Public Policy and K-12 School Shootings in the United States

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by
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Abstract

There have been over 1,400 school shootings since 1970 and prevention research focuses on gun control, mental health resources, and school security. I used data from the K-12 SSDB and on related public policies in the US to conduct econometric analysis identifying the most effective policies for preventing school shootings. While results of the econometric analysis were inconclusive, descriptive analysis suggests a relationship between firearm laws and school shootings while other policies have relationships with specific subsets of school shootings.

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1. Introduction

I remember sitting in my first class of the day, French class, when my friend received a text message. Just 13 minutes down the road, the unthinkable had happened. There had been a shooting at Great Mills High School. On March 20th, 2018, a little over a month after the February 14th shooting at Marjory Stoneman Douglas High School, the issue of school shootings hit closer to home than I could have ever expected. My classmates and I knew nothing about what was going on for the rest of the day. When we finally learned what had happened, we had to face the aftermath for the community. The victim was not some random name and face, it was someone that people went to school with and swam on the swim team with. However, it just became another statistic of school shootings in the United States.

The US experiences more school shootings annually than any other country (World Population Review, 2021). My generation has been consistently exposed to school shootings and active shooter drills. My first exposure to school shootings was in February of 2012 when a teenage boy opened fire on a cafeteria full of students at Chardon High School in Ohio, my mother's hometown. Using a firearm that he had stolen from his uncle, he shot at students, killing three, paralyzing one, and injuring two others (Thompson et al., 2012). The shooter was determined to have shot students at random, with no regard for any of his victims. This is the type of incident that people generally think of when they hear the term "school shooting" but this is not the only type of school shooting. There are many definitions of a school shooting and many different types of school shootings.

There has been debate for decades about what type of public policy is the most effective at preventing school shootings. As evidenced by the continued problem of school shootings, no conclusion has been reached. Much of the previous research on the prevention of school

shootings has only focused on one area of concern or has used specific shootings as case studies for the problem as a whole. The goal of this study was to look at all incidents of school shootings to attempt to determine which area of public policy is most effective at preventing school shootings. Only covering one area of policy or only looking at specific incidents can fail to recognize patterns in school shootings as a larger problem.

The first thing that this paper covers is revising the definition used by the Center for Homeland Defense and Security's K-12 School Shooting Database (K-12 SSDB) to cover incidents where the impact on students and staff is the largest. Next, this paper examines the causes of school shootings as identified in previous research. The three main areas of focus are access to guns, lapses in school security, and lack of mental health resources. The final part of the background explores methods suggested for preventing school shootings as found in previous research and tools currently being used to reduce fatalities in the event of a school shooting.

To attempt to answer the question that I posed, I conducted exploratory data analysis with school shooting data and other variables representing the three main public policy areas. My analysis relied heavily on the K-12 SSDB as it provided the data for the dependent variables. Using some of the relationships identified in the exploratory data analysis, I conducted an econometric analysis to identify which area of public policy plays the largest role in preventing school shootings. The results of the econometric analysis were inconclusive but the descriptive analysis suggests that there is likely a relationship between certain types of school shootings and the areas of public policy that target their causes.

2. An Overview of K-12 School Shootings in the United States

Since 1970, there have been 1,400 incidents of school shootings in K-12 schools in the United States[1]. Figure 1 shows the number of school shootings that have occurred in the U.S. annually since 1970.
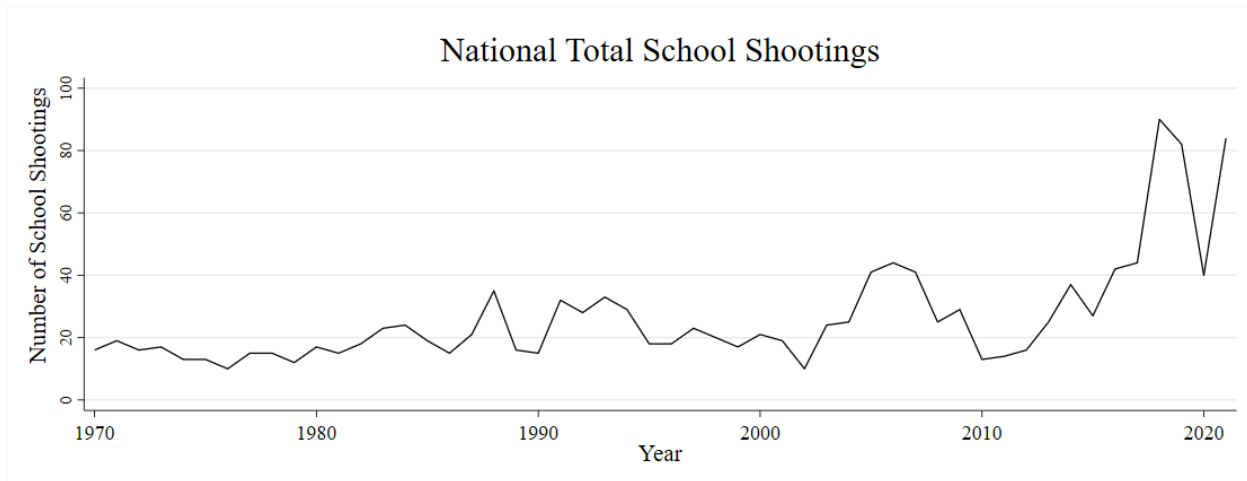
Figure 1. Annual School Shootings in the U.S. since 1970

School shootings that garner major media coverage generally fall into the category of indiscriminate shootings, where the shooter has no regard for potential victims and is shooting at anyone in their path. However, indiscriminate school shootings only make up 5.64% of all school shootings in the United States (Riedman & O'Neill, 2020). The shooting at Great Mills High School would be classified as a murder/suicide but it still had a significant impact on the community. All school shootings have an impact on students and staff, not only indiscriminate school shootings (Beland & Kim, 2016). To understand the impact of school shootings in the United States, we must define what a school shooting is.

2.1 Definition of a School Shooting

There is no single definition of a school shooting. Some definitions only include deliberate attacks on an educational institution using a firearm while others are broader,

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[1] This number reflects all incidents up to September 28th, 2021.

including any instance where a firearm is used or brandished on school property. Due to these varying definitions, it is difficult to find complete data on school shootings in the United States. There is also not a good record-keeping system for tracking school shootings nationally. Many school shootings are identified only by local newspapers and never receive national attention. Even incidents that receive national attention are not tracked consistently as there is no federal system for tracking these incidents. Details on school shootings are also difficult to confirm so private databases often have large gaps in their records. As of January 2022, the only national database of school shootings with information dating back more than 15 years is the K-12 School Shooting Database (K-12 SSDB).

2.1.1 K-12 School Shooting Database

The K-12 School Shooting Database (K-12 SSDB) is part of a project from the Center for Homeland Defense and Security and the Naval Postgraduate School. The database is an example of a comprehensive national database on school shootings. The researchers used newspaper articles, journal articles, research papers, and police reports to classify more than 2,000 incidents of school shootings in the United States. Each incident is given a reliability score based upon how much information was available about the event as well as the credibility of the source of the information. The data dates back to 1970 and is being updated every day. The data used in this paper include the updates to the database as of September 28, 2021.

The K-12 SSDB defines school shootings as "each and every instance in which a gun is brandished, fired, or a bullet hits school property for any reason, regardless of the number of victims, time, day of the week, or reason" (Riedman & O'Neill, 2020). This is a very broad definition, which the authors acknowledged as being designed to provide the most comprehensive view of the issue. This works well for providing a comprehensive dataset but is

less useful when trying to learn how to prevent school shootings. If two adult males argue on school grounds and shoot one another at three in the morning, the impact to students or staff will likely be low, especially when compared to an active shooter situation during the school day.

There were several incidents recorded in the K-12 SSDB that occurred during a school vacation or when schools were closed due to COVID-19. No students would be around and often no one outside of the incident was around either. These incidents are not useful in trying to understand what policies can help prevent school shootings and reduce the impact on students or staff of a school.

The K-12 SSDB provides as much detailed information about each incident as is available to the researchers. Each incident is identified by the date, state, city, and school as well as whether or not the shooting was during school. When possible, the location of the incident and the time of day are also provided. Each incident includes a summary and description of the events that are used to help categorize the incidents by the situation. Some incidents could be classified as multiple situations but in this database are only classified as one type of situation.

Many incidents do not have enough information to be classified so they are categorized as "Unknown" situations. Figure 2 was created from the K-12 SSDB data and shows the different situations that the incidents can be classified as and the frequency of each type of situation.

Situational Breakdown of School Shooting Incidents

Legend:
- Accidental
- Anger Over Grade/Suspension/Discipline
- Bullying
- Domestic w/ Targeted Victim
- Drive-by Shooting
- Escalation of Dispute
- Hostage/Standoff
- Illegal Activity
- Indiscriminate Shooting
- Intentional Property Damage
- Murder/Suicide
- Psychosis
- Racial
- Suicide/Attempted
- Unknown
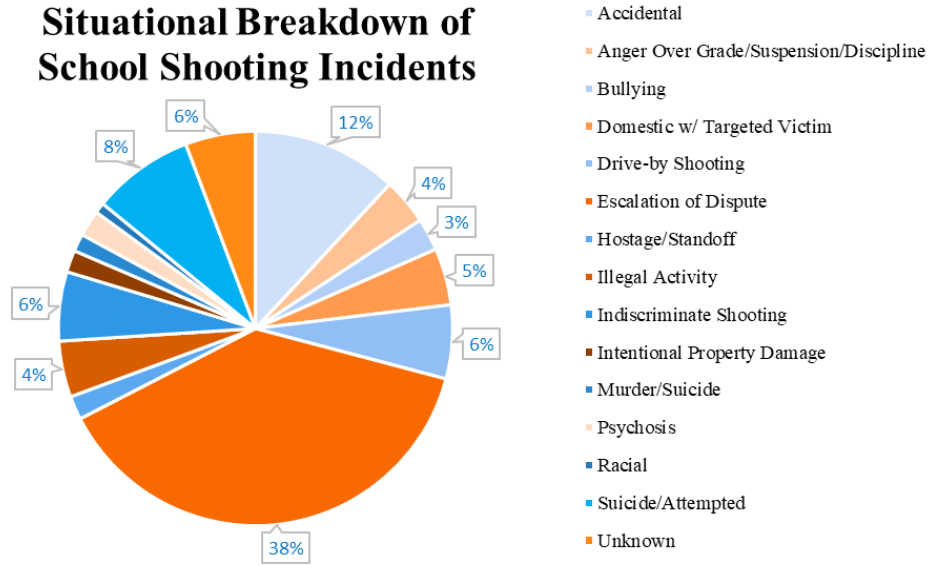
Figure 2. Situational Breakdown of School Shooting Incidents

The K-12 SSDB also classifies incidents by target type, if there were accomplices, hostages, or a barricade, if police officers were involved, if the incident was related to bullying or domestic violence, if the incident was gang-related or preplanned, and if there was an active shooter. When available, the number of shots fired is also included. The database also includes details about the shooters, victims, and weapons used. Demographic details about the victims and shooters are available as well as their affiliation with the school. Victim injuries are included along with the shooter's outcome after the incident (death, injury, arrest, etc.). Any charges filed against the shooter are included when available along with the verdict and whether the shooter was a minor charged as an adult or if there was any prior criminal history. The weapon caliber and type are also included in the K-12 SSDB.

