CONCEALED CARRY LAWS AND THEIR EFFECT ON MASS SHOOTINGS IN THE UNITED STATES

by

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ABSTRACT

NICHOLAS SPENCER BOWLES. Concealed carry laws and their effect on mass shootings in the united states. (Under the direction of DR. CRAIG A. DEPKEN II)

Mass shootings frequently provoke discussion around the adequacy of firearm legislation, and what can be done to prevent future attacks. Previous literature examining the relationship between concealed handgun laws and mass shootings provides contradictory findings on what effect gun laws have. Data was used to create a fixed-effects model to estimate if state level concealed carry laws have an effect on the amount of victims a state incurs in a year. Results indicate that concealed carry laws are not significant when estimating the severity of a mass shooting, and are likely not considered when planning an attack. Findings indicate that mass shooting prevention should not focus on concealed carry laws, and efforts would be better spent on studying what motivates the attacks.

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INTRODUCTION

Public mass shootings receive extensive media coverage and lead to emotional debates about how to prevent the next Virginia Tech, Pulse Nightclub, or Sandy Hook. Tragedy can take place at a mall, a school, or a restaurant, and many victims are left defenseless until the shooter reaches their goal and commits suicide, or is subdued or shot by police. The fear created by a mass shooting often results in proposals for stricter legislation on obtaining firearms, and a simultaneous increase in gun demand shown by surges in background checks for firearms.

Right-to-carry laws or concealed carry laws encompass where and how a citizen can carry their handguns and vary by state. Although federal gun legislation exists, such as the Brady Handgun Violence Prevention Act and the National Firearms Act (ATF.gov), right-to-carry legislation is a state issue. Concealed carry permits, in particular, may require extensive background checks, fees, interviews, fingerprinting, and often have restrictions on where a handgun can be carried concealed. The laws are often said to increase a potential shooter's access to guns and to provide citizens the ability to defend themselves.

Another area of interest is the shooter, and the motivations that cause these ultra-violent events. Knoll (2010) describes these individuals as "Pseudocommandos":

> The pseudocommando is a type of mass murderer who kills in public during the daytime, plans his offense well in advance, and comes prepared with a powerful arsenal of weapons. He has no escape planned and expects to be killed during the incident. Research suggests that the pseudocommando is driven by strong feelings of anger and resentment, flowing from beliefs about being persecuted or grossly mistreated.

Although measuring mental health and life events is difficult in an econometric model, economic theory and previous research suggests income measures, imprisonment rates, and poverty may have an effect on violent crime rates and homicides (Kovandzic, Marvell, and Vieraitis, 2005 and Lott and Landes, 1996). Given that the majority of shooters are killed or commit suicide, a state's suicide rate can be used as a proxy for other factors that cause a degradation or change in mental health.

Considering the increase in mass shootings in recent years and the continuing debate concerning gun laws, the aim of this thesis is to empirically examine the effect of concealed carry laws in three categories (shall-issue, may-issue, and no-issue) on mass shootings. Previous studies have contradictory conclusions, Lott and Landes (1996) find right-to-carry laws reduce the number of victims in mass shootings, while Duwe, Kovandzic, and Moody (2002) find no significant effect.

Using panel data for the fifty United States excluding Alaska because of gun law availability, I will attempt to determine if right-to-carry laws have a significant effect on the number of victims in a state, in a given year, and if other exogenous variables can explain the severity of these events. Mass shootings in the United States do not appear to be decreasing, therefore more research and analysis is essential to inform policy, and to hopefully reduce the number of victims and event occurrences. The results indicate that right-to-carry laws do not have a significant effect on the number of victims in a state, in a given year, and likely do not impact the severity of a mass shooting.

LITERATURE REVIEW

Previous research on mass shootings shows varying results; some find states with more lenient gun laws experience fewer mass shootings and lower violent crime rates while others show either no effect or a slight increase in crime and shootings. Duwe, Kovandzic, and Moody (2002) identify two different schools of thought concerning right-to-carry laws and mass shootings. One side argues that public mass shootings are a result of a gap in gun control. This side calls for longer waiting periods to obtain a handgun, stricter checks on those seeking concealed carry permits, and bans on assault weapons, large capacity clips, and, in some cases, right-to-carry laws altogether. They also support the idea that fewer restrictions will make it easier for a person to acquire a gun with which to commit the crime.

The other side asserts that more regulation will hinder the ability of citizens to defend themselves or protect others during a mass shooting event. Supporters of this side want fewer restrictions on issuance of concealed carry permits, reasoning that more restrictions would eliminate citizen intervention. Another argument from this side is that more permit holders can deter a potential shooter and might reduce the victim count of any particular event.

The authors empirically analyze these two possibilities by using pooled cross-section and time-series data from 1976 to 1999 from the United States. Negative binomial models, static models, and dynamic models including lagged variables were all estimated. The authors used a static fixed-effects negative binomial for their final model because it produces similar results to the other models, and was found to capture more variation. The authors found that right-to-carry laws showed no evidence of decreasing

the number of victims in a mass shooting. There was also no evidence suggesting that the laws increased the number of mass shootings, leading the authors to assert that right-to-carry laws do not have a significant effect on mass shootings.

Lott and Landes (1996) also analyzed the effect of right-to-carry laws on public mass shootings. Similar to Duwe, Kovandzic, and Moody, the authors discovered that opponents of right-to-carry laws argued the laws would increase gun availability, increase the number and severity of mass shootings, and raised the point that many of the perpetrators were afflicted by some form of mental illness. Some opponents stated the shooters would not react to the cost of being killed or arrested the same way a sane person would, which would mean right-to-carry laws would not have an effect.

The authors also found that supporters of right-to-carry laws in general wanted the benefits of being able to defend themselves. Many cases were cited where a potential victim was able to stop or subdue a shooter, in addition to cases where a victim could have acted during the shooting if they had access to their firearm. In some cases, right-to-carry states are said to have laws that are too strict on areas prohibiting concealed carry. For example, schools are a "gun-free" zone where mass shootings have occurred. Supporters argue these could have been prevented if faculty were allowed to carry.

