

The Relationship between Firearm Ownership and Violent Crime



Matthew D. Moore¹ and CariAnn M. Bergner²

Justice Policy Journal • Volume 13, Number 1 (Spring)

© Center on Juvenile and Criminal Justice 2016 • www.cjcj.org/jpj

Abstract

Criminologists and other researchers have attempted to understand whether there is a connection between firearm prevalence and crime. Some experts have argued that prevalence of firearms increases crime, while others have argued it reduces crime. The purpose of this study was to further investigate and clarify this relationship. The current analysis used suicide by firearm as a proxy for firearm ownership. Examining violent crime, homicide, rape, robbery, and assault for 1,997 counties in the United States, the findings indicate that increased prevalence of firearms was associated with increased violent crime, homicide, rape, robbery, and assault. The results of this study suggest that a decrease in prevalence of firearms has the potential to decrease violent crime in the United States.

¹ Grand View University

² Iowa State University

Corresponding Author: mmoore@grandview.edu

Introduction

It is currently unclear how large the prevalence of firearm ownership is in the United States. No database of firearm ownership exists, which is banned under federal law, and there is no clear counting system of how many firearms are available across the country. Azrael, Barnett, and Miller (2004) estimated that about 40% of households in the United States own at least one firearm. Regional culture may play a large role in firearm ownership across the United States as Azrael, Cook, and Miller (2004) pointed out that there are wide differences in firearm prevalence geographically. For instance, they reported that the Northeast had a firearm prevalence rate of 25% and the Pacific states had a 35% prevalence rate, while the East South Central Census division was reported to have a 60% firearm prevalence rate.

Criminologists and other researchers have attempted to understand whether there is a connection between firearm prevalence and crime. A variety of arguments exist regarding this connection, including both that the prevalence of firearms can increase crime as well as that firearm ownership can reduce crime. Cook and Ludwig (2006, pg. 379) discussed both of these arguments. They explained that increased firearm prevalence could “provide a general deterrent to criminal predation, lowering the risk to owners and non-owners alike.” However, they also stated that “widespread gun ownership could also lead to increased risks of various sorts, including the possibility that guns will be misused by the owners or transferred to dangerous people through theft or unregulated sale” (Cook & Ludwig, 2006, pgs. 379-380).

Statistics from the FBI demonstrated that firearms are involved in a large percentage of crime in the United States. In 2008, 67% of all homicides involved the use of a handgun, shotgun, rifle, and other firearms (Vito & Maahs, 2012). In fact, handguns alone accounted for 47% of all homicides in the United States (Vito & Maahs, 2012). Krug, Powell, and Dahlberg (1998) pointed out that, compared to other countries, the United States has a higher rate of a firearm being used during a homicide and a suicide. Miller, Azrael, and Hemenway (2002, pg. 267) reported that the “firearm-related homicide rate in the United States is 17 times higher” as compared to other industrialized countries.

In addition to homicides, firearms have also been found to be involved in accidental deaths as well as nonfatal injuries. According to Siegel, Ross, and King III (2013, pg. 2098) “firearms are responsible for more than 31,000 deaths and an estimated 74,000 nonfatal injuries among US residents each year.” Also, several hundred people per year die in gun-related accidents (Cook & Ludwig, 2009). As a point of comparison to other causes of death, only cancer claimed more lives among children ages five to fourteen years than did firearms (Miller, Azrael, and Hemenway, 2002). Cook and Ludwig (2004, pg. 590) suggested

that the common saying “guns don’t kill people, people kill people” should be amended to “guns don’t kill people, they just make it real easy.”

However, other scholars have argued that increasing the availability of firearms would reduce crime and violence in the United States (Kleck 1988; Kleck and Gertz 1995; Lott 1998; Lott and Mustard 1997). Wolfgang (1958) developed the “weapon substitution hypothesis,” which suggested that individuals who want to harm others would still be motivated without access to a gun. Thus, these motivated individuals would substitute a different weapon, such as a knife, to harm others. Squires (1999) pointed out that states passed conceal and carry laws because of the argument that more firearms would reduce crime and violence in the United States.