2.1.2 Revised Definition

To narrow down the type of events classified as school shootings, I have redefined a school shooting for the purpose of this paper. I have chosen to classify a school shooting as any incident where shots are fired on school property or at a school event when students and staff are present. I made this decision because these incidents are the most likely to impact students and

staff negatively and are the types of incidents that need to be addressed through policy changes. Research has been done on the outcomes of students who were exposed to gun violence at school, giving a better understanding of why school shootings should be prevented. Beland & Kim (2016) found that standardized test scores of students at schools that experienced a school shooting drop significantly and that the probability of doing well on standardized tests also decreases. This decline in academic achievement will have a negative impact on students as they continue with their education and careers.

There are some limitations to this new definition due to the generalized nature of the criteria. If someone brandishes a gun on school property but does not fire shots, then it is not a school shooting. However, there are recorded cases of students being held hostage by someone with a firearm, even though no shots were fired. This would not fall under the classification of a school shooting but could have a stronger impact on the students than someone accidentally discharging a firearm in a backpack. There are also cases where shots are fired on school property, during school from an airsoft or BB gun that school authorities do not find out about until later. An ideal definition of school shootings would work for every situation but each situation is different so this is not possible. Some incidents may not be classified as school shootings under this definition but could be covered through a focus on another issue, such as gun violence or violence at schools.

2.2 Causes of School Shootings

Following large school shootings, such as the one at Columbine High School in 1999, media attention often focuses on the cause of the shooting as well as on the causes of school shootings in general. In the case of Columbine High School and subsequent school shootings in the early 2000s, media attention largely focused on violent pop culture, school security measures,

and inadequate gun control laws (Lawrence & Birkland, 2004). Following some of the more recent school shootings, media attention has scrutinized gun control legislation as well as mental health resources availability. Just as there is no one definition of school shootings, there is also not one cause of school shootings. Not all shootings are caused by the same things but most of the causes tend to fall into the three main categories of school security lapses, illegal firearm access, and mental health issues.

2.2.1 School Security Lapses

The shooters in the Columbine High School incident were known to be obsessed with the video game series Doom and filmed a video for a school project that involved the pair pretending to kill students in the school hallways ("Columbine Massacre," 2007). Teachers at the school knew about the violent nature of their assignments but none of this was ever reported to school officials. The media focused on calling out the violent nature of video games and movies of the time as well as questioning how the shooters were able to submit such violent assignments.

Despite the media attention, only two bills were introduced in Congress to address the issue of violent pop culture (Lawrence & Birkland, 2004). The movie and video game industry has a large amount of influence and there is not much that the government can do to control what they produce. However, the legislative focus was on methods of increasing school security.

In an analysis of legislative action taken by Congress following the 1999 shooting at Columbine High School, Lawrence and Birkland (2004) found that 45% of new legislation addressing the school shooting problem was dedicated to increasing security in schools. Zero-tolerance policies were a significant method used by school systems to address school security.

On November 30th, 2021, a school shooting occurred at Oxford High School in Michigan. The shooter was called to the guidance office on the day before the shooting and again

on the morning of the shooting (Baldas, 2022). The first time was because the shooter had

brought ammunition to school and was showing it to classmates and the second was because he

had drawn a handgun and bullet on a class assignment. The shooter had also had previous

behavioral incidents and had posted a threat on Twitter the night before the shooting. Despite all

of this, school officials did not check his backpack on the morning of the shooting, nor did they

include the school security officer in the discussion with the shooter and his parents (Baldas,

2022). There were multiple opportunities for school security measures to prevent this shooting

but there was instead a breakdown in communication. Another key question in this shooting is

how the shooter got ahold of a firearm in the first place as he was only 15 years old.

2.2.2 Firearm Access

Gun control legislation has also been an area of focus following widely publicized school

shootings. The issue of gun control in the United States has remained a topic of discussion for

several decades. The shootings at Columbine High School, Chardon High School, Great Mills

High School, and Oxford High School all used firearms that were accessed illegally. The

shooters in the first three cases were 17 years old. The shooters at Columbine had someone over

the age of 18 purchase guns for them at a gun show but there were no background checks

required and no information about who purchased the gun was recorded by the gun dealers

("Columbine Massacre," 2007). The shooters at Chardon and Great Mills stole their weapons

from relatives who did not properly secure their guns (Thompson et al., 2012) (The Associated

Press, 2018). In both cases, the relative who did not properly secure their firearms faced no

consequences for failing to restrict access to the weapons. In Ohio, there is no legislation that

requires gun owners to properly secure firearms away from children, and in Maryland liability

for failing to restrict access to guns only applies if the child that accessed them is under 16 years

of age (Siegel, 2020). The shooter at Oxford High School was able to access the gun he used because his parents bought it for him as an early Christmas present and did not properly secure it (Baldas, 2022). After the shooting in 2018 at Marjory Stoneman Douglas High School, state legislators responded by passing 50 new gun control laws (Vasilogambros, 2018).

2.2.3 Mental Health Issues

More recently, some attention has turned toward mental health resources as a means of preventing school shootings. Both media outlets and politicians have been pointing to mental illness as the cause of school shootings. While some school shooters do experience issues with mental illness, only 2% of school shootings have been the result of the shooter suffering from psychosis (Riedman & O'Neill, 2020). The representation of mental illness and school shootings by the media is inaccurate and can create stigmas around mental illness (Melici, 2018). At the same time, there are behavioral warning signs that can be used to help identify potential school shooters. In the case of the shooting at Oxford High School, the shooter had been suffering from mental health issues but had not been receiving any help (Baldas, 2022). As of January 2022, the shooter pled not guilty by reason of insanity (The Associated Press, 2022). A distinction needs to be made in the media between warning signs and mental illness as a cause of school shootings to end the stigma that mentally ill people are dangerous.

2.3 Methods of Preventing School Shootings

As school shootings have become a larger issue, many methods for preventing school shootings have been proposed. The proposed methods fall into the three main categories of school safety measures, gun control policy, and mental health support. Within these categories, there are specific actions that can prevent school shootings.

2.3.1 School Safety Measures

Following the shooting at Columbine High School, most legislative action focused on school safety measures (Lawrence & Birkland, 2004). At the time, Columbine was the worst school shooting that the U.S. had ever seen and spurred a fear response from the public and legislators. Some of the school safety measures enacted included arming teachers, training students in active shooter drills, and implementing zero-tolerance policies.

Two decades later, students still participate in active shooter drills and different states and school districts have different requirements for the frequency that students must participate in these drills. Private corporations have also entered the market of school safety training. An example of this is ALICE Training response protocol, which was credited with saving students' lives during the Oxford High School shooting (ALICE Training Acronym & Response Protocol, 2022). ALICE is an acronym that stands for Alert, Lockdown, Inform, Counter, and Evacuate.

The intent of Alert is to get students and faculty to recognize that there is danger as quickly as possible. Lockdown is designed to keep students away from an intruder and give time to prepare to Evacuate or Counter as necessary. Inform is about providing information to law enforcement that can help get the situation under control. Critics of ALICE Training tend to take issue with the Counter protocol, which suggests that students and staff make noise and create distractions to keep the shooter from firing accurately. The ALICE website notes that this is a method of last resort. The final aspect of this training is teaching students and staff how to safely evacuate through non-traditional means, such as a window (ALICE Training Acronym & Response Protocol, 2022).

Arming teachers and zero-tolerance policies have been highly criticized in recent years. Many accidental school shooting incidents have occurred as the result of school staff bringing

firearms to schools. Zero-tolerance policies have also been seen to be applied unfairly to certain groups of students. Zero-tolerance policies are policies where "students receive predetermined penalties for any offense, no matter how minor" (Beger, 2002). According to Beger (2002), zero-tolerance policies have not been shown to have a positive impact on students' safety and tend to be applied disproportionately to Black students.

Schools have also addressed the issue of school security as a means of preventing school shootings. Implementation of metal detectors, increased presence of security cameras, specialized door stops, and employment of school resource officers (SROs) are designed to increase school security in an effort to prevent school shootings. Metal detectors have been installed in schools with the intention of preventing students from bringing weapons to school. Security cameras are used both to monitor student behavior and to deter misbehavior.

Specialized door locks are designed to keep intruders from being able to open classroom doors. Nightlock is a company that makes security door stoppers and had installed these on doors at Oxford High School (Nightlock, 2022).

The employment of SROs is a more complicated method of increasing school security. In some school districts, SROs are employed through private organizations while in others, SROs are members of the local police department. States generally do not have a state-wide policy on how SROs are employed, generally only dictating the level of training that they must complete to work in schools (Macdonald, 2019). This complicates the chain of command within schools and the question of student rights during school. The Fourth Amendment to the U.S. Constitution protects people from unreasonable searches; however, students at school have been understood to be exempt from this protection when the search is done by school officials (Beger, 2002).

SROs employed by local police departments blur the line of school officials versus state officials who would not have the right to search students without a warrant of probable cause. At the same time, recent school shootings, such as Marjory Stoneman Douglas and Great Mills High Schools, illustrate how a good SRO might make a difference in a school shooting. At Marjory Stoneman Douglas, the SRO was the only armed person on campus but did not go into the building to confront the shooter for the duration of the shooting (Minn, 2018). The shooter at Marjory Stoneman Douglas did not stop shooting until he felt like it. At Great Mills High School, the shooter walked down the halls for three minutes without doing anything. The SRO confronted the shooter and ultimately shot him when the shooter refused to put down the gun (The Associated Press, 2018). The shooter at Great Mills was determined to have committed suicide at the same time as the SRO shot him but there is no way to know if he would have done so had he not been confronted.

2.3.2 Gun Control Policy

School shootings cannot occur without firearms. However, the United States has had a long-standing debate around gun ownership. The Second Amendment protects the rights of citizens to bear arms and this has been upheld through Constitutional rulings in the modern day. As a result, guns are not going to disappear in the U.S. anytime soon. This does not mean that access to firearms cannot be safely regulated in a way that reduces the danger to the public.

Federal laws in the United States regarding gun control are not very comprehensive and most gun control legislation is left to state or local governments. The first federal act regulating firearms was the National Firearms Act of 1934 and it began to require the registration of certain types of firearms with the intent of reducing gang crime (ATF, 2019). The Gun Control Act of 1968 increased the provisions for registering firearms and started to prohibit certain individuals

from owning firearms. The Brady Handgun Violence Prevention Act was introduced in 1993 and created a waiting period of five days for handgun sales to unlicensed individuals unless the state had some other form of significant background checks (ATF, 2019). These laws only introduce the bare minimum of gun control and do not hold significant consequences when broken. Many states have introduced stricter firearm laws, including ones that introduce stricter penalties when broken.