The hypothesis stated that the deterrence effect of concealed carry holders would be greater in a mass shooting compared to a homicide. In a homicide, the probability of a single potential victim carrying is quite low. When there are multiple potential victims, the probability that at least one of them is carrying a weapon is multiplied. Shooters were expected to incur a larger cost and lower benefit from committing a mass shooting in a right-to-carry state because the chances are higher they will be killed or arrested. This of

course assumes that a shooter is both cognizant of the laws and will react to a change in laws.

Data were obtained from Lexis/Nexus which covered all fifty states and the District of Columbia from 1977 to 1997. Data excluded mass shootings that were related to organized crime/gang activity because the individuals involved in those activities are likely to carry concealed regardless of a state's laws, and would react little, if at all, to law changes. Poisson regressions were estimated using law and shooting data, in addition to personal income, unemployment rate, population, a time trend, arrest and execution rates, and various state demographic variables.

The authors found that right-to-carry states had fewer mass shootings and fewer victims compared to their counterparts. The reduction of victims was found to be larger than the number of shootings. Right-to-carry states with more gun free zones (schools, private businesses, etc.) were found to have more incidents and victims. Requirements around obtaining the permit were also studied, the reasoning being that higher fees and longer waiting times would slow down or deter the number of permit holders. Higher fees, increased injury and attack frequency, while more range time as a requirement reduced the number of injuries.

Although violent crimes and mass shootings may have different motivations, someone committing a mass shooting incurs some similar costs such as imprisonment or death. Kovandzic, Marvell, and Vieraitis (2005) studied the effect of right-to-carry laws on four main violent crimes categories: homicide, forcible rape, robbery, and aggravated assault.

The authors argued that previous research had multiple shortcomings, such as aggregating gun law variables, not accounting for the possibility of simultaneity between the timing of law passage and crime in the state, and using dummy variables to measure the effect of right-to-carry laws on crime. The authors sought to remedy these by using state-specific gun law variables, testing for Granger causality between violent crime and right-to-carry laws, and using a time trend variable to measure the treatment effect over time. Crime reports for cities were used instead of counties in order to address issues in county level crime recording. The authors used a fixed-effects model, including city dummy variables, a shall-issue time trend variable to measure the effect of laws, variables for each category of violent crime, and various control variables.

The authors find no aggregate negative impact of shall-issue laws on violent crime, but instead find a positive relationship between the time since a shall-issue law has been in place, and aggravated assault. Alternative models are also assessed and the effects on crime are not found to vary because of model specification. Results from the Granger test suggest no significant positive bias in the shall-issue variable, implying that simultaneity between law passage and crime rates is not an issue. The authors summarize that there is likely no deterrence to violent crime as a result of shall-issue law passage. They find it is possible that offenders commit crimes based more on opportunity than a standard cost-benefit analysis, which implies more spontaneity and less planning, and may be overly confident in their ability to handle armed resistance. Contrary to this, mass shootings are planned in advance such as the Aurora movie theatre shooting in 2012, where James Holmes planted homemade explosives in his apartment which he had

planned to remotely detonate in order to divert emergency response away from the theatre (Coffman 2015).

Psychological research on the relationship of mental illness and mass shootings is another area which is multi-faceted and highly political. Metzl and MacLeish (2015) discuss the stigma around mental illness as a result of mass shootings and argue that, although mental illness is a factor in some cases, the motivation behind a mass shooting is much more complex. The authors find that, although mentally ill individuals are only responsible for approximately four percent of violent acts in the United States, mass shooters are often said to be mentally ill, schizophrenic, or "lone wolves," with a mental state has degraded to the point that they would commit such a violent act. Because of many researchers and media sources citing mental illness as the driving force behind mass shootings, mentally ill individuals face increasing stigmatization. Limited research on the topic of mass murders, and the news media providing the majority of information on shootings (Bowers, Holmes, and Rhom 2009), strengthens the notion that mass shootings are a result of a persons afflicted by a mental illness.

Diagnosis of mental illness, particularly schizophrenia, has seen a shift in the past fifty years in which violent behavior has become a symptom of mental illness. Contrary to this, previous diagnosis identified schizophrenics as docile and withdrawn from society (Metzl and MacLeish 2015). Knoll (2010) finds that, although some mass shooters suffered from depression or social withdrawal, it was not common for them to be psychotic. An alternative motivation is the idea that mass shootings are primarily an act of revenge, and stem from shooters feeling inadequate and hoping to fulfill a fantasy where they are powerful. Shooters often have narcissistic traits, were bullied as children

and/or adults, and feel as though they have been wronged or made a pariah (Bowers, Holmes, and Rhom 2009).

Shootings are often targeted or motivated by resentment against a person or a specific group of people. The act of shooting is theorized to be an act of revenge against those who the shooter feels wronged them, and a show of power for shooters who feel powerless. Although the mass shooter intends to inflict pain upon those who have wronged them, very rarely does the shooter take any precautions to protect themselves or escape, and most shootings end in suicide or death by police intervention (Knoll 2010; Bowers, Holmes, and Rhom 2009).

Kalish and Kimmel (2010) argue that the shooting and subsequent suicide is a result of a damaged sense of identity manifesting into an ultra-violent act to assert one's masculinity, and then a suicide to avoid consequences. Similar to other literature, the studied shooters felt like outsiders in their schools and were constantly berated by peers. To the shooter, the destruction of those whose wronged him would mean regaining lost masculinity or identity, possibly preserving the shooter's image before dying. Shooters are also said to sometimes adopt a "warrior" identity to affirm their masculinity. During a shooting, some shooters bring large arsenals of guns and don camouflage or tactical gear, possibly a part of playing out a revenge fantasy as the role of a soldier or warrior killing their enemies (Knoll 2010; Bowers, Holmes, and Rhom 2009; Kalish and Kimmel 2010).

