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The Impact of Mass and Active Shooting Incidents on Residential Real Estate Values

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THE IMPACT OF MASS AND ACTIVE SHOOTING INCIDENTS ON
RESIDENTIAL REAL ESTATE VALUES

by
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of Mississippi as Partial Fulfillment of the Requirements for a Bachelor of Business
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Abstract

Gun control as a response to gun violence is currently at the forefront of political debate in the United States. The foundation of this paper revolves around crime and real estate supported by background literature detailing external effects on real estate prices to set up the framework for the research on mass shootings and residential real estate values. The findings in this paper are based on 73 events involving mass shootings in the United States from 1996 to 2015. I find that the effect of mass shooting events plays a significant role in the decline in real estate values following a mass shooting event in areas near the shooting event. Interestingly, this response is otherwise not supported by probability data as death by mass shooting is highly unlikely. The resulting economic changes are meaningful, suggesting between a 15%-20% decline in residential real estate prices within a three-year period around a mass shooting location.

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I. Introduction

a. Crime

Crime is a broad and widely used term, the very word itself encompasses various categories and subsets. There are two main types of crime according to the Federal Bureau of Investigation (FBI), violent and property. The Uniform Crime Report (UCR) provides detailed definitions of each type. Violent crime can be further broken down into four distinct subsets: Murder and Non-Negligent Manslaughter, Forcible Rape, Robbery, and Aggravated Assault. Property crime is further described as burglary, larceny-theft, and motor vehicle theft. Studies show that both property and violent crime have been steadily decreasing for decades.

The National Review reports that violent crime demonstrated a slow but steady decline from about 1990-2013 (Figure 1) However, U.S. News and World Report stated that while remaining around all-time lows, the violent crime rate rose in 2015 compared to the previous year. The graph by the U.S. News and World Report shows the categories of violent crime (Figure 2).

It is important to note that "guns were used in almost three-quarters of the numbers of the murders, nearly 41 percent of the robberies, and about a quarter of the aggravated assaults in 2015." According to the National Crime and Victimization Survey (NCVS) by the U.S. Department of Justice (DOJ), 29 percent of victims involved in a violent crime faced an attacker with a gun.

Gun-related crimes include but are not limited to mass shootings, spree killings, and active shooter incidents. *A Guide to Mass Shootings in America* by Mother Jones states that "there have been at least 85 [mass shootings] in the last three-plus decades…" The criteria for a mass shooting that Mother Jones uses is the following:

1. The perpetrator took the lives of at least four people

2. The killings were carried out by a lone shooter

3. The shootings occurred in a public place.

The list culminated by Mother Jones includes spree killings. A spree killing is a case in which the killings occurred in more than one location over a short period of time, that otherwise fit the criteria of a mass shooting. The definition of an active shooter as agreed upon by U.S. government agencies including the FBI is "an individual actively engaged in killing or attempting to kill people in a confined and populated area." It is implied by the definition that the criminal actions involve the use of a gun. In September of 2013, the U.S. DOJ released a comprehensive list of the active shooter events in the United States from 2000-2013. The incidents reported occurred on land related to commerce, education, government, open space, residences, healthcare, or house of worship. The study in conjunction with the list found that 70 percent of all incidents occurred in either a commerce/business or educational environment.

While the nationwide crime rates may be falling or at least at a steady low, the study on active shooters by the FBI shows inverse data. Incidents have increased 69.5 percent in the last seven years from an average of 11.4 to 16.4. Not only has the number of incidents risen, but the number of casualties related to gun violence has steadily increased as well, showing a direct relationship between the two.

The rise in gun-related violence has people wondering about gun control issues. Gun control has been and continues to be a topic of debate among political parties. One party's argument dates back to the 2nd amendment of the constitution stating that the right of the people to keep and bear arms shall not be infringed. Gun advocates tend to believe that more gun ownership creates a safer environment as a whole, stating that gun control is not the issue, but rather an education about guns and gun safety will prevent accidental deaths. Gun control advocates mainly cite the points that more gun control laws would reduce gun deaths and more gun control leads to fewer suicides as guns are the number one weapon of choice in suicides.

The arguments for each respective side of the gun control debate have strong, irrefutable evidence. A Pew Foundation report found that "79% of male gun owners and 80% of female gun owners said owning a gun made them feel safer, and 64% of people living in a home in which someone else owns a gun felt safer." Meanwhile, The Centers for Disease Control listed firearms as "the #12 cause of all deaths between 1999 and 2013, representing 1.3% of total deaths. They were also the #1 method of death by homicide (66.6% of all homicides) and by suicide (52.2% of all suicides). "

b. Real Estate

There is a plethora of studies linking guns to violent crime and their effects on suicide and homicide, but very few studies show the effect of gun violence on socioeconomic factors such as home values. However, a recent study was conducted to show the correlation between crime rates and home values in surrounding neighborhoods in the suburbs of Chicago. Specific neighborhoods that were analyzed include West

Garfield Park, East Garfield Park, Fuller Park, Englewood, Austin, and North Lawndale as well as their wealthy counterparts of Edison Park, Mount Greenwood, Forest Glen, and North Park.

This particular analysis was sparked by a recent publication by RealtyTrac, a leading provider of comprehensive U.S. housing and property data. Daren Blomquist, the article author and senior vice president at RealtyTrac, reports that "this new index provides concrete evidence that registered criminal offenders pose not only a potential safety risk for homeowners and their families but also a potential financial risk for what is likely a homeowner's biggest asset. This is clearly evident in the significantly lower home values and significantly higher foreclosure rates in zip codes with a higher offender index, but it may not be as evident in the home price appreciation numbers, which are actually slightly stronger over the past year and five years in zip codes with a higher offender index. However, the 10-year appreciation numbers demonstrate home values in the lowest-risk zip codes for offenders were not hit as hard during the housing downturn and have rebounded more quickly back to their previous highs – even exceeding those previous highs." The study was done on more than 10,000 zip codes, providing conclusive evidence to the point that home values are lower in high crime areas.

The major points that the article concludes are:

1. The higher the offender index, the lower the home value and home equity (Figure 3).

2. The higher the offender index, the higher the foreclosure rate (Figure 4).

3. Home prices rebound above 10-year-ago levels only in zips with very low offender index

This study shows that while home values have been on the rise since the recession in general, crime rates do likely play a role in the rate of value appreciation. The highest offender index was found to be Greenville, South Carolina while the lowest is Minneapolis-St. Paul. This then begs the question: is crime lowering home values, or are low home values attracting criminals? The article seems to imply the former. Criminals pose an imminent threat to homeowners as a large portion of assets are stored in one's home. Therefore, it is implied that when criminals (crime) infiltrate a neighborhood people want to move. Home values fail to appreciate due to the low desirability among homebuyers.