In 2020, there were 1,472 different state laws that regulated firearms and ammunition in the U.S. (Siegel, 2020). From 1991 to 2020, the total number of state firearm laws nationwide has almost doubled. California has the most firearm laws with 111 different laws while Idaho has the least firearm laws with one law. Massachusetts is the only state besides California with more than 100 firearm laws while there are 13 states with fewer than 10 laws regulating firearms and ammunition. The RAND Corporation created a State Firearm Laws database that contains information about firearm laws across the U.S..

This database divides firearm laws into 14 categories with several additional subcategories. Child access prevention and possession regulation laws play a large role in keeping firearms out of the hands of children. Child access prevention laws are designed to hold adults accountable if a child can or does access a firearm that they own. Possession regulation laws restrict the age of purchasing for both handguns and long-guns (rifles, shotguns, etc.). There are 29 states that have no laws about child access, making it difficult to hold firearm owners responsible when children get ahold of firearms (Siegel, 2020). Figure 3 shows which states have child access prevention laws and which do not.
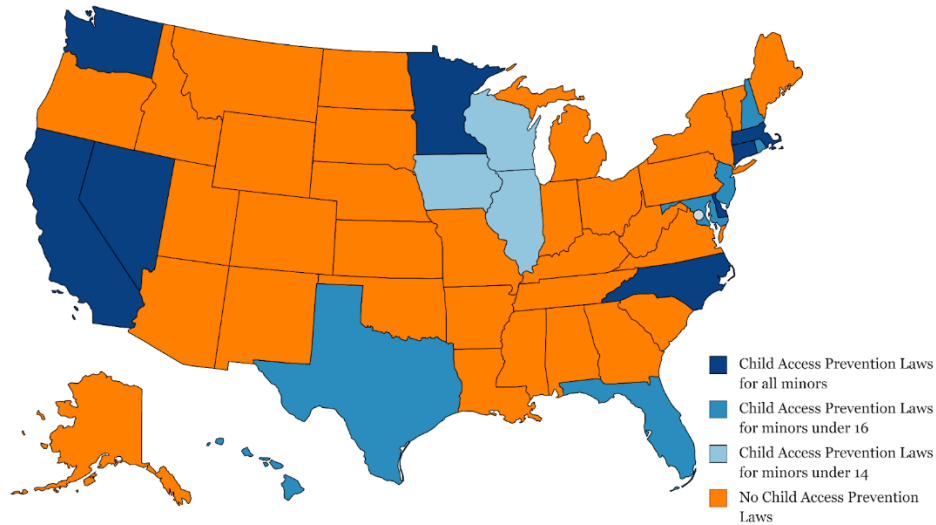
Figure 3. Map of Child Access Prevention Laws in Each State

Expanding federal firearm laws or having states increase the number of firearm laws would help to reduce the number of school shootings. Particularly, laws that introduce consequences when children access firearms would increase the incentives for firearm owners to make it more difficult for minors to access them.

2.3.3 Mental Health Support

While safety measures and gun control policy can help stop would-be school shooters, these measures do nothing to address why people commit school shootings in the first place. Varghese et al. (2020) explored policy options that would address mental health issues among children at school. While their research was specific to California, similar programs could be implemented across the U.S.. The first policy option would be the implementation of social-emotional learning (SEL) programs at all K-12 schools. SEL programs use age-appropriate methods to teach children how to regulate emotions and gain interpersonal skills to make connections with their peers. The second policy option is reducing the ratio of students to counselors in school. The American School Counselor Association (ASCA) recommends a

student to counselor ratio of 250:1 but the national average for the 2020-2021 school year was 415:1 (American School Counselor Association, 2022). Counselors in school often know the most about the mental state of individual students and can help students connect with mental health resources (Varghese et al., 2020). Each of these policy options could be used to address underlying causes of school shootings such as mental health and bullying.

Alongside mental health resources, schools can also learn about potential warning signs of school shooters. While studies conducted by the Department of Education and the FBI have shown that there is no profile of a school shooter or simple lists of warning signs, threat assessment can be used to prevent school shootings (Borum et al., 2010). Threat assessment is different from profiling because "the investigation is triggered by the student's own threatening or concerning behavior rather than by some broader combination of student characteristics" which means actions are used to identify threats (Borum et al., 2010). The FBI study found that most students who committed school shootings communicated their intentions in some way, prior to the actual incident. The study conducted by the Department of Education found that most attackers planned their attacks in advance (Borum et al., 2010). Both of these things can be used to help prevent school shootings if the information is provided to the correct people.

Hermann & Finn (2002) discussed the role of counselors in communicating with law enforcement officials when students exhibit warning signs or threatening behavior. School counselors may know and be able to recognize students who might be a threat to the school community faster than anyone else but they have to consider their students' privacy. However, if a counselor does not communicate with appropriate officials, they may find themselves being held legally liable for school violence. School counselors should make sure that they are taking all threats of violence seriously and notifying the correct individuals so that information is being

passed to the correct authorities (Hermann & Finn, 2002). This balance has come back into focus

following the Oxford High School Shooting. The families of several victims and students are

suing the school district and several school employees who they say failed to act to prevent the

shooter's actions (Baldas, 2022).

3. Methodological Approach

Preventing school shootings is not a new goal for policymakers but as more research has been conducted debate has continued about which area of public policy is the most effective in reducing school shootings. Different stakeholders have their reasons for supporting one area over another. The logistics of implementing certain types of public policy also plays a role in which areas receive the most focus. To identify the most effective policy options, I began by conducting exploratory data analysis with the main variables before conducting an econometric analysis. Both analyses rely heavily on the K-12-SSDB data.

3.1 Exploratory Data Analysis

To begin to prevent school shootings, we must understand what factors impact the rate of school shootings. Because the presence of a firearm is necessary for a school shooting to occur, it makes sense that firearm laws play a large role in the rate of school shootings. Mental health issues are also often cited as the cause of school shootings. This means there is likely a strong relationship between spending on mental health resources as well as the availability of mental health facilities. The amount of spending on mental health care may not accurately reflect the true rate of use of mental health resources so the utilization rate of mental health resources might be a better measure. School security is also scrutinized in the discussion of school shootings.

Requiring schools to have safety drills, banning firearms on school grounds, or requiring schools to have specially trained SROs likely impacts the rate of school shootings. When firearms are not allowed on school grounds, accidental shootings are less likely to occur. School safety drills and the presence of SROs could be a deterrent for any would-be school shooters. While school counselors are not generally talked about in discussions on school security, the

number of school counselors represents a unique crossover of school security and mental health resources.

All school shootings using the revised definition have some sort of impact on the students and staff at a school. Different types of school shootings have different causes and can impact students and staff differently. Indiscriminate shootings often cause a larger negative impact because of the randomness of the shooting. It is also much more difficult to prevent indiscriminate shootings because there is no way to create a profile of a school shooter. Accidental shootings would be prevented in different ways than indiscriminate shootings and impact a school community differently than indiscriminate shootings. The mental condition or age of the shooter would also impact the cause of the shooting or how the shooter accessed a firearm. These specific causes can be addressed with very different preventative actions.

There are also other variables that could impact the rate of school shootings indirectly. Areas with high firearm ownership rates would likely see higher rates of school shootings as firearms are more available. Areas with low population densities may see a higher rate of school shootings because students who have disagreements may only see each other at school and that is where a fight might take place instead of off of school property. States with higher divorce rates may be more likely to see domestic disputes make their way onto school property. To get a sense of relationships between the variables I first visually compared school shootings with some of the independent variables then I compared some additional dependent variables to the independent variables.

3.1.1 Relationships Between School Shootings and Key Variables

As a starting point for examining the data, I looked for any relationships between school shootings and the other variables. By looking at the variables graphically I was able to search for

potential relationships. After identifying these potential relationships, I was able to attempt further analysis.

First, I took the annual number of school shootings in the United States for every year from 1991 to 2021 and divided that number by the total population of the United States in each year. I also included the average number of firearm laws that states had for each year during the same time period. This could identify any potential relationships between the rate of school shootings and gun control legislation.

Next, I took the annual number of school shootings in the United States for every year from 2011 to 2021 and divided that number by the total population of the United States in each year. I also included the average per capita amount of money spent by state mental health agencies (SMHA) for each year from 2011 to 2020. This could indicate any potential relationships between the rate of school shootings and mental health services.

The third relationship that I looked at included the annual number of school shootings in the United States for every year from 2011 to 2021 divided by the total population of the United States in each year as well as the average utilization rate of SMHA resources. This is an additional measure that might indicate any relationships between the rate of school shootings and mental health services. Not every person in a population uses SMHA resources so this measurement may capture things that per capita funding missed.

The fourth relationship that I looked at included the annual number of school shootings in the United States for every year from 2011 to 2021 divided by the total population of the United States in each year as well as the availability rate of SMHA facilities. This is another measure that could indicate relationships between the rate of school shootings and mental health services.

Another way that I thought about breaking down the data was by looking at regional differences. The United States is so big that the different regions have very different cultures. One example of this is seen with gun control laws. The South is typically known for being more relaxed with gun control while the Northeast is known for being stricter. The Midwest and West tend to be more varied in their views of gun control. Mental health is another area where the different regions of the United States tend to take different approaches. Generally, the Northeast and the West are known to pay particular attention to peoples' mental health.

To isolate different regions and try to find patterns, I used the U.S. Census Bureau's regional designations for states. I classified the Northeast as Region 1, the Midwest as Region 2, the South as Region 3, and the West as Region 4. Figure 4 shows these regions and which states are included in each.
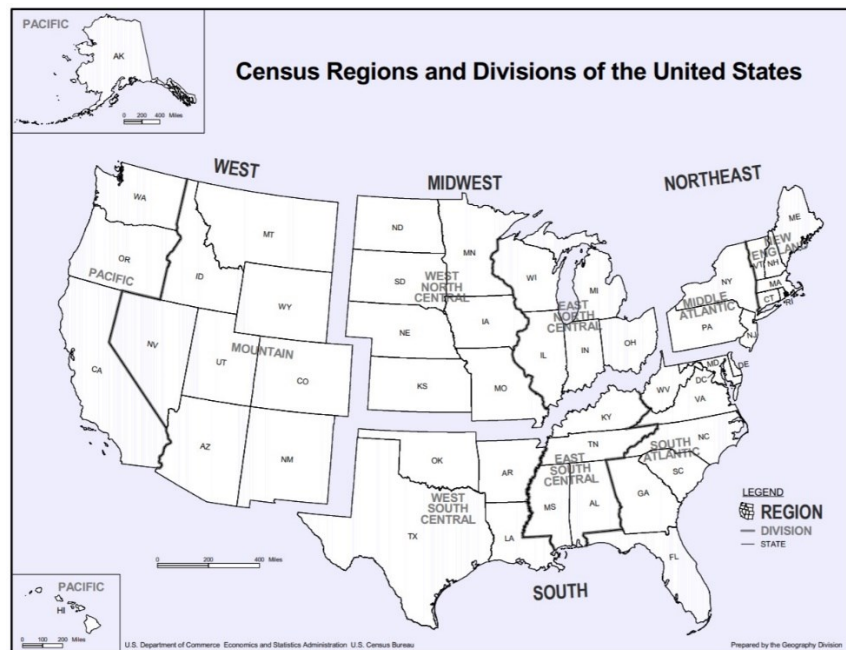

Figure 4. U.S. Census Bureau Regional Designations

Looking first at the rate of school shootings and the number of firearm laws, I dropped observations where there were no school shootings in that state for a given year. There were more instances where the rate was zero than not which was making it difficult to see any patterns

in the data. However, doing this fails to consider that there is a reason why states have no shootings in a given year.