Today, politicians, policy makers, and academics continue to debate the role of firearm prevalence in violence. The purpose of the current analysis was to further investigate the effect that firearm prevalence has on violent crime. Using suicide by firearm as a proxy for firearm prevalence the study examined violent crime, homicide, rape, robbery, and assault in 1,197 counties across the United States. We aimed to expand on the literature of firearm prevalence and crime by examining and adding further understanding to the relationship between firearm prevalence and violent crime.

Literature Review

Weapons Substitution Hypothesis

In 1958, Wolfgang developed the “weapons substitution hypothesis” of firearm prevalence. Examining Pennsylvania during 1924 and 1926, Wolfgang (1958) pointed out that the state had a homicide rate of 5.9 per 100,000. Wolfgang (1958) demonstrated that firearms were used in 68 percent of the homicides in Pennsylvania during this time period. Then he explained that Philadelphia in 1948 and 1952 had a homicide rate of 6.1 per 100,000, but only 33 percent of homicides involved a firearm. From this data Wolfgang (1958) concluded that there was no causal relationship between the homicide rate and the proportionate use of firearms.

Wolfgang (1958) then stated that individuals who are intent on killing another would find a way to do so. If a firearm was available then the individual would use a firearm. However, if a firearm was not available the individual would substitute the firearm for another weapon, such as a knife. Therefore, the firearm prevalence in an area should have

no effect on violent crime because individuals will find a substitute weapon to use to harm someone.

The weapons substitution hypothesis has been an influential argument in academic research. Scholars have found that increasing the prevalence of firearms would reduce crime. Lott and Mustard (1998) examined concealed carry laws for 3,054 counties for 17 years. They concluded that allowing more firearms to be carried would have reduced the number of murders in this time frame by about 1,500. Lott and Mustard (1998) also stated that allowing more firearms would be the most cost effective way of dealing with crime in the United States.

Kleck and Gertz (1995) explored how firearms are used in defensive ways. They argued that some individuals would use their firearm in a defensive way to fend off an attacker or would be attacker. If laws were tightened to restrict firearms Kleck and Gertz (1995) posited that there would be a sizable increase in the homicide rate in the United States. This research has demonstrated that increased firearm prevalence would reduce violent crime in the United States.

Weapon Instrumentality Effect

Other scholars have demonstrated that increased firearm prevalence would increase violent crime in the United States. Zimring and Hawkins (1987) argued that the weapon substitution effect was not accurate. Instead, Zimring and Hawkins (1987) believed that a firearm was more dangerous and likely to produce a death than other weapons, such as a knife. Therefore, if firearms are used during an altercation an individual is more likely to die, thus increasing the homicide rate. Zimring and Hawkins's (1987) belief that more firearms would increase homicide became known as the weapon instrumentality effect.

Other scholars have also found that an increased level of firearms produced an increased level of homicide. Cook and Ludwig (2006) examined the social costs of firearm prevalence in the United States by using suicide by firearm as a proxy for gun ownership. Using panel data for the 200 largest counties in the United States, the researchers found that as firearm prevalence increased, total homicide and homicide by firearm both increased. This finding indicates that firearms might play a significant role in the level of homicide in the United States. When examining homicide, rape, assault, larceny, and motor vehicle theft, Cook and Ludwig (2006) found that only homicide increased as firearm prevalence increased. Thus, a reduction in firearm prevalence could reduce homicide, but not other types of crime.

Continuing to examine the role of firearms and homicide, Miller, Azrael, and Hemenway (2002) investigated the relationship between firearm prevalence and death in children.