This paper will examine how mass shootings impact economic factors in relation to real estate value and risk perception among home buyers. While the probability of death by mass shooting is incredibly low, the surrounding markets are affected greatly. I will discuss how great of an impact a specific incident can cause on the local market and how risk perception changes as a reaction to such occurrences. The following background will set up the framework for the correlation between crime, disaster, and resulting risk perception.

II.   Relevant Background

a. Crime & Real Estate Value

Crime has affected the world throughout history, but has it changed one's perspective on geographic location and risk perception? Authors and researchers referenced in this paper began studying possible correlations in 1986 and have continued developing theories ever since. An article by Wesley Skogan investigates the impact of fear of crime on neighborhoods, not empirically, but physically and psychologically. Where other research focuses on statistical value increases and decreases, Skogan looks deeper into the emotion behind what causes such empirical reactions. It has been determined that fear of crime is a significant catalyst in accelerating neighborhood decline (Skogan, 1986).

While the fear of crime has been negatively linked to declining neighborhoods, in turn, research has been conducted to determine whether or not falling crime rates have played a major role in the real estate boom in New York City. New York City real estate has been on the rise for decades. One article seeks to determine whether or not the falling crime rates have anything to do with the increase in property value. Researchers used a number of models and a specific time period from 1988 to 1998 to conclude that falling crime does, in fact, play a role. While it is not the sole reason for the real estate boom, it can account for about one third of it. Falling crime paired with revitalization and overall growth has created a healthy and robust market in New York City (Schwartz, Susin, & Voicu, 2003). This research is further solidified by that of Devin and Jaren Pope who

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examined home pricing and crime in metropolitan areas. The results showed that zip

codes in the top decile in terms of crime reduction saw property value increases of 7–

19% during the 1990s. The conclusion was that decreasing crime leads to increasing

property values (Pope & Pope, 2011).

A professor from The Netherlands named Hans Nelen wrote a paper based on the

Dutch property market that looks at the effects of crime and circumstances. Crime reveals

the vulnerability in the Dutch market. The author found that crime in residential areas

varies largely due to different levels of self-regulation and efforts on behalf of

homeowners. This is an ongoing study. Real estate lends itself to both legitimate and

illegitimate investors and this author seeks to find conclusive results from the crimes of

illegitimate entrepreneurs (Nelen, 2008). After determining with near certainty that

people are leery of crime based on surrounding circumstances, authors of another paper

use a hedonic model of demand to determine if buyers are willing to pay a higher price to

avoid future violent crime areas. They found that this model indicates "the average

household is willing to pay $472 per year to avoid a 10 percent increase in violent crime."

The traditional myopic model underestimated these findings by 21 percent. This would

create a $278,870 downward discretion is homeowner's actual willingness to pay (Bishop

& Murphy, 2011).

b. *Megan's Law & Real Estate Value*

Megan's Law is an amendment to the Violent Crime and Law Enforcement Act of

1994 that requires notification when a registered sex offender moves into a

neighborhood. This law was passed in 1996 and recent studies have been conducted to

see just how this law affects households and property values. An article by Jaren Pope looks at Megan's Law in relation to surrounding property values. Housing prices in neighborhoods with registered sex offenders see a decrease in value by about 2.3 percent. This article also states that after the offenders move away, housing prices do see a rebound. Pope's article also points out the possible misuse of the sex offender registry and how that could skew the results (Pope 2008). A similar paper by Leigh Linden and Jonah Rockoff reviews combined data on property values and the North Carolina Sex Offender Registry to see how people feel about living within a certain proximity to a sex offender. Results show a slight decline within a tenth of a mile and a more drastic decline (12 percent) for a home next door to a convicted sex offender. Total estimates show that each offender can cost up to a million dollars for those in close proximity (Linden & Rockoff 2008).

c. Terrorism & Real Estate Value

Another serious form of crime is acts of violence in the way of terrorism. Following the events of September 11, 2001, the threat of terrorism has become a significantly more prominent risk factor. In turn, there has been more research on terrorism in regard to risk perception. The following summarizes post 9/11 responses to terror in terms of risk.

One of the first articles on terrorism after 9/11 discusses the impact of terrorism on urban form. Cities are great targets for mass violence due to the concentration of people and difficulty in evacuation by transportation. This article concludes that terrorism and warfare have not significantly impacted the form of cities and their constructs;

however, New York City is the exception. The authors seem to think that downtown New York City will never fully recover. The city's build up for more than 50 years resulting in the World Trade Center may never be replicated, at least not in any one lifetime (Glaeser & Shapiro 2002).

Another repercussion of the increased risk is the matter of risk coverage. With terrorism on the rise in the U.S. and all over the world, people are questioning the possibility of insurance coverage for such catastrophic events. This creates the question of who the insurance provider would be. The private sector, government, or some combination of the two? Terror events have such a low probability of occurrence but a high impact, creating difficulty in the insurance structure itself. Many believe that the government should intervene on the citizens' behalf, arguing that the attacks are partly controlled by the government. Kunruether and Michel-Kerjan's paper argues for a partnership between public and private sectors in combatting terror risk (Kunreuther & Michel-Kerjan 2004).

Another group of authors researched large city centers with dense populations such as Chicago to see how perceived risk has changed and affects vacancy rates after the 9/11 terrorist attack. Chicago's business district was chosen because of its parallels to New York City in addition to the fact that it holds the tallest building in the U.S. The evidence shows that vacancy rates increased in buildings in Chicago that housed Class A and B tenants. This is particularly important for the Sears Tower, the Anon Center, and the Hancock Center as the three most distinct buildings in the business district (Abadie & Dermisi 2008).

Due to the fact that the attack on September 11 was carried out by a radical Islamic group of terrorists, authors Gautier, Siegmann, and Van Vuuren (2009), decided to study the impact on minorities in relation to terrorism. Their article examines the theory that minorities, specifically Muslims, are considered a threat in terms of terrorism, and property values decline when minorities are present. Coming off of the murder of Theo van Gogh in Amsterdam, the hypothesis was found to be true. Results show that in neighborhoods with more than 10 percent Muslims, property values decreased about three percent over a ten-month period. Findings also indicate increased segregation as Muslims are more likely to move to the neighborhoods where other Muslims already reside.

d. Pollution/Site & Real Estate Value

Deviating from the theme of crime but still affecting one's decisions as far as risk and property values are concerned is the ever-growing problem of pollution and natural disasters. Several studies have been conducted concerning the relationship between pollution and/or site-related incidents such as oil spills and nuclear explosions and the value of residential properties surrounding such occurrences. The following articles discussed relate to the aforementioned research on this topic that has already been documented.