3.1.2 Relationships with Specific Types of School Shootings

After looking at all annual shootings compared with some of the main dependent variables, I also looked at some of the subsets of school shootings. Certain variables may have a larger effect on one subset over another. Each of these comparisons was presented on a different graph.

The first subset that I identified was specifically indiscriminate school shootings. I took the annual number of indiscriminate school shootings in the United States for every year from 2011 to 2021 and divided that number by the total population of the United States in each year. This was compared with the average per capita amount of money spent by SMHAs for each year from 2011 to 2020.

The second subset that I identified was specifically indiscriminate school shootings. I took the annual number of indiscriminate school shootings in the United States for every year from 1990 to 2021 and divided that number by the total population of the United States in each year. This was compared to the average number of firearm laws that states had for each year during the same time period.

The next subset included shootings classified as Murder/Suicide, Suicide, or Psychosis. I took the annual number of school shootings classified this way in the United States for every year from 2011 to 2021 and divided that number by the total population of the United States in each year. This was compared with the average per capita amount of money spent by SMHAs for each year from 2011 to 2020.

The fourth subset included accidental school shootings. I took the annual number of accidental school shootings in the United States every year from 1991 to 2021 and divided that number by the total population of the United States in each year. This was compared to the average number of firearm laws that states had for each year during the same time period.

The last three subsets were selected based on the age of the shooter. I included all incidents where the shooter was under 18, all incidents where the shooter was under 14, and all incidents where the shooter was 18, 19, or 20. These were then compared to the average number of firearm laws that states had for each year during the same time period.

3.2 Econometric Analysis

In addition to the exploratory analysis, I conducted econometric analysis to examine the relationships between variables more closely. The main dependent variable in this paper is the rate of school shootings in the 50 states of the United States. The rate of school shootings was calculated by dividing the annual number of school shootings in each state by that state's population. This number was calculated for each state across multiple years. The number of school shootings each year came from the K-12 SSDB. The state population came from the U.S. Census Bureau's population counts for each decade.

There are also several other dependent variables that are taken as subsets of the main dependent variable. The rate of accidental school shootings was calculated by dividing the annual number of accidental school shootings in each state by that state's population. Accidental school shootings are recorded as incidents where a firearm is unintentionally discharged. The rate of indiscriminate school shootings was calculated by dividing the number of indiscriminate school shootings in each state by that state's population. Indiscriminate school shootings are where the shooter has no specific targets. The next subset includes school shootings where the

incident was classified as Murder/Suicide, Suicide, or Psychosis. The last three subsets of school shootings relate to the age of the shooter. The first is any school shooting where the shooter is under the age of 18, the second is any school shooting where the shooter is under the age of 14, and the third is any school shooting where the shooter is between the ages of 18 and 20.

The first independent variable is the total number of firearm laws per state. This data was found in the RAND Corporation's State Firearm Law Database. Different states have different wordings for their firearm laws but many states have laws that do effectively the same thing. The State Firearm Law Database organized all of the firearm laws in the states and counted how many laws each state has. This was done for each year from 1991 to 2020.

The second independent variable is per capita spending on mental health resources. This was found by taking the amount of spending set aside in the state budget for mental health resources and dividing that by the state population. This data came from the Substance Abuse and Mental Health Services Administration's Uniform Reporting System. This data was available for different states from 2011 to 2020.

The third independent variable is the number of mental health facilities per 100,000 people. This data came from the Substance Abuse and Mental Health Services Administration's National Mental Health Services Survey. This was available for 2010, 2012, and each year from 2014 to 2019. This includes public and private psychiatric facilities, general hospitals with separate psychiatric units, residential treatment centers, and out-patient mental health facilities.

The fourth independent variable is the utilization rate of state mental health facilities per 1,000 people. This data came from the Substance Abuse and Mental Health Services Administration's Uniform Reporting System. This data was available for different states from 2011 to 2020.

The fifth independent variable is whether states require school resource officers to receive training in order to work with students in schools. This data is a dummy variable for each state from 1991 to 2021. This information was found in a report on K-12 School Safety that was conducted by the Education Commission of the States. This report was published in 2019 and looks at policies found in the state laws. Individual school boards can often set their own policies, which were not considered.

The sixth independent variable is the ratio of students to counselors in public high schools. The data on the total number of students enrolled at these schools was available for each state from 1997 to 2021. This data came from the National Center for Education Statistics. The data on the number of school counselors in public high schools came from the U.S. Department of Education's Civil Rights Data Collection. It was available for each state for 2012, 2014, 2016, and 2018. I started using this variable after I discovered how difficult it was to find data on school resource officers.

The first control variable is the estimated rate of firearm ownership. This information came from the RAND Corporation's State-Level Firearm Ownership Database. This database has state-level estimates of household firearm ownership rates dating back to 1980. The second control variable is population density. The state populations recorded by the Census Bureau for each decade were divided by the state's total area to get population density for each decade. The third control variable is the state divorce rates. This data comes from the Center for Disease Control's (CDC) National Vital Statistics System and is available from 1990, 1995, and 1999 to 2019.

3.2.1 Summary Statistics

The data used in this analysis was a set of panel data. Each value was associated with one state in the United States as well as one year between 1970 and 2021. Only the rate of school shootings and following subsets cover the entire span of years. The other variables contain measures for some combination of years in that range. Table 1 shows the summary statistics of all of the variables.

Table 1: Summary Statistics of Variables

Variable	Mean	S.D.	Definition
School Shooting Rate	.0094979	.0229058	Annual number of school shootings per state divided by the state population
Accidental Shooting Rate	.0010351	.0070818	Annual number of accidental school shootings per state divided by the state population
Indiscriminate Shooting Rate	.0005841	.0056135	Annual number of indiscriminate school shootings per state divided by the state population
Psychologically Influenced Shooting Rate	.0013704	.0088568	Annual number of school shootings classified as Murder/Suicide or Psychosis per state divided by the state population
Minor Shooter Shooting Rate	.0048808	.015578	Annual number of school shootings where the shooter was under 18 per state divided by the state population
Under-14 Shooter Shooting Rate	.0006954	.0059473	Annual number of school shootings where the shooter was under 14 per state divided by the state population
Young Adult Shooter Shooting Rate	.0010769	.0066077	Annual number of school shootings where the shooter was aged 18-20 per state divided by the state population
State Firearm Laws	23.96667	22.55572	Number of firearm laws per state
Mental Health Funding	124.6734	83.50959	Annual per capita spending by state governments on mental health care
Mental Health Facilities	5.27033	2.775889	Total mental health facilities per state divided by the state population

Mental Health Resource Utilization Rate	25.61851	14.38778	Utilization rate of state mental health facilities
Student to Counselor Ratio	256.0889	65.16466	Number of high school students by state divided by the number of high school counselors by state
Firearm Ownership Rate	.4151331	.1392955	Estimates of household firearm ownership rates calculated by the RAND Corporation
Divorce Rate	4.038813	1.220672	Annual number of divorces per state divided by the state population
Population Density	153.2176	194.3416	State population divided by area of state in square miles

The rate of school shootings includes all of the subsets of school shootings so it makes sense that the mean is higher than any of the subsets as well. Minor shooters appear to be the most common subset with the highest average of any presented in the table. Across the nearly 30-year period, the average number of firearm laws that a state had was 23.967 with a very high standard deviation of 22.556. Per capita spending on mental health resources also has a very high standard deviation of 83.51. The firearm ownership rate has an average of 0.415 with a standard deviation of 0.139.

To ensure that there were no variables with extremely high correlation, I checked their pairwise correlations. Table 2 shows the Stata output of the correlation table for all of the variables.

Table 2: Correlation Table of Variables

```
             shootr~e srotrain accide~e ind~rate psychr~e minors~e capsho~e yashoo~e firelaws mental~d mental~c utiliz~e  fireown divorc~e counse~o
  shootrate   1.0000
   srotrain   0.0054   1.0000
 accidentrate 0.3635   0.0823   1.0000
 indiscr~rate 0.2683  -0.0459   0.1056   1.0000
    psychrate 0.8002  -0.1199   0.0410   0.0396   1.0000
  minorshoot~e 0.6101  0.0674   0.4928   0.4563   0.2879   1.0000
  capshootrate 0.0944  0.0001   0.0759  -0.0287   0.0893   0.1960   1.0000
  yashoo~e    0.1010   0.0572  -0.0436  -0.0475  -0.0552  -0.0957  -0.0327   1.0000
   firelaws  -0.0919   0.1846  -0.1267   0.0267  -0.1004  -0.0541  -0.0523  -0.0949   1.0000
  mentalfund  0.0358  -0.0193  -0.1880   0.0141   0.0914  -0.0741  -0.1086   0.0435   0.2864   1.0000
   mentalfac -0.0346  -0.3296   0.0668  -0.0884   0.0756  -0.0828  -0.0807  -0.0006  -0.2327   0.3803   1.0000
 utilizatio~e 0.0226   0.0521  -0.1760   0.0291   0.1298  -0.0141   0.0203  -0.0617   0.0460   0.6007   0.2825   1.0000
    fireown   0.0761  -0.2435   0.0873  -0.0108   0.1045   0.0615   0.1116   0.0815  -0.8350  -0.2610   0.3534  -0.0387   1.0000
  divorcerate -0.1062 -0.3039   0.0474  -0.1010  -0.0203  -0.0504   0.2099  -0.0432  -0.4244  -0.1592   0.2517  -0.0439   0.4364   1.0000
 counselorr~o 0.0379   0.1065   0.1341   0.2243  -0.1917   0.1595  -0.0981   0.1286  -0.1669  -0.2402  -0.1644  -0.1135   0.0394   0.0527   1.0000
```

There are a couple variables that have a high correlation, mainly between the school shooting rate and the subsets of school shooting rates. Because the data for the subsets is included in school shooting rate and these variables are never included in the same equation it is not a problem that they have higher correlations. There is also a high correlation of -.83 between the number of firearm laws and the rate of firearm ownership. This is reasonable to see as states with more firearm laws often have barriers to firearm ownership that lower the rate of firearm ownership.

3.2.2 Fixed-Effects Regression Model

To explore the relationship between the variables, I decided to use a fixed-effects regression model. The data was available across several years from 1970 through 2021 and was also available for various states of the United States. This data was panel data and while I did try to use OLS, the data set was better suited to fixed-effects regression. Fixed-effects regression is best used when entities in a data set have differences that are not random. For example, there are different cultural climates in different U.S. states that are tied to the states and do not vary from year to year. Because states maintain differences across years that can be directly tied to the state, it did not make sense to used random-effects regression in this case. Different variables had varying levels of availability by year and state. As additional variables were added to the model, the total number of observations declined.