DATA & METHODOLOGY

This section describes the sources and data used in my analysis, and the methodology used to test the hypothesis of whether concealed carry laws have an effect on mass shootings. The data span from January 1982 to December 2013 according to the availability of concealed carry law data. Geographically, the data cover the fifty United States excluding Alaska, the District of Columbia, and the various U.S. Territories.

Mass shooting data are sourced from *Mother Jones,* which is a non-profit news organization that does "independent and investigative reporting on everything from climate change to education and food" (Mother Jones Website). *Mother Jones* performed an investigation into mass shootings, and publicly provided the original data, supplemented by new events as they occur. The data are organized by "case" or event, and include detailed information providing location, number of fatalities, number of injured, and the number of total victims, in addition to various explanatory variables such as publicly available information about the suspect(s) including mental health, the type of weapons used in the event, and race/gender of the suspect(s). The demographic and more descriptive variables pose other interesting questions, but for the scope of this thesis I focused on the number of events and victims.

The events were aggregated by state to directly compare events and victim count to concealed carry laws by state. The total number of state-year fatalities, wounded, and total victims follows from the aggregation. The count of events occurring in the other forty-eight states for each state-year was also created by taking the total number of victims for each category, and subtracting the amount of victims for that state-year creating the variables *othkilled*, *othwounded*, and *othtotal*. One-period lags were created

for each of these three variables to measure if recent events in the other states inspired current mass-shooting events in a particular state, creating *lagothkilled*, *lagothwounded*, and *lagothtotal*.

Gun law data are from White (2016), and are listed as the dummy variables *shall*, *mayissue*, and *noissue,* which take a value of one if the state's gun laws fall into that category for that year, and zero otherwise. A shall-issue state will award concealed carry permits if an applicant meets the requirements and pays appropriate fees. May-issue states allow the authorities to deny applications for various reasons, or may have additional requirements such as needing applicants to have a "good reason" for acquiring a permit. No-issue states do not have laws in place to allow for concealed carrying, and do not honor an out of state permit. The poverty rate and prison rate by state, both from this same source, are included as *povprcnt*, and *prisonrate,* respectively. Variables to represent change to and change from one law category to another in a given state and year were also created in order to measure if the suspect reacted to a change in laws.

Income and wealth data were included from Frank (2016), to analyze if various measures of income had an effect on the number of events in a state. Average income and unemployment rate were included as *avginc* and *unempl* and a measure of income inequality was also created by taking the ratio of the top 10 percent of that state's household income, to the average income for each state, *top10ratio*. Population and the suicide rate were both sourced from the Center for Disease Control and Prevention presented as *pop* and *suicruderate*. Population is divided by 1000 so that a one unit change in population represents a 1000 person change.

Table 1 reports summary statistics of mass shooting events, which is measured as three fatalities or more in a public venue, and does not include gang-related shootings. The shootings average a mean of eight victims killed and eight wounded, summing to an average of sixteen total victims for the eighty-three events. Table 2 displays summary statistics after the data have been transformed to time-series format. The gun laws across time and states are predominantly shall carry laws, which would suggest more right-to-carry states. Population ranges from approximately 449,000 to 38.4 million, average income from approximately 13,000 to 83,000, and poverty percentage from 2.9% to 27.2%, showing that the additional variables generally have large ranges.

The mass shooting data shows an upward trend in the number of events by year in Figure 1. Number of events were highest in 2012 and 2015 at seven events, and lowest in 1983, 1985, and 2002 with 0 events. In addition to increases in event frequency, the severity and number of total victims for each event is also trending upward seen in Figure 2. The Orlando Nightclub Shooting which occurred in 2016 was to date the deadliest mass shooting at 102 victims, however, most shootings claim between 3-20 total victims.

Five cities, Aurora and Colorado Springs in Colorado, Dallas and Fort Hood in Texas, and Seattle, Washington have experienced two mass shootings. This could be due to the fact that there are factors in that city or state that would encourage, or fail to discourage a mass shooting. The idea of a "copycat" criminal could also be the case, where a crime is committed in an attempt to replicate, or possibly pay homage to a previous crime. Nearby shootings might play an act in inspiring more, which could be one of the reasons the two Colorado Springs shootings took place within 30 days of each other. No city has yet experienced more than two mass shootings.

By state, California had the most shootings at 13 events, followed by Florida and Texas at seven each. The event count grouped by state is displayed in Table 3, showing that a mass shooting event has not occurred in 16 states, and 18 states have only experienced 1 event. Going forward with the analysis, it is clear that some variation of shootings by state exists, and shootings are occurring more frequently and becoming deadlier.

Models will follow this general structure:

$$(killed, wounded, total)_{it} = \beta_0 + \beta_1 shall_{it} + \beta_2 mayissue_{it} + \beta_3 noissue_{it} + \beta_4 pop_{it} + \beta_5 prisonrate_{it} + \beta_6 avginc_{it} + \beta_7 top10ratio_{it} + \beta_8 unempl_{it} + \beta_9 povprcnt_{it} + \beta_{10} suicruderate_{it} + \beta_{11} lagothkilled_{it} + \beta_{12} othkilled_{it} + u_{it},$$

where the number of victims killed, wounded, and total victims is the dependent variable estimated by the exogenous variables on the right side of the equation.

A pooled ordinary least squares (OLS) model was the first model estimated, along with variations using clustered standard errors by *stateid*, and robust standard errors. Table 5 show the pooled OLS models, grouped by the dependent variables: killed, wounded, and total victims. The difference in the models are the *oth(killed, wounded, total)* and *lagoth(killed, wounded, total)* variables that are matched with their associated dependent variable.

A fixed effects model using robust standard errors, a fixed effects clustered by *stateid* model, and a between effects model were the next models estimated. Table 6 displays the results of these models grouped by the dependent variables: killed, wounded, and total victims. The difference in the models are the *oth(killed, wounded, total)* and

lagoth(killed, wounded, total) variables that are matched with their associated dependent variable.