A study conducted by McClusky and Rausser (2001), consists of research centered on examining the effect of manmade disasters. Specifically, a hazardous waste sites and pollution. They found that property values decreased with an increase in perceived risk between 1979-1995. The authors also noted that factors contributing to the

risk such as media coverage and overall awareness of the risk played a role in decreasing the property value in addition to the risk itself (McClusky & Rausser 2001). Meanwhile, Richard Arnott, Oded Hochman, and Gordon Rausser studied pollution in regard to surrounding land use, specifically the proximity to residential areas. The issue stems from long commutes for those who work in polluting factories and other plants. Residential neighborhoods are then built closer and closer to cut down the commute while adding to the pollution risk for people in their own homes. Gray area ensues when residential and industrial zoned areas begin to cross lines. Rent rates and density drops drastically when pollution becomes severe. Emission taxes have been enforced to help alleviate the conflict areas (Arnott, Hochman, & Rausser 2008).

One of the earliest pieces of literature in this category was written by Jon Nelson and covers Three Mile Island, which suffered a nuclear accident in 1979. This paper used data spanning May through December of that year to see if there was a significant effect on home values. Data shows that empirically, property values did not show relative change. However, after the incident, lawsuits were filed against the company for alleged impairment as a result of the nuclear plant accident amounting to about $1.3 million (Nelson, 1981). Also in the nuclear category, authors Gawande and Jenkins-Smith later researched the reprecussions of nuclear facilities on property values. Their article specifically focuses on the shipment of spent nuclear fuel and the surrounding properties along a shipment route in South Carolina. Areas with widespread knowledge of the existing nuclear plant activity and low-risk perception did not see a change in property values. However, highly populated urban areas like Charleston County saw a substantial

decrease in value. Homes on the route were on average three percent lower in value than their counterparts just five miles away (Gawande & Jenkins-Smith 2001).

Daniel Winkler and Bruce Gordon studied the effect of the British Petroleum oil spill on real estate prices along the coast. The BP oil spill in 2010 was the largest offshore drilling explosion in U.S. history. It sparked a cleanup lasting a number of months and affected more than just the aquatic environment. This paper proves that the oil spill caused a seven percent decline in condominium prices on the affected shoreline in just the first six weeks following the disaster. Price deterioration continued until it reached a trough at 8.8 percent (Winkler & Gordon 2013).

The Environmental Protection Agency (EPA) collects and releases data on hazardous sites. In the aftermath of the 9/11 terror attack, the EPA removed data for certain chemical facilities from its website. Information on Tier Two sites is not publicly available, and it is only given upon request from state officials. This article values the level of fear of environmental hazards among the public. It was concluded that the determining factor in decreasing property values was individual hazardous sites themselves (Wesinger 2006). Prior to EPA imposed restrictions, lead was a leading pollutant. One article focused on a particular lead smelter during its operation compared with after it shut down. Lead smelters are notorious for their contribution to acute lead poisoning. The smelter was open for about 50 years. Property values were found to be lower while it was in operation and rebounded fairly well after it shut down; however, the closest properties took significantly more time to bounce back but are still increasing nonetheless (Dale, Murdoch, Thayer, & Waddell 1999). Similarly, power plants receive a bad reputation in terms of risk. In this most recent article, Darin Blomquist studies the

effect of a power plant on property values within a certain vicinity. He chose an isolated power plant to see the real costs of such an amenity and found that power plants can cause residual costs of 200 thousand to 17 million dollars. Blomquist's findings show that properties lose 0.9 percent of their value for every 10 percent closer within 11,500 feet of a power plant (Blomquist 2017).

e. *Natural Disaster & Real Estate Value*

Unlike pollution, natural disasters have plagued the world since the beginning of time. The following articles review and research some of the most notorious disasters from wildfires, to earthquakes, to hurricanes and wind storms. First, while the connection between terrorism and natural disasters may seem far-fetched, one particular author evaluated the personal risk of terror attacks compared with that of traffic accidents. Following the earlier discussion on terrorism risk, terror attacks are difficult to value due to the inconsistency and unpredictable nature of the events. This form of risk is rarely thought of in personal terms but rather as a public concern. The government has pumped billions into the Department of Homeland Security to help alleviate the risk associated with terrorism. The results show that the public values reducing terrorism related deaths twice as much as deaths due to natural disasters. Death by a natural disaster was found to be less likely by individuals in comparison to terror or motor-vehicle death (Viscusi, 2009).

The remaining articles referenced in this paper deal strictly with the effects and risk perception linked to natural disasters. Two authors gathered evidence on earthquakes in Tehran, Iran as the region is highly susceptible to earthquakes. The authors consulted

with real estate agents in Tehran to determine the effects of earthquake preparation on housing prices in the area. The agents gave conclusive information that houses that have implemented earthquake risk reduction measures are valued significantly higher than their unprepared counterparts. Increased risk perception in buyers only increases that value gap (Willis & Asgary, 1997).

Natural disasters generally have two major implications in terms of the housing market, short-term fluctuations in home values and long-term risk perception. Three tornado and three hurricane-prone areas were examined by a group of authors to decide if the housing price index is affected by wind disaster and if so, how much. The study used an econometric model to analyze the information with wind in each city. The evidence shows that housing prices drop anywhere from one half to two percent with an increase in wind disasters, however, the decline in home values is very short lived and rebounds quickly back to normal (Ewing, Kruse, & Wang, 2007). In conjunction with this evidence, Lee County in Florida was analyzed in relation to Hurricane Andrew in 1992. It was perceived that the county would take a huge hit from the hurricane. When Andrew missed this particular county, property values were studied to determine the perceived risk of the hurricane without actual damage. Using a differences-in-differences framework (DND), evidence shows that property values in the county decreased by about 19 percent (Hallstrom & Smith, 2004). These authors demonstrate that while the market reacts dramatically to impending disaster risk, it typically rebounds quickly.