The first model includes the main dependent variable, the rate of school shootings, as well as all of the independent and control variables. Equation (1) shows the estimated equation and hypothesized signs of the coefficients, indicated by the signs above or below each coefficient.

$$\overset{(-)}{shootrate_{it}} = \beta_0 + \beta_1 \overset{(-)}{firelaws_{it}} + \beta_2 \overset{(-)}{mentalfund_{it}} + \beta_3 \overset{(-)}{mentalfac_{it}} +$$

$$\beta_4 \overset{(-)}{utilizationrate_{it}} + \beta_5 \overset{(-)}{srotrain_{it}} + \beta_6 \overset{(+)}{counselorratio_{it}} +$$

$$\beta_7 \overset{(+)}{fireown_{it}} + \beta_8 \overset{(+)}{divorcerate_{it}} + \alpha_i EF_i + \rho_t TF_t + \epsilon_{it}$$

Where:

shootrate = Annual number of school shootings by state divided by state population, Rate of School Shootings

firelaws = Number of firearm laws per state, Number of Firearm Laws

mentalfund = Per capita total SMHA mental health expenditures by state, SMHA Per Capita Funding

mentalfac = Total number of SMHA facilities divided by state population, Availability Rate of SMHA Facilities

utilizationrate = Rate of use of state mental health agency resources, Utilization Rate of Mental Health Facilities

srotrain = Whether states have training requirements for School Resource Officers, School Resource Officer Training

counselorratio = Ratio of students to counselors in public high schools, Student to Counselor Ratio

fireown = Annual estimated rate of firearm ownership per state, Firearm Ownership Rate

divorcerate = Annual divorce rate per state, Divorce Rate

The expected signs for all of the independent variables, except ratio of students to counselors, are

negative because these are all variables that are representing policies that are designed to prevent

school shootings. The expected sign for the ratio of students to counselors is positive because the

ideal ratio is a low number of students per counselor. There is a possibility that a positive sign for SRO training could be reasonable as well, given that SROs often have firearms on campuses, immediately increasing the likelihood of an accidental shooting.

3.2.3 Additional Regression Models

Based on the exploratory data analysis that I completed, I also tried a couple other models using some of the subsets of school shootings. First, I changed the dependent variable to be indiscriminate school shootings. Equation (2) shows this model.

$$(2)$$

$$indiscriminateshootrate_{it} = \beta_0 + \overset{(-)}{\beta_1 firelaws_{it}} + \overset{(-)}{\beta_2 mentalfund_{it}} + \overset{(-)}{\beta_3 mentalfac_{it}} + \overset{(-)}{\beta_4 utilizationrate_{it}} +$$

$$\overset{(-)}{\beta_5 srotrain_{it}} + \overset{(+)}{\beta_6 counselorratio_{it}} + \overset{(+)}{\beta_7 fireown_{it}} + \overset{(+)}{\beta_8 divorcerate_{it}} + \alpha_i EF_i + \rho_t TF_t + \epsilon_{it}$$

In this model, *indiscriminateshootrate* refers to the rate of school shootings that were classified as indiscriminate, meaning the shooter had no specific target. Just as in the first model, I would expect the signs on the independent variables to be negative again, with the exception of student to counselor ratio.

The next subset that I explored was school shootings classified as psychosis, murder, or suicide with all of the independent variables from the original model. This is shown in Equation (3).

$$(3)$$

$$psychshootrate_{it} = \beta_0 + \overset{(-)}{\beta_1 firelaws_{it}} + \overset{(-)}{\beta_2 mentalfund_{it}} + \overset{(-)}{\beta_3 mentalfac_{it}} + \overset{(-)}{\beta_4 utilizationrate_{it}} +$$

$$\overset{(-)}{\beta_5 srotrain_{it}} + \overset{(+)}{\beta_6 counselorratio_{it}} + \overset{(+)}{\beta_7 fireown_{it}} + \overset{(+)}{\beta_8 divorcerate_{it}} + \alpha_i EF_i + \rho_t TF_t + \epsilon_{it}$$

In this model, *psychshootrate* refers to the rate of school shootings that were classified as psychosis, murder, or suicide. Just as in the first model, I would expect the signs on the independent variables to be negative for the same reasons.

Next, I used the rate of all school shootings as the dependent variable once again and added dummy variables for the different regions of the U.S. along with all of the independent and control variables from Equation (1). Equation (4) shows the model used.

(4)

$$\overset{(-)}{shootrate} = \beta_0 + \beta_1 \overset{(-)}{firelaws} + \beta_2 \overset{(-)}{mentalfund} + \beta_3 \overset{(-)}{mentalfac} + \beta_4 \overset{(-)}{utilizationrate} + \beta_5 \overset{(-)}{srotrain} +$$

$$\beta_6 \overset{(+)}{counselorratio} + \beta_7 \overset{(-)}{region1} + \beta_8 \overset{(+)}{region2} + \beta_9 \overset{(+)}{region3} + \beta_{10} \overset{(+)}{fireown} + \beta_{11} \overset{(+)}{divorcerate} + \epsilon$$

In this model, *region1* is a dummy variable for the Northeastern U.S., *region2* is a dummy variable for the Southern U.S., and *region3* is a dummy variable for the Midwestern U.S.. The Western U.S. is also indirectly represented in this model whenever the three dummy variables are all zero. Given regional differences, I would expect *region1* to have a negative coefficient while I would expect the other two to have a positive coefficient.

While these additional models used some of the same variables as the original model, these equations could help provide insight into how specific types of school shootings could be reduced by targeting policy types. Not all school shootings are alike, making it reasonable that the method for addressing each may vary.

4. Results

Through my review of previous literature, I had found that the three main areas of public policy that effect school shootings were gun control, mental health resources, and school security. Using the available data, I was able to conduct exploratory data analysis and econometric analysis on the relationship between the rate of school shootings, gun control, and mental health resources.

4.1 Exploratory Data Analysis Results

Exploratory data analysis does not provide proof of any relationships between variables but it does give a starting point for exploring the data further. By looking at the variables visually, I was able to choose some potential relationships between variables to explore further. First, I looked at the overall school shooting rate compared to some of the dependent variables before looking at some subsets of the rate of school shootings.

4.1.1 School Shooting Rate and Independent Variables

The first relationship that I looked at was between the rate of school shootings and gun control. Figure 5 shows the annual rate of school shootings in the United States and the national average number of firearm laws in a state for each given year.
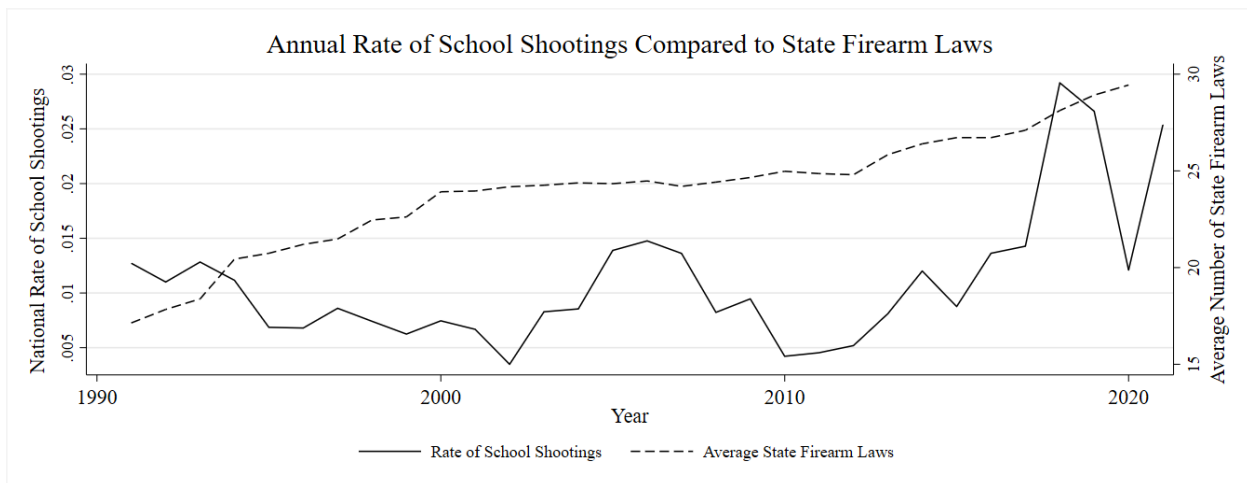

Figure 5. National Annual Rate of School Shootings vs. State Firearm Laws

The rate of school shootings has been increasing since 1991 as has the average number of state firearm laws. However, it is likely that the firearm laws have been increasing at least partially as a reaction to the school shootings. The second-largest annual drop in school shootings was during 2020, as a result of the COVID-19 pandemic closing schools. In 2021, when students began returning to schools, the rate dramatically increased, nearly to pre-pandemic levels. The shooting at Oxford High School was one of many school shootings that occurred in 2021. The dramatic increase in 2021 suggests that 2020's dramatic drop is not indicative of a larger trend and should not be used to identify relationships between the variables.

The next relationship that I examined was between the rate of school shootings and mental health resources. The next three figures examine different variables related to mental health resources. Figure 6 shows the annual rate of school shootings in the United States and the average per capita amount of money spent by state mental health agencies (SMHA) for each year.
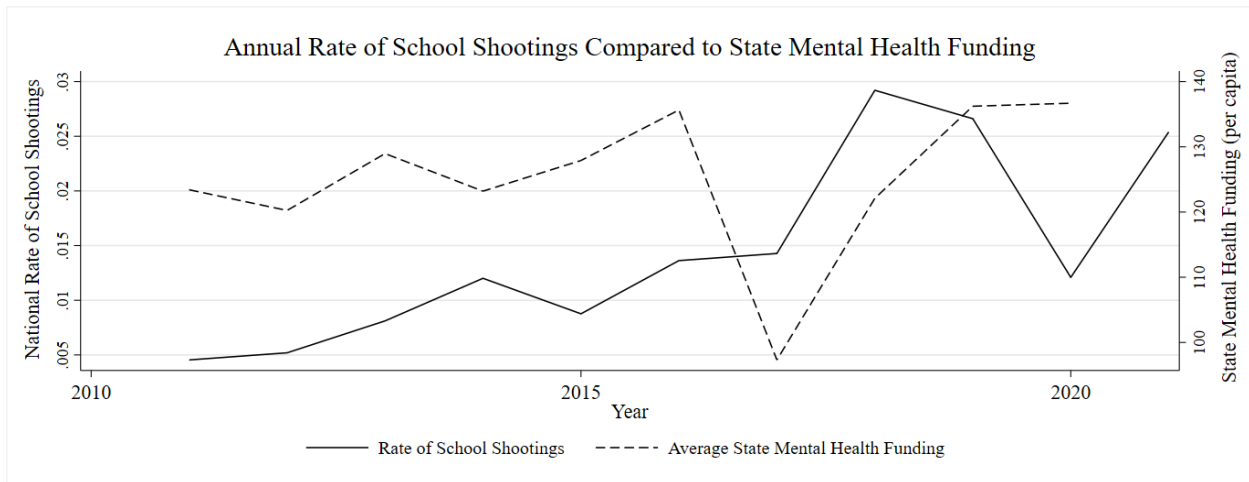

Figure 6. National Annual Rate of School Shootings vs. State Mental Health Funding

There was a dramatic drop in SMHA funding in 2017 before it rose to previous levels in 2019. Interestingly, 2018 was the year that saw the greatest spike in school shootings. This could mean

that there is a relationship between the school shooting rate and the per capita mental health funding in the year prior.