To measure if changes in right-to-carry laws had an effect on mass shootings, the next models created were models substituting law change variables for the laws themselves. The variables *shallChange, mayChange,* and *noChange* represent a state changing their right-to-carry law from shall issue, may issue, and no issue respectively, to another category. The opposite variables, *shall2Change*, *may2Change*, and *no2Change* represent a state changing their right-to-carry law to shall issue, may issue, and no issue respectively. The results of the models are similar to the other model results and are not displayed. The results suggest that none of the variables are significant even at the ninety percent confidence level. No states have changed their laws from shall issue or may issue, to no issue. A tobit model and a random-effects tobit model were also estimated, but are not displayed because the results did not greatly differ from the other models estimated. The coefficients and t-scores for both tobit models were identical.

Another consideration when examining the right-to-carry laws is the amount of gun-free zones (schools, parks, etc.) that concealed carrying citizens are not allowed to carry, which would render the permit useless in that area. Given many of the shootings happen in traditionally gun free zones such as schools/universities, workplaces, or religious institutions, a model was created that excluded those venues, and only included shootings coded as "other" which would include malls, restaurants, and other public businesses, and "military." The results of the venue specific model did not greatly vary from the other models, so the results are not displayed.

Variable correlation was tested for, with the results in Table 4 showing that most variables are not highly correlated. The *avginc* variable and *top10ratio* have a negative 0.88 correlation simply because top10ratio is partially derived from avginc. Gun law variables have higher negative correlation simply because they are dummy variables, and laws sometimes change from one category to another.

DISCUSSION OF RESULTS

Table 5 shows the results of the pooled OLS models. The *pop* variable is positively correlated and statistically significant at the ninety-five percent confidence level across all pooled models. The *avginc* variable is positively correlated and statistically significant at the ninety-five percent confidence level for all three of the pooled killed models, and the pooled total model. At the ninety percent confidence level, *avginc* becomes significant in the pooled cluster total and pooled robust total models. The *top10ratio* variable is positively correlated and statistically significant at the ninety-five percent confidence level for the pooled killed model. The *suicruderate* variable is positively correlated and statistically significant at the ninety-five percent confidence level for the pooled wounded model.

At the ninety percent confidence level, *avginc* becomes statistically significant in the pooled cluster total and pooled robust total models, and is positively correlated. *Suicruderate* becomes statistically significant for the pooled total model and is positively correlated. *Top10ratio* becomes statistically significant for the pooled cluster killed and pooled robust killed models and is positively correlated.

The highest r-squared value for any of the pooled OLS models is 0.05, which suggests that the pooled OLS models are extremely weak in describing the variation within the model. This is likely because the differences by state are important, and will allow the model to capture more variation. The models from this point onward will treat the data as panel data, and will make the assumption that differences by state have an effect on the amount of mass shooting events.

Table 6 shows the results for the fixed effects and between effects models. We see that the *pop* variable is slightly negatively correlated and statistically significant at the ninety-five percent confidence level in the between models, and in the fixed robust and fixed cluster killed models. *Pop* becomes statistically significant and negative in the fixed robust total and fixed cluster total models at the ninety percent confidence level. The *avginc* variable is positively correlated and statistically significant at the ninety-five percent confidence level for all killed models, and the fixed robust total and fixed cluster total models. The *top10ratio* variable is positively correlated except in all three between models where it is negative, and statistically significant at the ninety-five percent confidence level for the fixed robust killed and fixed cluster killed models. At the ninety percent confidence level *top10ratio* becomes significant for the fixed robust total, and fixed cluster total models.

The *suicruderate* variable is statistically significant at the ninety-five percent confidence level for only the between wounded model and is positively correlated. No other variables are statistically significant at the ninety percent confidence level. The r-squared values for most models are still poor, but improve greatly for the between models, with r-squared values of 0.6121, 0.4569, and 0.5427 for the killed, wounded, and total models respectively.

The fixed-effects model for the number of victims killed indicates that the gun law variables are not statistically significant at the ninety-five percent level. The gun law variables also have small negative coefficients all around ~ -0.8. *Pop, avginc,* and *top10ratio* are all statistically significant, and positively correlated. *Unempl* is not statistically significant at the ninety-five percent level, but is significant at the ninety

percent level. *Prisonrate, suicruderate, lagothkilled,* and *othkilled* are all not statistically significant at the ninety-five percent level.

The fixed-effects model for the number of victims wounded indicates that the gun law variables are not statistically significant at the ninety-five percent level. The gun law variables also have negative coefficients. *Pop, prisonrate, avginc, top10ratio, unempl, povprcnt, suicruderate, lagothwounded,* and *othwounded* are all not statistically significant at the ninety-five or ninety percent level. The reason for these results is possibly that shooters are not aiming to wound people, they are aiming to kill them, and therefore wounded victims may be random. Victims that escape death will vary by situation, and also depend on the type of weapon used, the shooter's accuracy with that weapon, etcetera.

The Hausman test was used to verify the most appropriate model between the fixed-effects and the random-effects models. The Hausman test for short, has a null hypothesis that both the fixed-effects and the random-effects models are both consistent, but the random-effects model is also efficient. The alternative hypothesis being tested is that the fixed-effects models is consistent, where the random effects model is inconsistent. The results of the Hausman test indicate that at the ninety-five percent level, we can fail to reject the null hypothesis. However, after performing an equal-effects test, the results for all variables indicate that we can reject the assumption of equal effects. Given the test results, the fixed-effect model is used for a final estimation.

The fixed-effects model for the total number of victims indicates that the gun law variables are not statistically significant at the ninety-five percent level. The gun law variables also have negative coefficients. *Avginc* is statistically significant at the ninety-

five percent level, and for every $10,000 increase in average household income, one can expect a 1.12 increase in the number of total victims. *Pop* and *top10ratio* are both significant at the ninety percent confidence level. *Pop* is negatively correlated and a one-million-person increase will result in one less victim. *Top10ratio* is positively correlated, and implies a 0.001 increase in the ratio results in a 3.6 victim increase. *Prisonrate, unempl, povprcnt, suicruderate, lagothtotal,* and *othtotal* are not statistically significant.