In addition to the most common disastrous events, hurricanes and tornadoes, studies have been conducted on the impact of flood and fire. Carolyn Kousky focused on St. Louis, Missouri, for data on floodplains. She studied the area from 1979 to 2006,

specifically the flood in 1993. She found that property values were not drastically affected, but homes on the Missouri River saw a 6-10 percent decrease in property value. In areas with 100-year floodplains, property values did not change, showing that the buyers understood the risk more accurately. 500-year floodplain homes saw a slight decrease because less risk was perceived in that area (Kousky, 2010). Meanwhile, homeowners in wildfire prone areas face a unique risk that is mitigated by creating defense space with the land surrounding their homes. This risk is impacted by neighboring properties as they also need to create defense space in order to maximize safety and reduce the risk of fire damage. Policy makers in these areas also play a vital role in risk mitigation (Shafran, 2008).

After reviewing literature based on crime, Meghan's Law, terrorism, pollution, and natural disasters in relation to real estate values, the resulting decrease in home values show that these major external factors have an impact on individual's risk perception. Some externalities have a more lasting effect on real estate prices than others, but there is an overwhelming theme of increased risk perception overall. For example, since the 9/11 attack on the Twin Towers, there has been an increased risk perception for tall landmark buildings in major U.S. cities like Chicago (Abadie and Dermisi 2008). Insurance companies have kept pace with the increase in risk in the U.S. providing new lines of business in terrorism insurance for commercial buildings and mass shooting insurance for schools.

III.   Hypothesis

Specific Aim: To examine how mass shootings impact economic factors in relation to real estate value and risk perception among home buyers. The probability of death by mass shooting is incredibly low. Literature has shown an impact on real estate value across factors related to general crime, gun violence, violent crime, and natural disasters. This is some of the first work to look at mass shootings and real estate values.

H$_{01}$: There will be no differences in residential home prices following a mass shooting event compared to pre-event pricing.

H$_{A1}$: There will be significant decline in residential home prices following a mass shooting event compared to pre-event pricing.

Considering the background literature on violence and/or risk perception reviewed in correlation with this paper, I predict that the value of residential homes will go down in response to mass and active shooter incidents. Although the chance of a repeat occurrence in the same place with similar magnitude is highly unlikely, human response and risk perception in regard to gun violence will be more extreme than that of rational individuals.

IV.   Data

a. Real Estate data

Data was collected on house characteristics and sale prices for all houses sold in the defined mass shooting area for a five-mile radius around the mass shooting property over a two-year-month period from CoreLogic. This data includes property addresses, characteristics, sale prices and dates, subdivision name, and geographic coordinates of the block in which the property is located.

Multiple property characteristics that could affect the sale price were included. The first variable, *Gross Living Area* is the size of a house in thousands of square feet. The following are variables presented and described. *Square Feet above Finish,* which represents the square feet of the property above ground. *Rooms* is the number of rooms, and *Bedrooms* and *Bathrooms* is the number of bedrooms and bathrooms above ground. *Year Built* is the year in which the property was built. *Stories* is the number of stories of the property. *Exterior* is a dummy variable equal to one if a house has vinyl siding, 2 if a house has brick, or 0 if a house has any other siding. *Flooring* is a dummy variable equal to one if a house has hardwood floors, 2 if a house has carpet or 0 if a house has any other flooring. *Foundation* is a dummy variable equal to one if a house has a concrete slab, and 0 if a house has any other foundation type. *Carport* is a dummy variable equal to one if a house has a carport or garage, 0 otherwise. *Number of Car Garage* is defined as the number

of cars able to fit in a garage. *Pool* is a dummy variable equal to one if a house has a pool, 0 otherwise. *Manufactured* is a dummy variable equal to one if a house is a manufactured home, 0 otherwise.

Multiple financial characteristics of the property were also included. The *Last Sale Price* is the dollar ($) value that for which the property was last sold. The *Value of Improvements* is the dollar ($) value of improvements made to the land. The *Value of Land* is the dollar ($) value of non-depreciable land. Value total is the dollar ($) value of improvements, land and real property. *Property Tax* is the dollar ($) value of annual property taxes paid. *Homeowners Exemption* is a dummy variable equal to one if the property has been accepted for homestead exemption, 0 otherwise. *Loan Type* is a dummy variable equal to one if a house has a conventional mortgage, 0 otherwise. Table #2 describes variables used in our regression models.

b. *Mass Shooting Data*

Data on the mass shooting events are gathered using the previously mentioned, stringent definition of a mass shooting provided by the Federal Bureau of Investigation: 1) shootings were carried out by a single gunman, 2) shootings happened during a single incident and 3) shootings occurred in a public place with a minimum of four fatalities. This definition cross referenced with a dataset by Follman, Aronsen, and Pan (2013), makes up the mass shooting evidence base.

Data was obtained based on a set of characteristics for both mass shootings and the gunmen specifically. The characteristics for each category respectively are as follows: location, date of shooting, number of fatalities, number of non-fatal victims, and venue of

the mass shooting; gender, age, race, recorded signs of mental illness, prescription mental illness medication history, influence of prescription medication at the time of the mass shooting, death of gunman (suicide or lethal force by police), and arrest of gunman. Weapon criterion includes the legality of weapon purchase, number of weapons used and specific types, and ammunition capacity.

Mass shooting incidents are extremely low probability events with low economic costs. As Table 1 illustrates, relative to assault by firearm, individuals are 54 times more likely to die of heart disease, 12 times more likely to die of a stroke, and 6.7 times more likely to die of diabetes (Table 1). Comparing the mass shooting data to other aggregate data on mortality indicates that, at most, mass shootings account for .0029 percent of all deaths in a given year.

c. Gun Laws

Gun laws for each individual state can be found through the state's Department of Public Safety or state equivalent, the United States Code of Federal Regulations (CFR) Title 27, Part I sub-chapter C, and the United States Bureau of Alcohol, Tobacco, and Fire Arms (ATF).

Purchase Permit: A certificate, identification card, or other permit (terminology varies state by state) is required to acquire/purchase any lawful firearm.

Gun Registration: Requires gun owners to record the ownership of their firearms with a designated law enforcement agency.

Assault Weapons Ban: Bans the sale of assault weapons. It should be noted the federal assault weapons ban expired in 2004; however, several states either fully adopted

or have modified the definitions of the 2004 law. The Federal Assault Weapons Ban of 1994 defined certain firearms as assault weapons based on the features they possessed (Public Safety and Recreational Firearms Use Protection Act, H.R.3355, 103rd Congress (1993-1994)).

License Requirement: Requires a state license to possess a lawful firearm.