Figure 7 shows the annual rate of school shootings in the United States and the average utilization rate of SMHA resources.
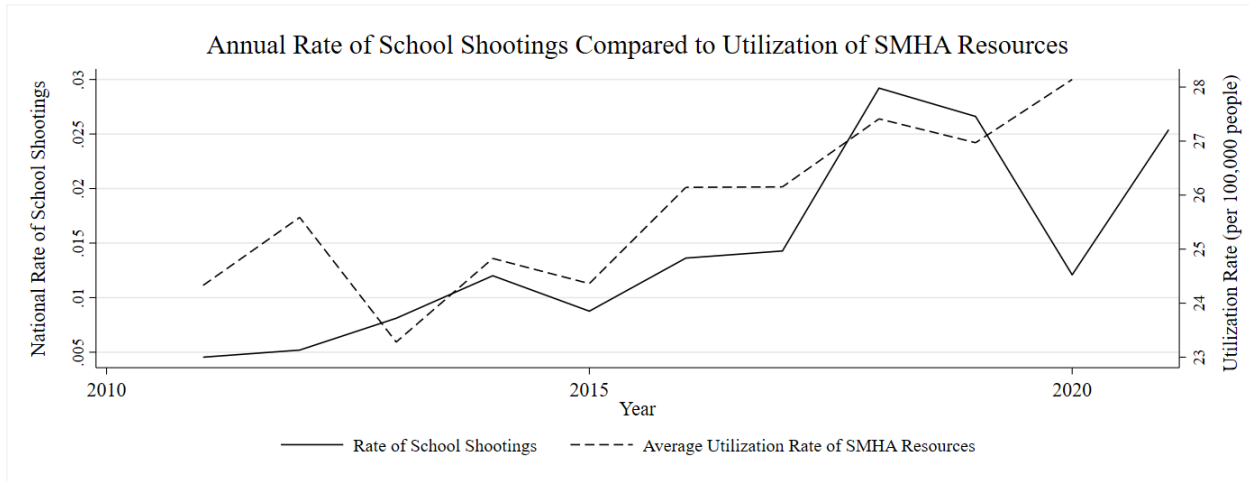

Figure 7. National Annual Rate of School Shootings vs. Utilization of SMHA Resources

The utilization rate of SMHA resources appears to be correlated with school shootings. It is unlikely that either of these variables has a completely causal relationship with the other but there is likely some other factor that is causing both to increase in this way.

Figure 8 shows the annual rate of school shootings in the United States and the average availability rate of SMHA facilities.
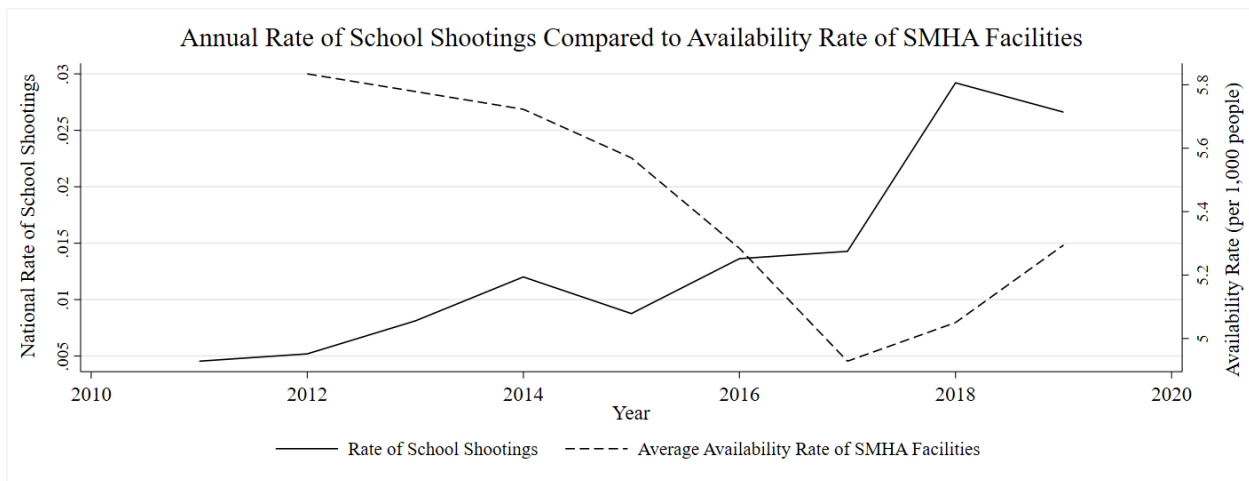

Figure 8. National Annual Rate of School Shootings vs. Availability of SMHA Facilities

The availability of state mental health facilities was declining from 2012 until 2017. Between

2017 and 2018 there was a dramatic increase in the availability of facilities which happens to

correspond to the spike in the school shooting rate that occurred in 2018. However, the decline

and then increase in facility availability was not a very big change as the rate fluctuated by less

than one percent.

Regional differences in the United States may also have an effect on what public policy

category plays the largest role in the prevention of school shootings. Figure 9 shows the

relationship between the rate of school shootings and the number of state firearm laws for each

region of the U.S..
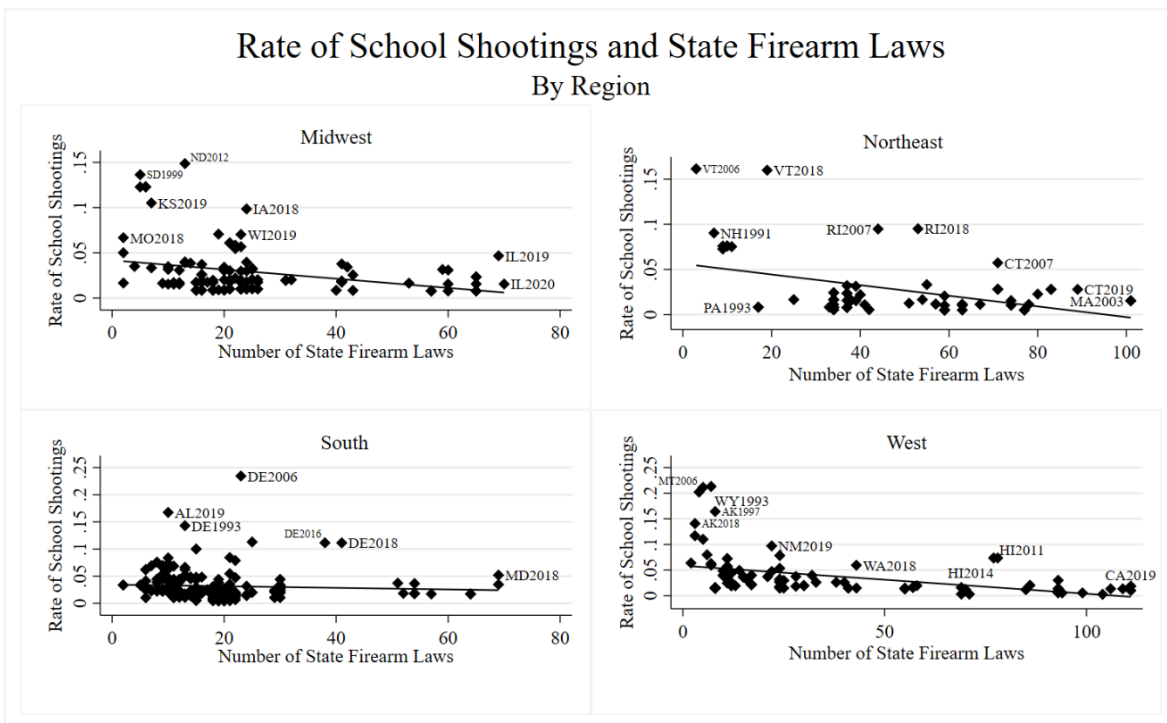
Figure 9. Regional Relationships between School Shootings and State Firearm Laws

The Northeast, Midwest, and West showed a negative relationship between firearm laws and the

rate of school shootings while the South did not show any strong relationship. States more

frequently only see a few shootings in one year with some years seeing dramatic spikes. This

results in clusters of low shooting rates which pulls the line of best fit closer to the x-axis.

However, there are some states and years where the rate of shootings is extremely high and the number of firearm laws is very low. The opposite is also seen where the rate of school shootings is low and the number of firearm laws is high. This is particularly evident in the northeast with Vermont in 2006 and 2018 and Massachusetts in 2003. The Midwest and West have similar examples.

4.1.2 Additional Dependent Variable Relationships

After creating the graphs for the main variables, I also looked at subsets of the dependent variables. Different school shootings have different causes and shooters have different motivations. Different types of public policy may be better at addressing certain cause than others. There are four figures that look at three mutually exclusive subsets of school shootings and a figure that separates shootings based on the age of the shooter.

Figure 10 shows the annual rate of indiscriminate school shootings and the average per capita amount of money spent by SMHAs for each year. These school shootings do not have specific targets and often have mentally ill shooters.
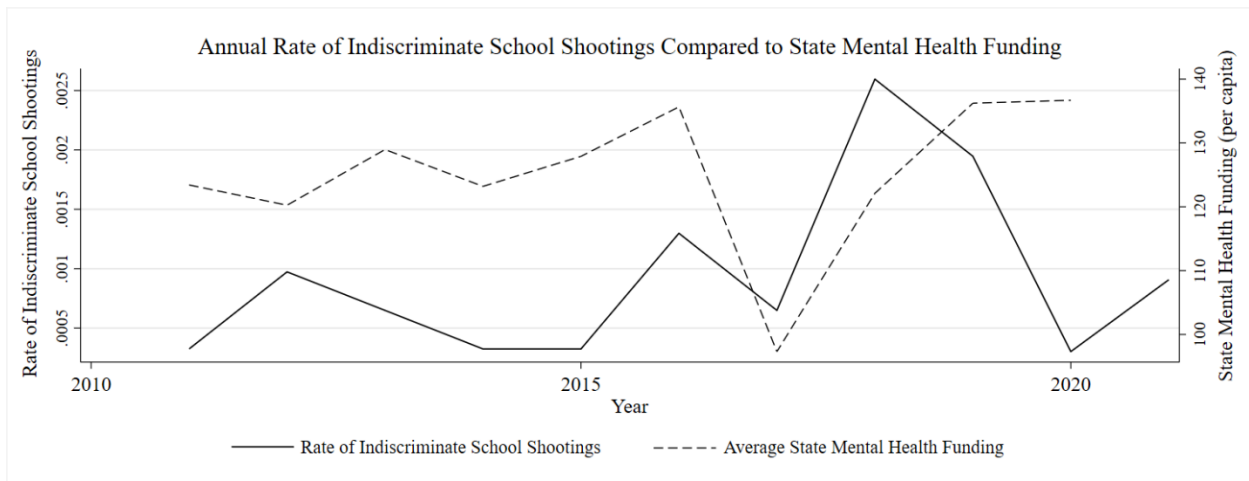

Figure 10. National Annual Rate of Indiscriminate School Shootings vs. State Mental Health Funding

There was a dramatic drop in SMHA funding in 2017 before it rose to previous levels in 2019. Interestingly, 2018 was the year that saw the greatest spike in school shootings. This could mean

that there is a relationship between the indiscriminate school shooting rate and the per capita mental health funding in the year prior. However, it is hard to say if SMHA funding increases in response to school shootings or if school shootings decrease in response to SMHA funding increases. This graph and Figure 6 show very similar relationships and pieces of information.