Specifically, they examined firearm prevalence, suicide, homicide, and unintentional deaths for children ages five to fourteen. The researchers used four different proxies of firearm prevalence. First, they used the Behavioral Risk Factor Surveillance System (BRFSS), which is a state-level survey that asks respondents about firearm ownership. Second, they utilized data from the General Social Surveys (GSS) which asks about gun ownership rates. They also used the Cook's Index, which is an average of all suicides and homicides committed with a firearm. Finally, they used suicides by firearm. Miller, Azrael, and Hemenway (2002) used the four separate proxies to ensure consistency in results and prevent making generalizations based on an outlier. The findings demonstrated consistency among all proxies used in the analysis. The results indicated that, regardless of the proxy used, there was a significant and positive association between firearm prevalence and state-level rates of homicide, firearm homicide, suicides, firearm suicides, and unintentional firearm deaths.

At the regional level, the researchers found that, regardless of the proxy, there was a significant and positive association between firearm prevalence and unintentional firearm deaths and suicides. Miller, Azrael, and Hemenway (2002, pg. 271) pointed out that children living in high firearm prevalent states were "16 times more likely to die from unintentional firearm injury, 7 times more likely to die from firearm suicide, 3 times more likely to die from firearm homicide, and overall, twice as likely to die from suicide and homicide" than children living in states with low firearm prevalence.

Siegel, Ross, and King III (2013) examined firearm prevalence and firearm homicides from 1981 to 2010. The authors collected information for the fifty states from 1981 to 2010 and used suicide by firearm as a proxy for firearm prevalence. Using a negative binomial regression model the researchers found that firearm prevalence was a significant predictor of firearm homicide. In fact, Siegel, Ross, and King III (2013) stated that a one standard deviation increase in firearm prevalence was associated with a 12.9% increase in the homicide rate.

Branas et al. (2009) explored whether having a firearm would reduce the risk of harm from an attack. They compared a sample of individuals in Philadelphia from 2003 – 2006 who were victims of assault, including those who had a firearm and those who did not have a firearm. Branas et al. (2009) matched the subjects on a number of factors, such as age. They found that victims who were in possession of a gun were 4.46 times more likely to be shot in an assault and 4.23 times more likely to be fatally shot in an assault. Further, in assaults where the victim had a chance to resist, individuals in possession of a firearm were

5.45 times more likely to be shot. Branas et al. (2009) stated that firearm possession may falsely empower individuals to think they can handle dangerous situations and that individuals who are in possession of a firearm may be more likely to enter a dangerous situation and be in harm's way because of their overconfidence.

Other scholars have examined firearm prevalence and crime using a cross-national research design. Using the International Crime Survey, Killias (1993) found wide variation in firearm ownership. For instance, only 2% of households in the Netherlands owned a gun, while 48% of homes in the United States reported owning a gun. Killias (1993) was also interested in whether a lack of availability of firearms would lead individuals to compensate by using other means to commit suicide and homicide. He found that firearm prevalence was positively correlated with national homicide and suicide rates and positively correlated with homicide and suicides committed by a firearm. Killias (1993) demonstrated that there is no weapon substitution effect for countries with low firearm prevalence rates. Individuals did not find other means to commit homicide and suicide when a firearm was not present.

Examining 26 high-income countries, Hemenway and Miller (2000) used the Cook's Index and suicides by firearm as proxies for firearm prevalence. They found that, regardless of the proxy utilized, there was a significant and positive correlation between homicide rates and firearm prevalence. Killias, van Kesteren, and Rindlisbacher (2001) examined firearm prevalence and suicide and homicide. Using data from the International Crime Victimization Surveys for 1989, 1992, and 1996 for 21 countries, the researchers found that firearm prevalence increased rates of suicide by firearm, homicide by firearm for female victims, and firearm assault.

Results from the previous literature are mixed with some scholars advocating that there is a weapon substitution effect and other scholars supporting the weapon instrumentality effect. The current analysis expands on the previous research on prevalence of firearms and homicide. To examine the weapon substitution effect and the weapon instrumentality effect we used a large number of counties across the United States (1,197) and examine different types of crime to understand how firearm prevalence is associated with several other types of violent crime.