Concealed Carry Permit: Permits the carry of a lawful firearm in public in a concealed manner on one's person or in close proximity. Requirements for carrying a concealed weapon (CCW) vary widely by state with a typical permit requiring residency, minimum age, submitting fingerprints, passing a computerized instant background check (or a more comprehensive manual background check), attending a certified handgun/firearm safety class, passing a practical qualification demonstrating handgun proficiency, and paying a required fee.

Open Carry: Permitting the carry of a lawful firearm in public in an open manner where a casual observer can observe an individual carrying a firearm. Similar to a concealed carry permit, requirements for CCW vary widely by state with a typical permit requiring the same standards listed above for CCW.

National Firearms Act restrictions: The National Firearms Act of 1968 (NFA) defines a number of categories of regulated firearms which are collectively known as NFA firearms. These range from the firing capacity (semi and fully automatic) of a firearm, the length of the firearm barrel, suppression devices, and ancillary devices considered destructive devices (i.e. grenades, bombs, explosive missiles, poison gas weapons and other comparable devices).

Peaceable Journey Law: Regulates the transport of a firearm for any lawful purpose from any place where someone may lawfully possess and carry such firearm to any other place where he or she may lawfully possess and carry the firearm if, during transportation, the firearm is unloaded, and neither the firearm nor any ammunition being transported is readily accessible or is directly accessible from the passenger compartment of such transporting vehicle.

Stand Your Ground: The legal concept that a person may justifiably use force in self-defense when there is a reasonable belief of an unlawful threat at any location, without an obligation to retreat first. This is analogous to the Castle doctrine, stating that a person has no duty to retreat when their home is attacked.

V. Empirical Methods

I examined the influence of a mass shooting on residential real estate sale price controlling for housing characteristics using a fixed effect regression model. The dependent variable is the natural log of home prices over a three-year period around a mass shooting event. The independent control variables for real estate characteristics included are: building size (square footage), lot size, age of home, number of bedrooms, number of bathrooms, additional amenities (fireplaces), and ultimately the distance of the property from the mass shooting event site. Gun law control variables were discussed previously.

The following equation was used to estimate the concluded effects:

Ln Sale Price =f(Shooting, Ln(DistShoot, Age, Lotsize, Buildingsize, Bedrooms, Bath, PerchasePerm, GunRegister, AssaultLaw, LicenceReq, CCWpermit, OpenCarry, NFArestrict, PeacjounLaw, StandGround)

VI.   Results

Table 2 (see tables and figures) describes the variables used in the estimation while Table 3 presents a summary of the data. Table 3 shows that the mean sale price during our sample time period is $304,123. Of particular interest is the average distance from a house in our sample to a shooting event is 3.47 miles. The average age of the house is 7.13 years and square footage is 2,987. Additionally, there is an average of 3.12 bedrooms and 2.43 bathrooms, with 38% of the houses having at least 1 fireplace. Table 2 also reports summary statistics for the nine indicator variables that encompass state gun laws. I found that 24 percent of states required a permit to purchase guns (*PurchasePerm*). Only 12 percent of states required the registration of guns (*GunRegister*) while 12 percent of states had assault weapon restrictions during the sample time period (*AssaultLaw*). Nearly 11 percent of states required licenses for the purchase of firearms (*LicenseReq*), while 78 percent of states required concealed carry permits (*CWWpermits*). More than 72 percent of states had open carry laws (*OpenCarry*) and 41 percent of states restrict ownership of weapons that fall into a category collectively known as NFA firearms (*NFArestrict*). Finally, 41 percent of states had Peaceable Journey Laws (*PeacJournLaw*) and 75 percent of states had Stand-your-Ground Laws (*StandGround*).

Table 4 Column 1 shows the results of the regression while controlling for home characteristics. I found that *Shooting* is negative and significant suggesting that post shooting event home sales price decrease. Additionally, I saw that the *Ln(DistShoot)* is

negative and significant indicating that homes closer to a shooting event see a great decrease in the sale price. Furthermore, *Building sqft* is positive and significant indicating larger homes have higher sale prices.

Column 2 presents the findings while controlling for state-specific gun laws. Once again *Shooting* is negative and significant suggesting that post-shooting event home sales price decrease. *AssaultLaw* is negative and significant and *CCWPermit* and *StandGround* are positive and significant. These results suggest that home sale price is directly related to laws that are identified with ones right to possess or carry in public as well as defend one's property. Column 3 presents results controlling for both home characteristics as well as state specific gun laws. The results are quantitatively and statically similar to columns 1-2.

VII.   Discussion

In the wake of recent shootings, gun violence is at the forefront of the media and seemingly at an all-time high. The reality is that the murder rate in the United States is at a 50 year low. Specifically, violence in schools has seen a dramatic drop in the last twenty years. However, more than half the population thinks that gun violence has gone up. Risk perception has such a significant impact on human decisions that even proven facts cannot counteract. It is because of these overriding themes that the research in this paper is particularly relevant.

Individuals rely on cognitive information retrieval mechanisms to make decisions when evaluating and responding to risk. Highly-visible and emotionally intense events can influence cognitive retrieval mechanisms such that individuals' behaviors when facing risk may deviate from what would otherwise be expected of rational individuals. However, while the literature posits theoretical predictions or provides experimental evidence from a laboratory setting on the subject, most studies fall short of examining whether individuals' conduct in the economic marketplace is affected by the occurrence of a vivid, emotionally intense mortality-related event. Our study helps fill this void in the literature by examining individuals' behaviors pertaining to a high-value decision in a setting outside of the laboratory – the residential real-estate marketplace.

More specifically, 73 mass shooting events that occurred between 1996 and 2015 were examined to see if the residential real estate market responds to these events. The intuition of our study is that mass shooting events are highly publicized, emotionally-

intense events that, via their effect on cognitive retrieval mechanisms, potentially influence individuals' attitudes toward mortality risk. As a result, if mass shooting events cause people to overestimate their probability of death, we would expect to observe a decrease in residential real estate sale prices in markets that experienced a mass shooting.

Consistent with this expectation, the results suggest that the occurrence of a mass shooting event in a given state is associated with a decrease in residential home prices post-event. Overall, the analysis suggests that the occurrence of a mass shooting event, through its influence on individuals' perception of risk, is associated with real economic consequences in the residential real estate marketplace. The fact that individuals change their behavior in the marketplace following the occurrence of an event – despite the fact that the probability of death due to a mass shooting event is extremely small – suggests that individuals irrationally overweight their probability of death following the occurrence of these events.