Figure 11 also shows the annual rate of indiscriminate school shootings but instead compares it to the average number of state firearm laws for each year. These shootings generally have more firearms involved than other categories of school shootings.
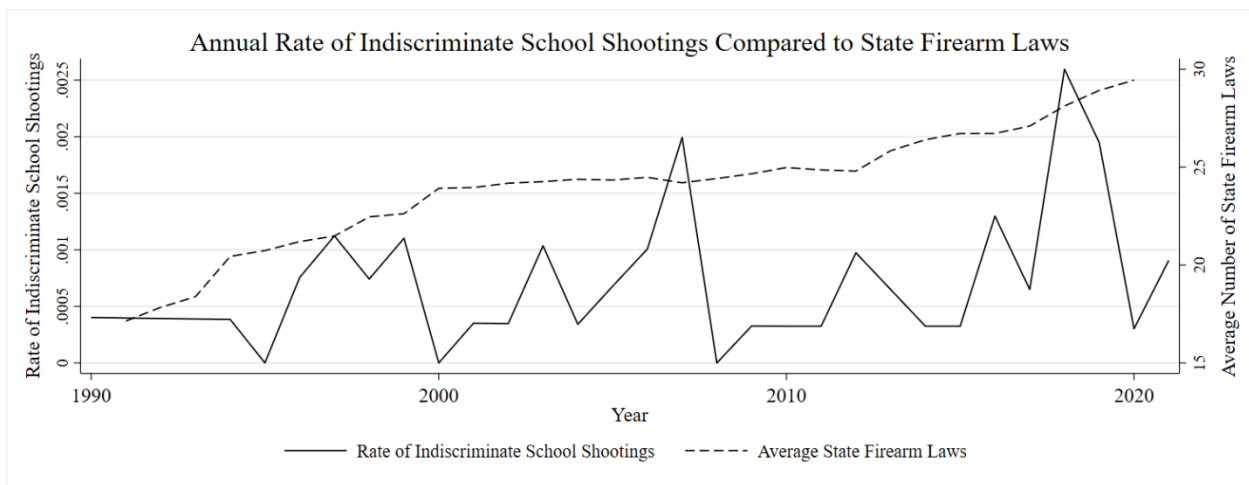
Figure 11. National Annual Rate of Indiscriminate School Shootings vs. State Firearm Laws

The rate of indiscriminate school shootings fluctuates significantly between years but more recently, the years with high rates of indiscriminate school shootings are higher than in the past. Firearm laws have been steadily increasing but as I mentioned with Figure 5, it is not easy to separate how much of the increase is in response to the increase in the rate of school shootings.

Figure 12 shows the annual rate of school shootings classified as Psychosis, Murder, or Suicide compared to state mental health funding. This subset could also have been compared to SMHA facility availability rate or utilization rate but these measurements may not account for the quality of available resources. Funding is likely a better measure of quality.
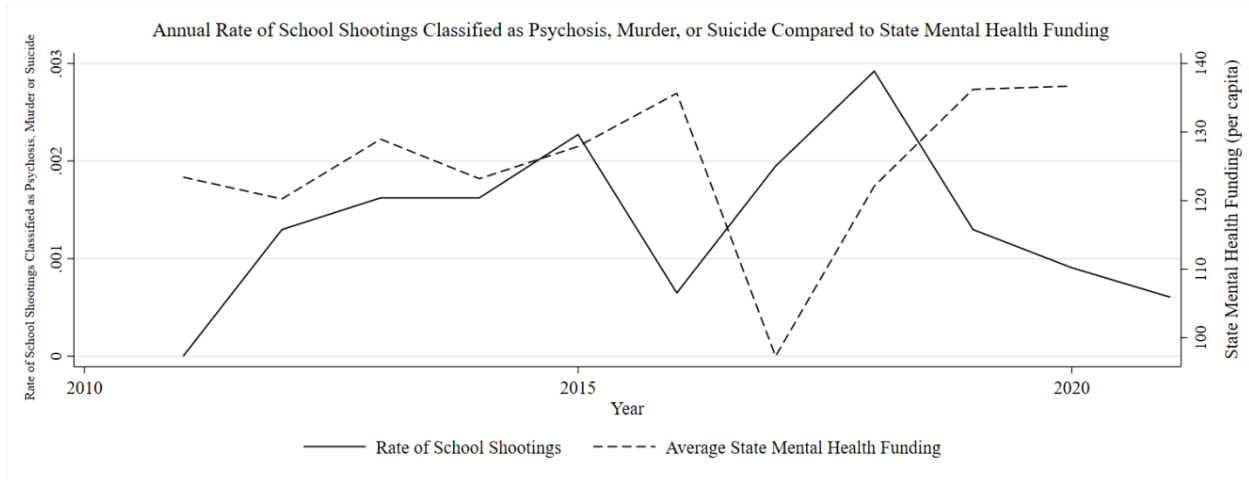
Figure 12. National Annual Rate of School Shootings Classified as Psychosis, Murder, or Suicide vs. State Mental Health Funding

This figure shows a relationship similar to Figure 6. In 2017, mental health funding dropped significantly and in the following year, the rate of this category of school shootings spiked. While this does not say anything definitive about the relationship between these variables, it suggests that there may be something worth exploring more

Figure 13 explores the next subset of school shootings. The annual rate of accidental school shootings is compared to the average number of state firearm laws in a given year.

Figure 13. National Annual Rate of Accidental School Shootings vs. State Firearm Laws

As seen before, the average number of state firearm laws was steadily increasing. The rate of accidental school shootings stayed relatively low, with two spikes in 2005 and 2018. These spikes are dramatic compared to the typical rate but are still very low.

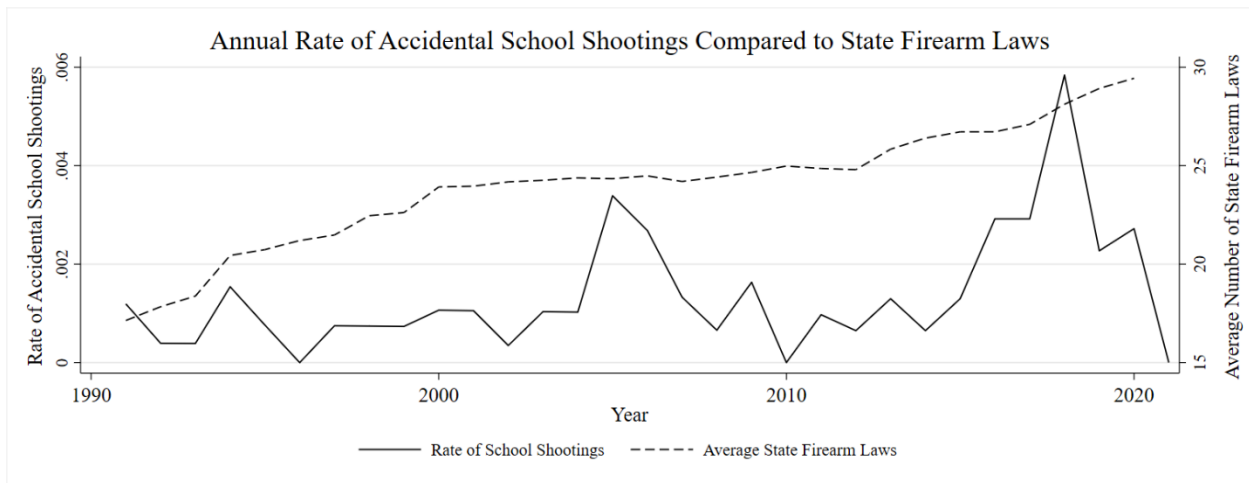Figure 14 contains three different graphs comparing shootings by age of the shooter with state firearm laws. The top left graph compares the annual rate of school shootings committed by someone under 18 to the average number of state firearm laws. The top right graph takes the data from the first graph and only includes school shootings where the shooter was under the age of 14. Child access laws for firearms across the country vary, but most states with any child access laws require firearms to be secured away from children under the age of 14. The bottom left graph examines a different age group: young adults between the ages of 18 and 20. Depending on the firearm laws in each state, people in this age group may have legal access to a firearm.
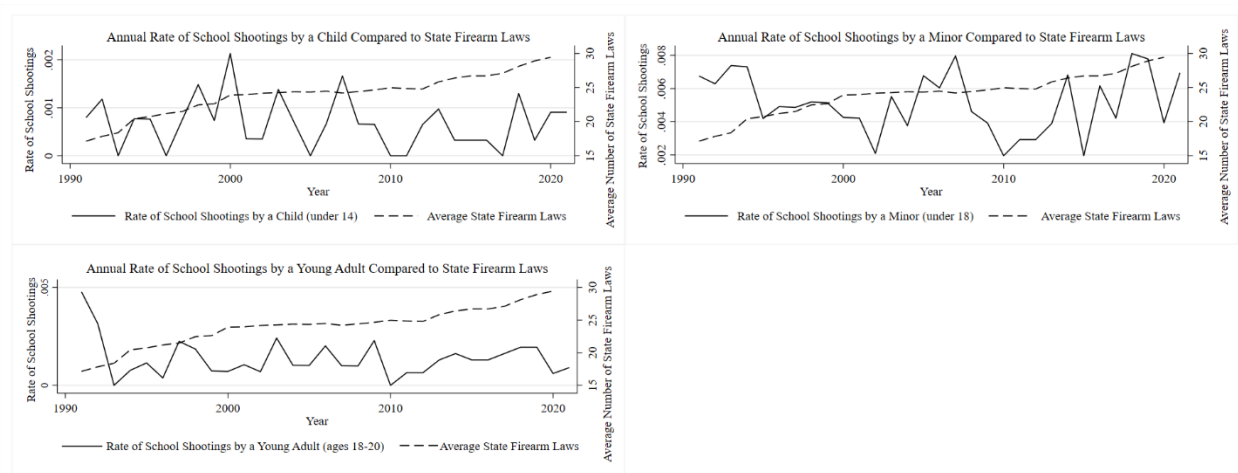
Figure 14. National Annual Rate of School Shootings by Shooters of Certain Ages, vs. State Firearm Laws

While the rate of school shootings by a minor fluctuates between years, it never drops to zero. In any given year between 1991 and 2021, there was always at least one school shooting committed by a minor, even as the number of state firearm laws have been increasing.