Given the results from the three models, the *shall, mayissue,* and *noissue* variables do not seem to have a significant effect on the severity of a mass shooting. This is possibly because in a normal cost-benefit analysis, a sane individual would be deterred by the possibility of dying. Considering most of the shooters commit suicide, or die during firefights with law enforcement, the shooters do not seem to fear death. This implies the threat of an armed citizen is likely undesirable but not enough of a deterrent to stop the attack from happening. Something else worth noting is that out of the eighty-three events, only one was ended by a civilian, and a weapon was not used in detaining the shooter. The effects of concealed carry holders preventing attacks may not be present because the data does not include events that were prevented by an armed citizen, but only events that did transpire to some extent.

Concerning the income related control variables, it is likely that many are not significant because these attacks are not motivated by need or opportunity, but are motivated by revenge and infamy (Knoll 2010). *Avginc* is significant and positively correlated for the killed and wounded models, implying that richer states often incur more fatalities. Given the *lagothtotal* and *othtotal* variables are not significant, this likely means that there is no "copycat" effect concerning very recent events. This may be

because these attacks take time to plan, and regardless of related activity, the shooter does not act until they feel adequately prepared.

Prisonrate is likely not significant because factors that would lead to higher crime rates and imprisonment are likely not the same that contribute to a mass shooting. Although many of the shooters commit suicide, *suicruderate* is not significant. This may be because *suicruderate* is acting as a general proxy for mental health, and factors that contribute to general suicide are not correlated with factors that drive an individual to commit a mass shooting. This would imply a distinction needs to be made when examining the psychology of the mass shooter.

CONCLUSION

The goal of this thesis was to determine if concealed carry laws have an effect on the collective severity of mass shooting events in a given state and year in the United States, by empirically examining the available data. Data used for this analysis span from January 1982 to December 2013, and include the fifty United States excluding Alaska. Public mass shootings are increasing in both frequency and severity, causing the need for more preventative measures, and reducing the severity of these attacks. Frequently after a new attack, media and family members of victims will publically call for stricter legislation. This is justified by the belief that more legislation will make it more difficult for a potential shooter to obtain a weapon or carry out an attack. Using relevant data and empirical analysis, we can examine if differences in concealed carry laws by state will have an effect on the severity of public mass shootings a state experiences.

A fixed-effects model was chosen as the best fit model to test the hypothesis. This model was chosen based off of previous research, economic theory, and comparison to the other models estimated. Three models were created to estimate the total number of victims, the number of victims killed, and the number of victims wounded from public mass shooting events in a given state and year. Additional variables that could also affect the number of victims were chosen based off of theory and previous research, including income and wealth measurements, population, suicide rate, and prison rate.

The model results indicate that right-to-carry laws do not have a significant effect on the severity of public mass shooting events by state and year. The majority of all three gun law dummy variables had small, negative coefficients, however, because of their very low significance interpretation is not useful. It would seem the severity of public

mass shootings in a state are inelastic to differences or changes in right-to-carry laws, and that potential mass shooters may not react to laws the same way other criminals will. States with larger populations are likely to see an increase in severity, and states with higher average incomes and greater income disparity are also likely to see an increase in the number of victims.

Further research should focus on the personal factors that inspire mass shootings, such as major life changes including losing a job or a marriage separation. Knoll (2010) stated that many of these acts are personal and revenge based, so it is possible that these events are not driven by changes in state level variables. Venue location also requires further study, and venues that often experience mass shootings such as schools could benefit from increased security measures. Studying the proximity between a shooter's home or workplace, and the location of the shooting might also yield interesting results. This would determine if there is a "tourism" effect that motivates the shooter to attack a different state or county with the assumption he or she will encounter less armed resistance. Future research should continue to study the motivation behind a public mass shooting, and other ways to deter individuals from committing these attacks.

Results of this thesis and other research indicate right-to-carry policy should not be motivated by the fear of a mass shooting considering the two are likely not correlated. Policy should instead be based upon other costs and benefits a state will see from legislation. Legislation to prevent public mass shootings should be based upon factors other than right-to-carry laws, and may benefit from research around mental health.

REFERENCES

Bowers, Thomas G., Eric S. Holmes, and Ashley Rhom. "The Nature of Mass Murder and Autogenic Massacre." Journal of Police and Criminal Psychology 25.2 (2009): 59-66. Web 17 Oct. 2016.

"Bureau of Alcohol, Tobacco, Firearms and Explosives." *Rules and Regulations | Bureau of Alcohol, Tobacco, Firearms and Explosives*. N.p., n.d. Web. 3 Sept. 2016.

Coffman, Keith. "Colorado Movie Massacre Gunman Booby-trapped Home with Bombs, Trial Hears." *Reuters*. Thomson Reuters, 05 May 2015. Web. 20 Oct. 2016.

Duwe, G., T. Kovandzic, and C. E. Moody. "The Impact of Right-to-Carry Concealed Firearm Laws on Mass Public Shootings." *Homicide Studies* 6.4 (2002): 271-96. Web.

Follman, Mark, Gavin Aronsen, and Deanna Pan. "US Mass Shootings, 1982-2016: Data From Mother Jones' Investigation." *Mother Jones*. N.p., 24 Sept. 2016. Web. 25 Sept. 2016.

Frank, Mark W. "The U.S. Income Inequality Page of Mark W. Frank." *The U.S. Income Inequality Page of Mark W. Frank*. N.p., n.d. Web. 10 Oct. 2016.

Kalish, Rachel, and Michael Kimmel. "Suicide by Mass Murder: Masculinity, Aggrieved Entitlement, and Rampage School Shootings." Health Sociology Review 19.4 (2010): 451-64. Web.

Knoll, James L., IV, MD. "The "pseudocommando" Mass Murderer: Part I, the Psychology of Revenge and Obliteration." *The Journal of the American Academy of Psychiatry and the Law* 1st ser. 38 (2010): n. pag. *National Center for Biotechnology Information*. U.S. National Library of Medicine. Web. 27 Oct. 2016.