VIII. Conclusion

For the purposes of this thesis, 73 mass shooting events over the course of 19 years were studied in order to determine whether or not the events could be directly correlated to changes in residential real estate values. Due to the fact that mass shootings are publicized through various media platforms paired with the emotional intensity of the occurrences, individuals' attitudes and mortality risk perception are irrationally altered. With this foundation, one would expect to see a decrease in home values as a result of an increased chance of death.

In conclusion, I find that although the probability of death by mass shooting is extremely low, residential real estate values decrease by roughly 15%-20% percent. This would suggest that individuals' risk perception is unreasonably high following the occurrence of a mass shooting.

IX.   References

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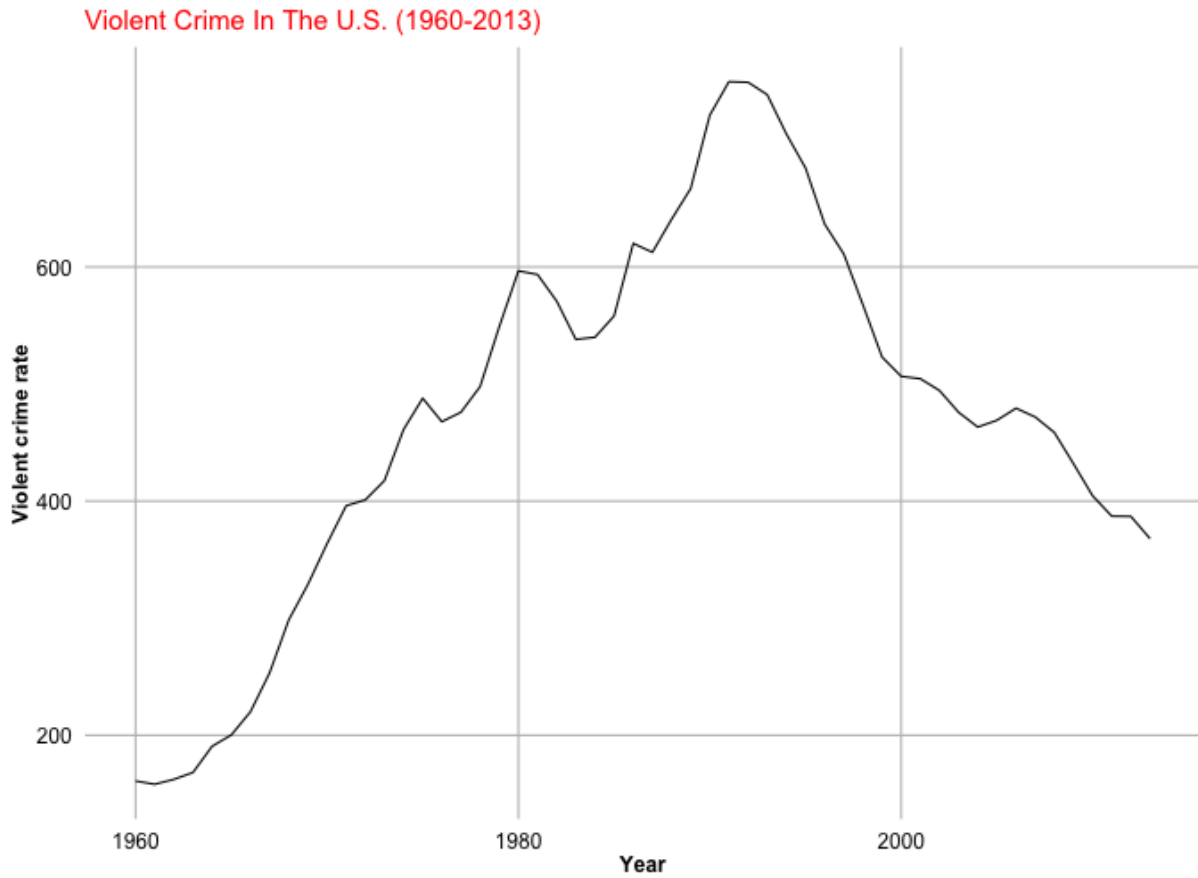
Violent Crime In The U.S. (1960-2013)