Table 3: Negative Binomial Regression Analysis for Types of Crime in Rural and Urban Counties

	<i>Total Violent Crime</i>	<i>Homicide</i>	<i>Rape</i>	<i>Robbery</i>	<i>Assault</i>
Northeast	-.776*** (.125)	-1.032*** (.162)	-.294* (.135)	-.564*** (.134)	-.838*** (.125)
South	-1.600*** (.085)	-1.599*** (.105)	-1.329*** (.091)	-1.670*** (.093)	-1.600*** (.084)
Midwest	-1.355*** (.095)	-1.668*** (.129)	-.699*** (.103)	-1.464*** (.105)	-1.380*** (.095)
Adjacent to Metro	-.164** (.063)	-.217* (.086)	-.083 (.072)	-.140* (.068)	-.174** (.063)
Rural	-.191* (.077)	-.252* (.113)	-.138 (.091)	-.215* (.086)	-.213** (.077)
Residential Mobility	.032*** (.005)	.016* (.007)	.035*** (.006)	.036*** (.006)	.031*** (.005)
Ethnic Heterogeneity	2.530*** (.229)	3.159*** (.299)	1.762*** (.257)	3.144*** (.245)	2.422*** (.231)
Female Households	.059 (.049)	.103 (.064)	.097 (.056)	.170** (.055)	.042 (.049)
Poverty	.019** (.007)	.055*** (.009)	.007 (.008)	.028** (.008)	.019* (.007)
Population at Risk (log)	-.320 (.347)	-.632 (.465)	-.193 (.393)	.047 (.386)	-.324 (.347)
Unemployment Rate	.015 (.019)	-.017 (.027)	-.026 (.023)	.014 (.022)	.019 (.019)
Population Density (log)	1.575*** (.059)	1.810*** (.081)	1.314*** (.066)	2.186*** (.067)	1.489*** (.059)
Firearm Prevalence	.600* (.245)	1.708*** (.343)	.920** (.281)	1.052*** (.279)	.497* (.245)

*p < .05; **p < .01; ***p < .001; Unstandardized Coefficients (Standard Error)

Methods

The current analysis used 1,997 counties in the United States to examine the effect that firearm prevalence has on violent crimes. Because the Center for Disease Control does not

release information for all counties (e.g. in order to protect confidentiality) the current analysis was not able to use every county in the United States. Using Beale codes from the U.S. Department of Agriculture (2013), counties were labeled as rural and urban. This analysis distinguished between rural and urban counties because of recent problems that have been pointed out about rural county-level data (Kaylen & Pridemore, 2011; Lott & Whitley, 2003; Maltz & Targonski, 2002; Wiersema, Loftin, & McDowall, 2000). Counties with small populations have been demonstrated to pose problems in criminological analyses. For example, rural counties may handle antisocial behavior in an informal manner, making actual crime in rural areas seem lower than the true level. Furthermore, inaccuracy in reporting data across counties can exist. One crime may be reported as a robbery, which is a violent crime, and in another county may be reported as a burglary, which is a nonviolent crime. While the Uniform Crime Report (UCR) county-level data has been questioned, it had been demonstrated to be a reliable source of crime data available to criminologists (Barnett & Mencken, 2002; Deller & Deller, 2010), and differentiating between urban and rural counties will allow this analysis to detect outliers that may be found in rural counties. The current analysis included 1,043 rural counties and 954 urban counties.

To continue to monitor the effect that rural counties could have on the analysis we ran a second model with all the rural counties removed. In this way the current analysis can provide an understanding of whether the rural counties had a significant effect on the results and remove some of the concerns of county-level analysis. Furthermore, violent crime is more likely to occur in urban areas (Vito & Maahs, 2012). Therefore, the second analysis with only urban counties could also be beneficial to examine because crime is more pronounced in urban areas.

The analysis used negative binomial regression to explore the effect that firearm prevalence has on violent crimes. Osgood (2000) verified that negative binomial regression is the recommended statistical technique for examining county-level crime. When one event occurs in an area with a small population, this would result in a large increase in crime rate for that area, but areas with larger populations would not see this same increase in crime rate based on one event. Thus, rural areas would have the potential to have similar crime rates as urban areas even though one crime had occurred in a rural area and many crimes had occurred in an urban area. To solve for this potential problem Osgood (2000) recommended the use of negative binomial regression, which uses counts as the dependent variable rather than crime rates.