"Leading Causes of Death." *Centers for Disease Control and Prevention*. Centers for Disease Control and Prevention, 02 Nov. 2016. Web. 16 Aug. 2016.

Lott, John R., and William M. Landes. "Multiple Victim Public Shootings." *SSRN Electronic Journal SSRN Journal* (1996): n. pag. Web.

Metzl, Jonathan M., and Kenneth T. MacLeish. "Mental Illness, Mass Shootings, and the Politics of American Firearms." American Journal of Public Health 105.2 (2015): 240-49. Web. 30 Oct. 2016.

Reports, FBI Uniform Crime. “Expanded Homicide Data Table 9.” N.p., 2012. Web. 16 Aug. 2016

White, John A. *THE EFFECT OF SHALL-ISSUE POLICY ON CRIME RATES*. Thesis. University of North Carolina at Charlotte, 2016. N.p.: n.p., n.d. Web. 15 Aug. 2016. Retrieved from: http://search.proquest.com.librarylink.uncc.edu/.

APPENDIX A: TABLES

Table 1 : Mass shooting summary statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
fatalities	8.13	6.81	3	49
injured	8.11	11.39	0	70
total victims	16.24	15.94	3	102
month	6.69	3.46	1	12
year	2004	9.8	1982	2016

Table 2 : Variable summary statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
shall	0.566	0.496	0	1
mayissue	0.259	0.438	0	1
noissue	0.149	0.357	0	1
pop	5700.804	6177.389	453.401	38062.780
prisonrate	0.338	0.199	0.108	1.538
avginc	40638.01	11785.82	17871.55	83061.70
top10ratio	0.001	0.000	0.001	0.002
unempl	0.005	0.002	0.002	0.014
povprcnt	12.731	3.623	2.900	27.200
suicruderate	12.872	3.325	5.970	29.640

Notes: Number of Observations is 1225

Table 3 : Mass shootings by state

State	Number of Shootings	Percent of Total
Arizona	1	1.20
Arkansas	1	1.20
California	13	15.66
Colorado	5	6.02
Connecticut	3	3.61
D.C.	1	1.20
Florida	7	8.43
Georgia	2	2.41
Hawaii	1	1.20
Illinois	2	2.41
Iowa	1	1.20
Kansas	1	1.20
Kentucky	2	2.41
Louisiana	1	1.20
Massachusetts	1	1.20
Michigan	2	2.41
Minnesota	2	2.41
Mississippi	1	1.20
Missouri	1	1.20
Nebraska	1	1.20
Nevada	1	1.20
New York	4	4.82
North Carolina	2	2.41
Ohio	1	1.20
Oklahoma	1	1.20
Oregon	2	2.41
Pennsylvania	1	1.20
South Carolina	2	2.41
Tennessee	1	1.20
Texas	7	8.43
Utah	1	1.20
Virginia	1	1.20
Washington	6	7.23
Wisconsin	4	4.82

Notes: This table displays the number of mass shootings that have occurred in a state, and that state's percent share of the total number of mass shootings. Data span from August 1982 to July 2016

Table 4 : Variable correlation matrix

	shall	mayissue	noissue	pop	prisonrate	avginc	top10ratio	unempl	povprcnt	suicruderate
shall	1									
mayissue	-0.6769	1								
noissue	-0.4791	-0.2481	1							
pop	-0.136	0.1694	0.0309	1						
prisonrate	-0.0973	0.073	0.0356	-0.2304	1					
avginc	0.121	0.0604	-0.2403	0.1687	-0.3125	1				
top10ratio	-0.0832	-0.0709	0.206	-0.0439	0.2669	-0.8798	1			
unempl	0.0682	-0.0253	-0.0411	0.239	-0.1438	-0.0571	0.2144	1		
povprcnt	0.1438	-0.208	0.0963	0.1567	-0.1894	-0.3746	0.5154	0.5027	1	
suicruderate	0.3224	-0.3571	-0.0578	-0.3492	-0.0384	-0.1738	0.1634	0.0975	0.2129	1

Table 5 : Pooled model results

	pooled killed		pooled cluster killed		pooled robust killed			pooled wounded		pooled cluster wounded		pooled robust wounded	
	b	t	b	t	b	t		b	t	b	t	b	t
shall	-0.042	-0.109	-0.042	-0.217	-0.042	-0.186	shall	-0.266	-0.453	-0.266	-0.564	-0.266	-0.568
mayissue	-0.139	-0.343	-0.139	-0.616	-0.139	-0.611	mayissue	-0.235	-0.382	-0.235	-0.456	-0.235	-0.479
noissue	0.155	0.372	0.155	0.632	0.155	0.573	noissue	-0.038	-0.061	-0.038	-0.075	-0.038	-0.073
pop	0.000	4.138	0.000	3.891	0.000	2.603	pop	0.000	3.947	0.000	4.897	0.000	2.494
prisonrate	0.215	0.601	0.215	1.098	0.215	1.043	prisonrate	0.319	0.586	0.319	1.206	0.319	1.161
avginc	0.000	4.245	0.000	2.213	0.000	2.037	avginc	0.000	1.397	0.000	0.900	0.000	1.012
top10ratio	1447.151	2.723	1447.151	1.872	1447.151	1.652	top10ratio	417.362	0.518	417.362	0.572	417.362	0.684
unempl	33.295	0.884	33.295	0.708	33.295	0.758	unempl	34.099	0.596	34.099	0.894	34.099	0.636
povprcnt	-0.015	-0.613	-0.015	-0.931	-0.015	-0.845	povprcnt	-0.006	-0.164	-0.006	-0.228	-0.006	-0.285
suicruderate	0.011	0.511	0.011	0.540	0.011	0.571	suicruderate	0.085	2.617	0.085	1.354	0.085	1.427
lagothkilled	-0.005	-0.826	-0.005	-0.938	-0.005	-0.999	lagothwounded	0.008	1.143	0.008	0.892	0.008	1.114
othkilled	0.001	0.231	0.001	0.232	0.001	0.204	othwounded	-0.009	-1.691	-0.009	-1.542	-0.009	-1.619
_cons	-3.659	-3.383	-3.659	-2.217	-3.659	-2.136	_cons	-2.339	-1.430	-2.339	-0.947	-2.339	-1.055
N	1176		1176		1176		N	1176		1176		1176	
R-sq	0.050		0.050		0.050		R-sq	0.026		0.026		0.026	