Figure 1. Trends in Violent Crimes from 1960-2013 (Careful with the Panic: Violent Crime and Gun Crime are Both Dropping: C. Cook, 2015)
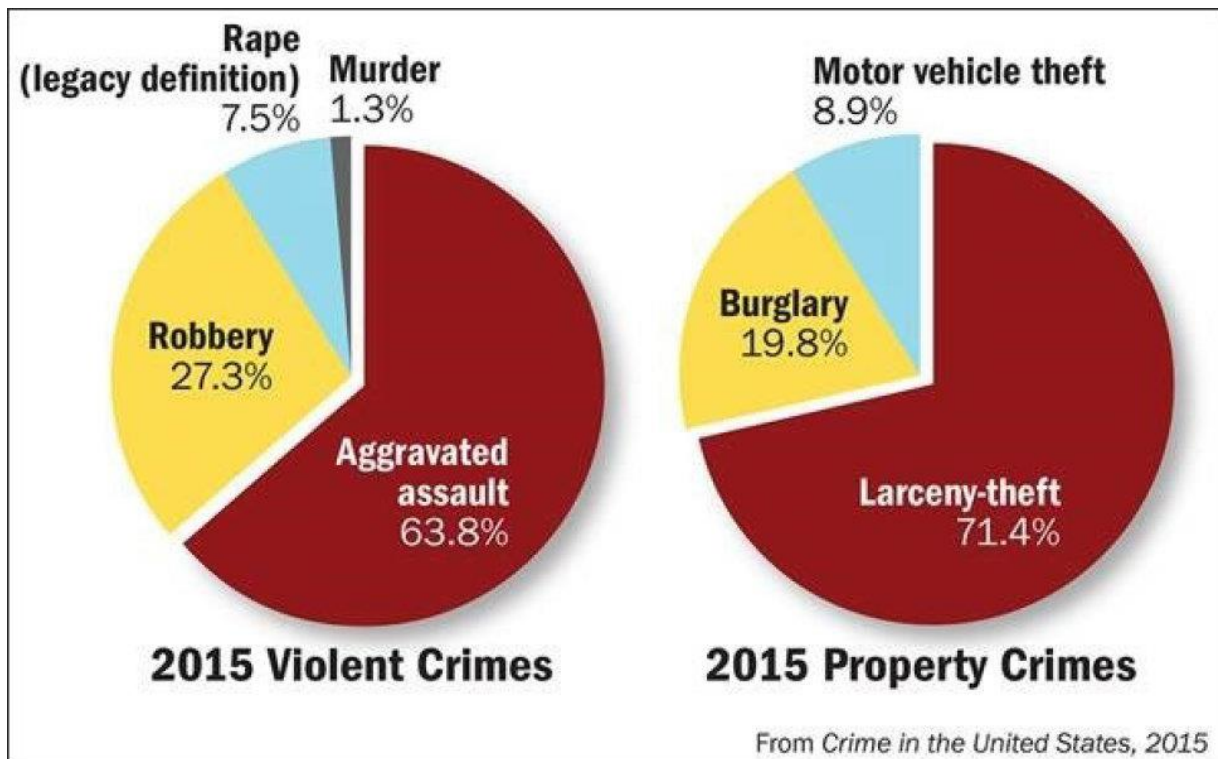
Figure 2. Breakdown of Gun Use in Violent and Property Crime in 2015 (U.S. Crime Rate Rises Slightly, Remains near 20 Year Low...:A. Nauhauser, 2016)
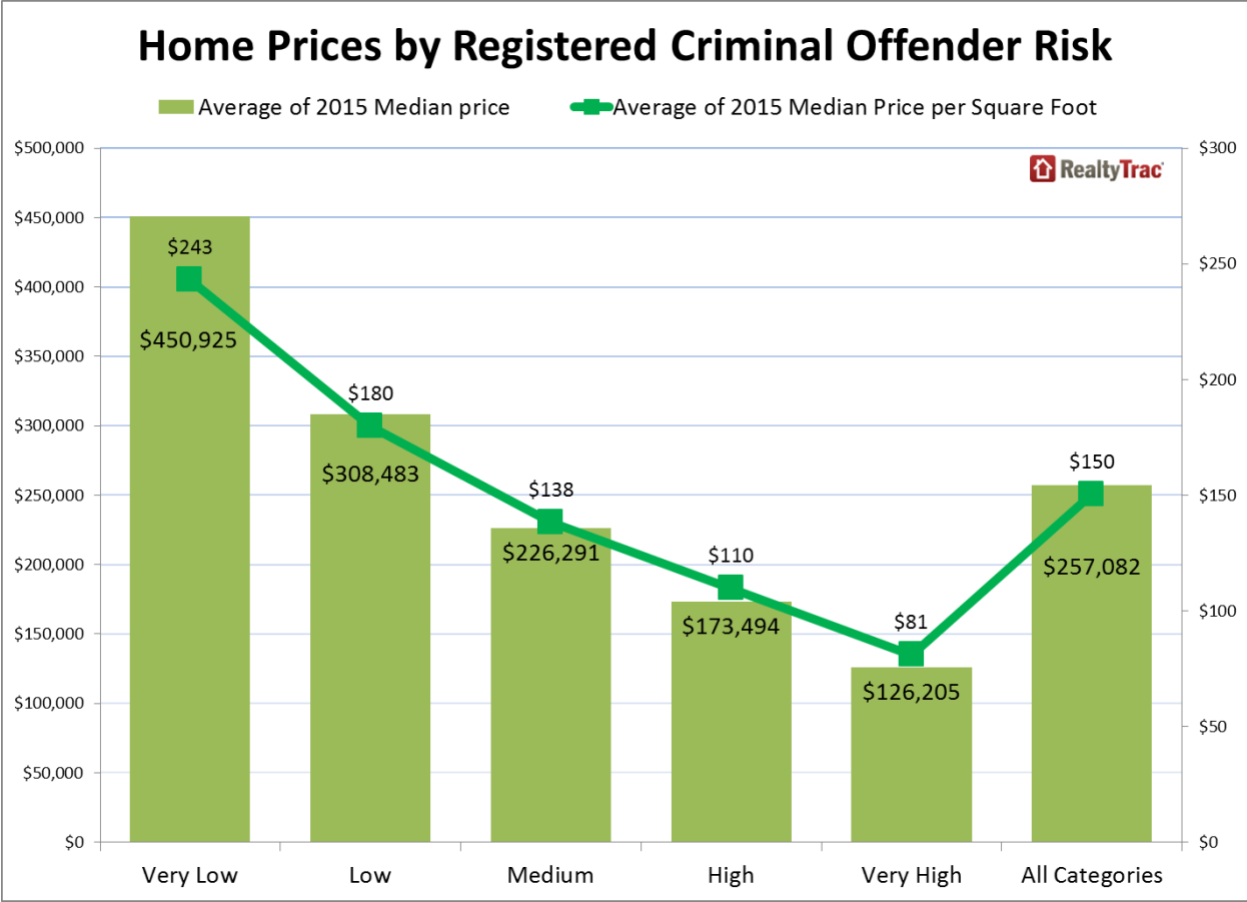
Figure 3. Correlation between Home Prices and Criminal Offender Risk (Home Values Lower in Zip Codes with a Higher Density of Registered Criminals: D. Blomquist, 2016)
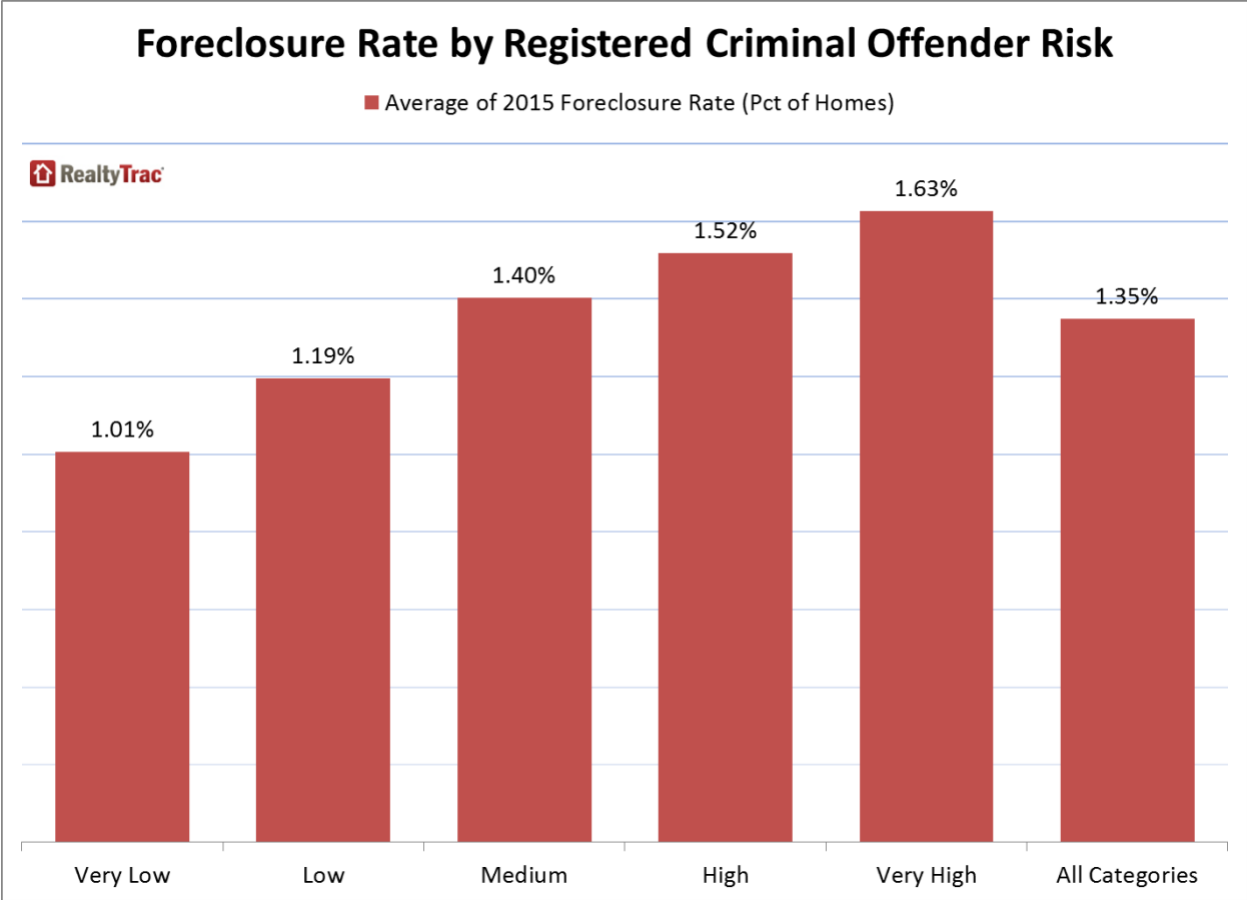
Figure 4. Correlation between Foreclosures and Criminal Offender Risk (Home Values Lower in Zip Codes with a Higher Density of Registered Criminals: D. Blomquist, 2016)

