature, even though this data set included only the events in which the shooter was a child.

The laws that have the greatest impact on preventing this unfortunate event from happening are those requiring guns to be sold with locks. Our results show that about four of these fateful events can be prevented in states that have this type of provision. Unfortunately, only three states have this provision: California, Massachusetts, and New

York. The number of shooting in those states for the years included in the sample account for only 5.18% of the total number of shooting. The average number of shootings per year in those states is 0.28 shootings for every million in population. In the case of the states that do not have that provision, that number increases to 1.22 shootings. This law is the only one included in the model that gives the responsibility to the seller, not to the gun owner. In this case, we are not talking about a negligently stored gun, but a gun that would make it more difficult for a child to fire.

The age provision was also found to be effective in preventing shootings. Holding the gun owner criminally liable if a child under eighteen has access to the gun prevent more than two shootings annually. Five states have implemented this law (including California and Massachusetts) and the total number of shooting in those states for the years included in the sample account for only 7.2% of the total number of shooting.

Criminal liability of the gun owner, regardless of whether the stored gun is loaded or unloaded, is not significant in our model. This result could be justified by thinking that having a gun that is securely locked and stored, kept away from the reach of children, might avoid this kind of event. Having a provision that penalizes the gun owner if the gun is loaded or unloaded would have no effect on the number of shootings since, in theory, children are unable to access a securely stored and locked gun.

The opportunity cost of engaging in an illegal activity in which you risk being charged with a felony is considerably higher than the cost of being charged with a misdemeanor, and our results support that. We see that being criminally liable if a child is

"likely" or "may" access a gun, which is the stricter category among the ones included in model two, is enough to prevent almost three shootings to happen. But when we take a deeper look into which type of penalty those individuals are risking, the results are slightly different.

But what happens to how we value the costs of our actions when we talk about intentional events? As discussed in the results section, and in accordance with the results obtained by Antunes and Hunt (1973), there are two types of crimes - rational and emotional - and the effectiveness of penalties depends on which type of crime we are talking about. It is that the reason we see that risking being charged with a felony in the case of individuals that intentionally give a gun to a child gives us results that are not as we would expect. Individuals who intentionally give a gun to a child are not acting rationally. Their emotional action ignores the fact children or others could get hurt. They are willing to risk being charged with a felony and prison time.

With these results, new questions arise. What is the right path to solve this problem? The answer unfortunately is not simple. We know that some laws are effective and if more states decide to implement them, we could prevent many of these shootings from happening. We also know that for some individuals the implementation of these laws and penalties are never going to be enough, that having them in place would not change their actions. Is that enough to stop us from implementing and creating new laws? The answer is no. We are talking about human lives that can be saved; therefore, all efforts need to be made.

5.2 Limitations and Future Research

Gun laws and the implementation and their efficacy, is a very complex topic. There are many variables that surround the decision of an individual to buy, store, or intentionally give a gun to a child. Further research could help us understand some of the components of this issue that were not able to be addressed in this study.

In any econometrics study, we want our sample to represent the population in question. The more data we can collect and use, the better, as it helps us reduce the uncertainty that we might have about some of our results. With only 250 observations, one of the limitations of this study has been the amount of data available. Having more years of data on the number of shootings (in which we can identify the age of the shooter) is crucial to understand the long-term effects of these laws. During the years data on shootings is available, states have not implemented any new CAP laws, so being able to get more years and see the before and after effects of the laws during that period of time would be helpful for the analysis.

We cannot limit the decrease or increase of the number of shootings and attribute the responsibility only to the CAP laws included in the models. Testing for the effects of other laws and doing a comparative analysis between them might also contribute to the answer to the research question. The implementation of background checks, laws that prohibit people convicted of domestic violence from possessing guns, and other laws might also be influencing our results. Including some of them in future research might help us understand the numbers better.

Sometimes laws are not able to achieve their objectives individually, but when these are coupled with other laws, the effect might be different. In future research it may be important to include interaction terms between the laws to try to capture any differential effects between them.

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