Table 5 Continued : Pooled model results

	pooled total		pooled cluster total		pooled robust total	
	b	t	b	t	b	t
shall	-0.283	-0.324	-0.283	-0.434	-0.283	-0.413
mayissue	-0.355	-0.389	-0.355	-0.490	-0.355	-0.501
noissue	0.138	0.147	0.138	0.196	0.138	0.180
pop	0.000	4.497	0.000	4.898	0.000	2.882
prisonrate	0.498	0.616	0.498	1.293	0.498	1.195
avginc	0.000	2.738	0.000	1.769	0.000	1.803
top10ratio	1837.035	1.531	1837.035	1.465	1837.035	1.460
unempl	66.901	0.786	66.901	0.886	66.901	0.774
povprcnt	-0.024	-0.442	-0.024	-0.618	-0.024	-0.704
suicruderate	0.093	1.937	0.093	1.181	0.093	1.293
lagothtotal	0.002	0.406	0.002	0.385	0.002	0.464
othtotal	-0.003	-0.633	-0.003	-0.630	-0.003	-0.604
_cons	-6.021	-2.468	-6.021	-1.712	-6.021	-1.832
N	1176		1176		1176	
R-sq	0.037		0.037		0.037	

Table 6 : Fixed-effects and between-effects model results

	fixed robust killed		fixed cluster killed		between killed			fixed robust wounded		fixed cluster wounded		between wounded	
	b	t	b	t	b	t		b	t	b	t	b	t
shall	-0.820	-0.872	-0.820	-0.872	0.066	0.161	shall	-2.138	-1.075	-2.138	-1.075	-0.283	-0.408
mayissue	-0.854	-0.839	-0.854	-0.839	-0.285	-0.631	mayissue	-2.917	-1.453	-2.917	-1.453	-0.306	-0.403
noissue	-0.758	-0.758	-0.758	-0.758	-0.083	-0.178	noissue	-2.105	-1.030	-2.105	-1.030	-0.247	-0.318
pop	0.000	-2.646	0.000	-2.646	0.000	3.736	pop	0.000	-0.673	0.000	-0.673	0.000	2.956
prisonrate	-0.084	-0.134	-0.084	-0.134	0.035	0.081	prisonrate	0.873	1.108	0.873	1.108	0.463	0.636
avginc	0.000	2.756	0.000	2.756	0.000	2.550	avginc	0.000	1.215	0.000	1.215	0.000	0.807
top10ratio	2556.681	2.510	2556.681	2.510	-120.826	-0.119	top10ratio	1168.242	0.816	1168.242	0.816	-1621.982	-0.941
unempl	110.433	1.916	110.433	1.916	-2.159	-0.020	unempl	25.389	0.449	25.389	0.449	130.672	0.731
povprcnt	-0.046	-1.727	-0.046	-1.727	0.042	1.117	povprcnt	-0.005	-0.102	-0.005	-0.102	0.067	1.062
suicruderate	-0.030	-1.091	-0.030	-1.091	0.003	0.125	suicruderate	0.128	1.019	0.128	1.019	0.087	2.283
lagothkilled	-0.005	-1.007	-0.005	-1.007	-0.053	-0.624	lagothwounded	0.008	0.915	0.008	0.915	0.093	0.960
othkilled	0.001	0.191	0.001	0.191	0.074	0.917	othwounded	-0.009	-1.443	-0.009	-1.443	-0.084	-1.218
_cons	-2.769	-1.209	-2.769	-1.209	-2.533	-1.577	_cons	-0.897	-0.166	-0.897	-0.166	-1.795	-0.627
N	1176		1176		1176		N	1176		1176		1176	
R-sq	0.030		0.030		0.620		R-sq	0.017		0.017		0.426	

Table 6 Continued : Fixed-effects and between-effects model results

	fixed robust total		fixed cluster total		between total	
	b	t	b	t	b	t
shall	-2.918	-1.013	-2.918	-1.013	-0.197	-0.194
mayissue	-3.740	-1.265	-3.740	-1.265	-0.588	-0.529
noissue	-2.815	-0.948	-2.815	-0.948	-0.315	-0.276
pop	-0.001	-1.673	-0.001	-1.673	0.000	3.640
prisonrate	0.754	0.611	0.754	0.611	0.451	0.424
avginc	0.000	2.197	0.000	2.197	0.000	1.592
top10ratio	3633.635	1.747	3633.635	1.747	-1677.697	-0.666
unempl	138.469	1.403	138.469	1.403	119.285	0.451
povprcnt	-0.054	-0.783	-0.054	-0.783	0.107	1.160
suicruderate	0.086	0.643	0.086	0.643	0.092	1.636
lagothtotal	0.003	0.400	0.003	0.400	0.044	0.521
othtotal	-0.003	-0.565	-0.003	-0.565	-0.032	-0.472
_cons	-3.281	-0.525	-3.281	-0.525	-4.345	-1.060
N	1176		1176		1176	
R-sq	0.020		0.020		0.522	