The main difference between the first two graphs in Figure 14 is that there are several years where no children under the age of 14 committed a school shooting. The rate of school shootings by children under 14 has also seen fewer dramatic spikes in more recent years. This happens to coincide with the increase in the number of state firearm laws.

From 1993 to 2009 the rate of school shootings by young adults fluctuated from year to year but stayed in roughly the same place. During this time, the average number of state firearm laws grew a little before remaining roughly the same. In 2010, the rate of school shootings by young adults was zero and while it began to grow over the next several years, it never spiked as high as it did in 2009. This was around the same time as the average number of state firearm laws started to increase again.

4.2 Econometric Analysis Results

The exploratory data analysis helped to show potentially interesting relationships between variables. I used econometric analysis to try to explore some of the visual relationships more closely. Using both fixed-effects estimation models with the rate of all school shootings as the dependent variable and multiple other models involving some subsets of school shootings as the dependent variable, I was trying to see if there was interaction between the variables in addition to the correlations that I saw.

4.2.1 Fixed-Effects Regression Results

Using Stata, a fixed-effects estimation model was used to generate an estimated equation in the form of (1). The second column shows the regression results when the control variables are left out of the equation while the third column shows the results when all control variables are included. The dependent variable in both cases in the annual rate of school shootings. The results of this regression are seen in Table 3 below.

Table 3: School Shooting Regression Results

	Rate of School Shootings	
	Basic Equation	**All Incidents with Additional Controls**
Number of Firearm Laws	-0.00107 (-0.73)	-0.00128 (-0.86)
SMHA Per Capita Funding	0.0000114 (0.09)	0.0000113 (0.08)
SMHA Facility Availability Rate	0.00336 (0.50)	0.00316 (0.46)
Utilization Rate of SMHA Resources	0.00112 (0.94)	0.000942 (0.78)
School Resource Officer Training	0.0194 (1.77)	0.0145 (1.23)
Student to Counselor Ratio	-0.000152 (-1.41)	-0.000195 (-1.71)
Firearm Ownership Rate	----	-0.116 (-0.85)
Divorce Rate	----	-0.0118 (-0.83)
_cons	0.0188 (0.32)	0.128 (1.17)
Number of Observations:	**97**	**97**
Adjusted R^2:	**0.1150**	**0.1428**

t statistics in parentheses

* $p<0.05$, **$p<0.01$, *** $p<0.001$

Neither of these equations yielded statistically significant results for any of the variables. In both equations, the number of firearm laws and the student to counselor ratio matched the expected signs based on theory however when firearm ownership rate and divorce rate were added they had unexpected signs. The number of observations was the same in both cases and the adjusted R^2 increased after adding the control variables.

The lack of statistically significant effects led me to test whether fixed-effects was actually the correct method to use with this data set. I conducted a Hausman test on (1) and the same variables but in a random effects model. The resulting p-value was .3433 causing me to fail to reject the null hypothesis that the difference in coefficients is not systematic. There is a chance that this data set fails to capture the state characteristics across years because it is so small. The student to school counselor ratio had limited available data which greatly restricted the total number of observations used in this equation. To test for heteroscedasticity in my model, I used the Wald test. The χ^2 value that the test returned was -1052.21 and Prob $> \chi^2$ was 1.00. This led me to fail to reject the null hypothesis that the model is homoscedastic. This suggests that heteroscedasticity is probably not an issue in the model that I used.

4.2.2 Additional Regression Results

To explore the shooting subsets and regional differences, I used Stata to generate two additional fixed-effects estimations and one pooled estimation with dummy variables. The first two dependent variables are subsets of school shootings. The first model includes the rate of indiscriminate school shootings, where there is not a specific target. The second model includes the rate of school shootings that are classified as Psychosis, Murder, or Suicide. The third dependent variable is the annual rate of all school shootings as is used in Equation (1). Table 4 shows the results of the additional regression models.

Table 4: Additional Regression Results

	Rate of School Shootings		
	Indiscriminate	**Psychosis, Murder/Suicide**	**Controlled for Regions**
Number of Firearm Laws	-0.000186 (-0.91)	0.000130 (0.11)	-0.000116 (-2.03)
SMHA Per Capita Funding	-0.000000948 (-0.05)	-0.0000423 (-0.39)	0.0000203 (2.17)
SMHA Facility Availability Rate	-0.000144 (-0.15)	0.00198 (0.36)	-0.00111 (-1.29)
Utilization Rate of SMHA Resources	0.00000505 (0.03)	0.00144 (1.48)	0.00000863 (0.10)
School Resource Officer Training	-0.00195 (-1.20)	0.00895 (0.95)	-0.000813 (-0.22)
Student to Counselor Ratio	0.00000941 (0.60)	-0.0000662 (-0.72)	0.0000144 (0.31)
Northeast	----	----	-0.00338 (-0.67)
South	----	----	-0.00873 (-2.36)
Midwest	----	----	-0.00919 (-7.16)
Firearm Ownership Rate	0.0212 (1.12)	-0.0209 (-0.19)	0.0277 (1.82)
Divorce Rate	-0.00231 (-1.17)	0.0102 (0.89)	-0.00738 (-3.90)
_cons	0.00352 (0.23)	-0.0537 (-0.61)	0.0352 (2.30)
Number of Observations:	**97**	**97**	**97**
R²:	**0.1094**	**0.1064**	**0.0640**

t statistics in parentheses

* $p<0.05$, **$p<0.01$, *** $p<0.001$

In all three models, there were no statistically significant coefficients. When the dependent

variable was indiscriminate school shootings, all of the independent variables had the expected

signs on the coefficients except for the utilization rate of SMHA resources. This suggests that the expected signs are likely correct and maybe the model would be more significant with more observations. It was interesting that all three regions had negative coefficients but there is a chance that it means the regions do not have as strong of a relationship with school shootings as I would have assumed.

4.3 Further Research and Policy Implications

While the regression analysis did not yield statistically significant results, some of the relationships seen in the exploratory analysis could have interesting policy implications if researched farther. Past research has identified gun control, mental health resources, and school security measures as the three main areas of focus for reducing the rate of school shootings. Both the rate of school shootings and the average number of state firearm laws have been increasing over the past three decades. Looking at it visually, it is difficult to identify if the increase in firearm laws has been a response to the increase in school shootings or if the two are simply correlated. Looking more closely at when states introduced specific pieces of legislation could help distinguish between these possibilities.

When the school shootings were separated by region and compared to firearm laws, there seemed to be a negative relationship between the two variables in three of the four regions. This could potentially indicate that regional attitudes around gun control impact how effective gun control policy is as a method to reduce school shootings. If more extensive data on mental health resources or school security could be collected, a similar regional analysis may help to determine which category of policy plays the biggest role in each region.

School shootings have a wide variety of causes and as such there will necessarily be a wide range of prevention methods. The methods employed will largely rely on the specific cause,

type of shooting, or outcome that you are trying to prevent. Preventing the fatalities associated with school shootings is often the primary focus of school officials. While preventing school shootings would limit this outcome, there are also ways to make shootings less deadly through the use of school security measures.

Previous research has also shown that even students who do not experience fatal school shootings are negatively impacted. To mitigate these negative effects, state and local governments would need to focus on the most common causes and types of school shootings in their jurisdiction. The most common type of school shooting over the last 50 years has been the escalation of a dispute. If students did not have access to firearms, they would not be able to escalate a dispute to the level of a school shooting. Another possibility to address this type of scenario is implementing SEL in schools so that students learn how to handle disputes without resorting to violence. School districts could also work to ensure that the student to counselor ratio remains below the levels suggested by the American School Counselor Association.

While no statistically significant empirical conclusions were reached with this data, there are plenty of relationships between variables that can be used to understand how the variables interact. Identifying the basic relationships provides direction for examining variables in more depth in the future. Each of the areas of public policy have many possible policies that could be employed to target specific areas of concern with school shootings.

4.4 Critique of Methods

The analysis that I conducted did not reveal anything statistically significant or definitive. Part of this is the result of available data. The dataset that I began with, the K-12 SSDB, contains extremely detailed and extensive data about school shootings in the U.S. dating back quite far. It seemed to be unique as the data I found for the other variables was not nearly as detailed or

extensive. The database on state firearm laws was nicely organized and covered a wide range of laws but only dated to 1991, starting more than 20 years after the K-12 SSDB has data compiled for. However, thirty years of data for all 50 states was still extensive. The data on mental health resources was much less comprehensive. For all three variables, there was less than a decade's worth of data and it was not available for all states in any given year.

The biggest impediment came from lack of data on school security measures. From my review of the literature, SROs seemed to be the easiest school security measure to get data on. Finding any data about school security is complicated because school districts are allowed to make their own rules about school safety. While attempting to find the numbers of SROs employed in each state in the U.S. I learned that most states do not collect numbers from school districts. There is a national estimate from the National Center for Education Statistics but it comes from a dataset that does not identify schools by what state they are in. Ultimately, school security in my research was represented by a dummy variable for whether states require training for SROs, a variable that does not provide much information about school security measures.

I also included the ratio of students to school counselors in my research to fill in some of the gap for school security measures. However, this is not a clear variable for school security as school counselors often play a large role in the mental health of students. They are often the only staff members at a school that have any deep insight into a student's mental health as well as a student's living situation. School counselors play a role in making sure that students are not a threat to themselves or the school but they have to balance this by caring for the mental health of students as well, which blurs some of the lines between school security and mental health resource.

This lack of data negatively impacted my ability to conduct regression analysis. I had enough observations to run the model but the missing observations for mental health funding made it difficult to get significant results. There is also the possibility that the variables I picked are not the variables that actually have an effect on the rate of school shootings. This could be another reason why the regression analysis did not yield significant results.

5. Conclusion

Despite decades of debates, lawmakers have never been able to agree on the best way to prevent school shootings. The three main policy areas related to school shootings have been identified as gun control, mental health resources, and school security measures but concrete evidence in favor of one area being more effective than the other two has not been found. The analysis that I completed for this paper highlighted some key relationships that should be explored further in the future. The findings make it apparent that the area of focus is going to depend on what issue one is trying to address.

In this paper I tried to conduct an analysis of all school shootings and the three main areas of public policy. Despite no statistically significant results from the econometric analysis, the exploratory analysis pointed to some interesting relationships that are worth further exploration. There are always going to be political reasons and personal biases that influence the area of focus of individual lawmakers but the problem of school shootings is too multifaceted to not consider all the areas of policy. The most important thing to understand when addressing the problem of school shootings is that the desired outcome needs to be clearly defined. If the goal is to prevent school shootings, the most effective area of focus is likely different than if the goal is to reduce fatalities and injuries caused by school shootings. In the case of all shootings, keeping firearms out of the hands of students may be the best place to start while school security measures may be more effective at reducing the number of fatalities in school shootings.

Preventing all school shootings would be possible in a perfect world but realistically it is not that easy. Some of the causes of school shootings can be addressed at state or local levels while others require national attention. School shootings not only occur in K-12 schools but at a college and university level as well. School shootings are part of the growing problem of gun

violence in the United States and many indiscriminate school shootings fall into the category of

mass shootings as well. These problems share may similarities that may be missed when only

looking at the problem of school shootings.

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