Table 1: Leading Causes of Death

Cause	Probability
Heart Disease	23.72%
Cancer	21.38%
Chronic Lower Respiratory Diseases	5.68%
Stroke	5.13%
Accidents	5.03%
Alzheimer's Disease	3.38%
Diabetes	2.94%
Influenza and Pneumonia	2.14%
Kidney Disease	1.18%
Suicide	1.57%
Total	72.76%
Assault by Firearms	*0.44%*

Source: National Vital Statistics Report – Causes of Death (2010)

Table 2. Variable Definitions

Variable	Definition
Shooting	Indicator variable for a mass shooting =1 the year of and following the event, 0 otherwise
Ln(Sale Price)	Natural log of sale price (dependent variable)
Ln(DistShoot)	Natural log of the distance (in miles) from the house to the shooting location
Age	Age of house at the time of sale
Lot size	Size of the lot on which the house is built in square feet
Bsqft	Square footage of the house
Bedrooms	Number of bedrooms
Baths	Number of bath rooms
Fireplace	Indicator variable for presence of fireplace, Fireplace=1, and o otherwise
Sale_year	Year during which the house was sold (1996 – 2015)
PurchasePerm	Indicator variable for a state in which a permit is required to purchase a gun
GunRegister	Indicator variable for a state in which a gun is required to be registered
AssaultLaw	Indicator variable for a state which bans the sale of assault type weapons
LicenseReq	Indicator variable for a state in which a license to possess a lawful firearm is required
CCWpermits	Indicator variable for a state in which a concealed carry permit is available
OpenCarry	Indicator variable for a state where open carry is legal
NFArestrict	Indicator variable for a state which falls under the NFA restrictions
PeacJournLaw	Indicator variable for a state that has a peaceable journey law
StandGround	Indicator variable for a state that has a stand your ground law

Table 3. Summary Statistics

Variable	Mean	SD	Min.	Max.
Sale Price	304,123	107,447	42,113	1,211,421
Ln(Sale Price)	12.63	11.58	10.65	14.01
Ln(DistShoot)	3.47	1.02	0.31	5.00
Age	7.13	11.26	0	84
Lot size	19,523	13,654	3,789	141,231
Building sqft	2,987	814	566	7,365
Bedrooms	3.12	0.62	2	7
Baths	2.43	0.54	1	7
Fireplace	0.38	0.41	0	1
PurchasePerm	0.24	0.43	0	1
GunRegister	0.12	0.27	0	1
AssaultLaw	0.12	0.29	0	1
LicenseReq	0.11	0.31	0	1
CCWpermits	0.78	0.26	0	1
OpenCarry	0.72	0.38	0	1
NFArestrict	0.41	0.44	0	1
PeacJournLaw	0.41	0.35	0	1
StandGround	0.75	0.38	0	1

Table 4. Regression Results

Variable	DV: Natural Log of Home Sale Price		
	[1]	[2]	[3]
Shooting	-0.201***	-0.158***	-0.213***
	(0.000)	(0.000)	(0.000)
Ln(DistShoot)	-0.100***	-0.168***	-0.213***
	(0.001)	(0.000)	(0.000)
Age	-0.006		-0.018
	(0.114)		(0.136)
Lot size	0.002**		0.004**
	(0.031)		(0.042)
Building sqft	0.001***		0.009***
	(0.000)		(0.000)
Bedrooms	-0.221		-0.187
	(0.184)		(0.421)
Baths	0.136		0.025
	(0.187)		(0.168)
Fireplace	-0.007		-0.004
	(0.222)		(0.114)
PurchasePerm		-0.022	0.0110
		(0.116)	(0.372)
GunRegister		0.001	0.003
		(0.123)	(0.151)
AssaultLaw		-0.006**	-0.004**
		(0.021)	(0.032)
LicenseReq		-0.216	-0.0135
		(0.156)	(0.021)
CCWpermits		0.041**	0.002**
		(0.032)	(0.041)
OpenCarry		-0.004*	-0.031*
		-0.054	(0.062)
NFArestrict		0.002	0.001
		(0.123)	(0.123)
PeacJournLaw		0.011	0.051
		(0.132)	(0.168)
StandGround		0.012***	0.022**
		(0.001)	(0.034)
Constant	0.216***	0.289***	0.266***
	(0.000)	(0.000)	(0.000)
Observations	4256	4256	4256
R-squared	0.356	0.163	0.298
Number of shootings	73	73	73