APPENDIX B: FIGURES

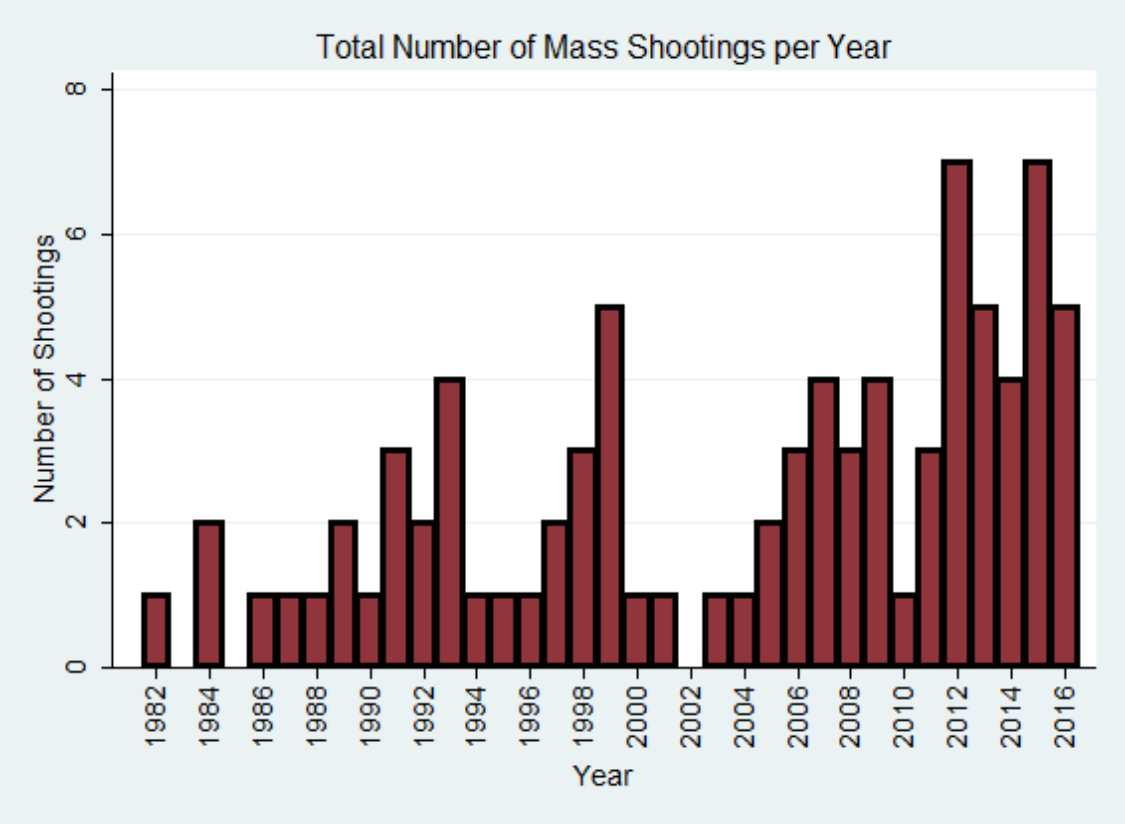

Figure 1 : Number of Shootings per Year

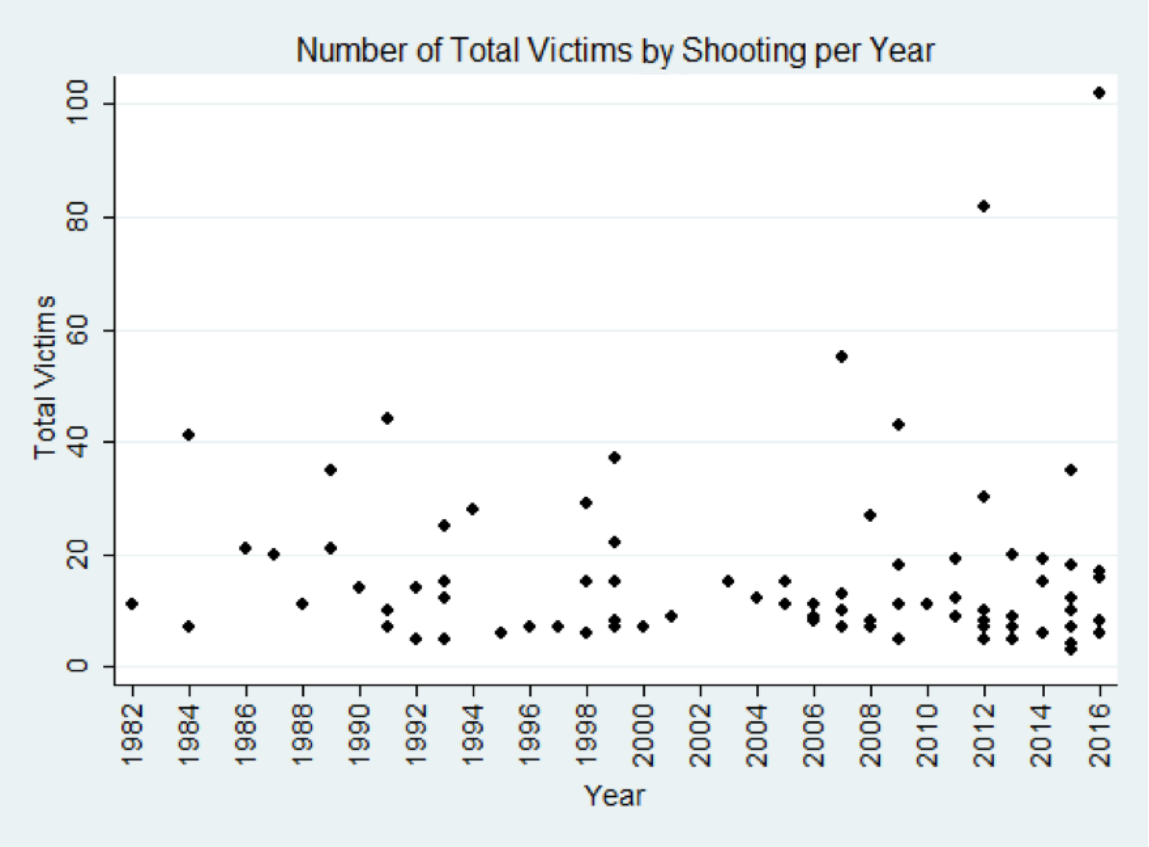

Figure 2 : Number of Total Victims by Shooting per Year Scatter