The study is a cross-sectional design. Kleck (2004) argued that because gun prevalence does not vary over time there is no need for longitudinal studies. According to Kleck (2004: 23) surveys reveal that there is “enormous variation across areas within the United States” in gun ownership, but there is “virtually no variation over time, for either the nation as a

whole or its regions." Kleck (2004: 25) goes on to state that "this alone may be reason enough to question the utility of longitudinal designs for assessing the effects of gun prevalence – if it does not vary over time, there is no opportunity to estimate its effects." Therefore, the current design does use a cross-sectional design.

Violent Crimes used in the Analysis

The dependent variables used in the current analysis were collected from the Uniform Crime Report (UCR) for 2010. The variables used were homicide, rape, robbery, aggravated assault, and total violent crime. Total violent crime consists of the sum of homicide, rape, robbery, and aggravated assault. The purpose of this analysis was to examine the effect that firearms have on crime, thus violent crimes were used in the analysis because the use of a firearm in a crime is classified as violent. Furthermore, the potential problems with county-level crime discussed previously have been found more so when examining property and nonviolent crimes; therefore, examining violent crime is less likely to result in such problems.

Firearm Ownership

Firearm prevalence in the United States is difficult to determine because there is no database that collects information on firearm ownership and prevalence. Thus, analyses that study firearm prevalence have had to develop proxies for firearm ownership. As a proxy for firearm ownership, the current analysis used the percentage of suicides by a firearm from 2000 to 2010. The percent of suicides by firearm has been used in numerous studies (Azrael, Cook, & Miller, 2004; Cook & Ludwig, 2006; Hemenway and Miller, 2000; Ruddell & Mays, 2005; Siegel, Ross, & King III, 2013) as a proxy for firearm ownership. Other analyses have used proxies such as the rate of hunting licenses issued per capita (Krug, 1968) and the percentage of homicides and suicides involving a firearm (Cook, 1979), which became known as the Cook Index. More recently, Duggan (2001) used county-level subscription rates to *Guns & Ammo* magazine as a proxy for firearm ownership.

The current analysis used the percent of suicides by firearm as a proxy because this proxy has been demonstrated to be the most reliable proxy for firearm prevalence (Azrael, Cook, & Miller, 2004). Azrael, Cook, and Miller (2004, pg. 56) concluded that of all the known proxies for firearm prevalence "the percentage of suicides committed with a gun,

performs consistently better than the others in cross-sectional comparisons.” Azrael, Cook, and Miller (2004) also pointed out that the percent of suicides by firearm provided the accurate information of gun ownership over time. Therefore, the percent of suicides by firearm is the most reliable proxy that can be used in a cross-sectional design of firearm prevalence and crime.

The total suicides and suicides by firearm were collected from the Center for Disease (CDC) control website. The CDC lists suicide as external causes of morbidity and mortality in the intentional self-harm category. Suicides are categorized by the manner in which the suicide was committed. The current analysis used averages from the years 2000 to 2010. Suicide rates display a large amount of variability from year to year (Flavin & Radcliff, 2009), and studies on suicide often use averages to control this variability (Cutright & Fernquist, 2000; Flavin & Radcliff, 2009; Moore, Recker, & Heirigs, 2014). The CDC does not release information for each county in the United States because some counties have a low number of suicides, and the CDC withholds these counties from the analysis to protect confidentiality. Thus, the current analysis used counties that had information available from 2000 to 2010.

Control Variables

The control variables used in the analysis were collected from the United States Census Bureau. The five-year estimates from the American Community Survey were used for the years 2006 to 2010. The five-year estimates were used because the Census Bureau does not collect information for every year for all counties. Counties with small populations do not have data available for every year. Therefore, the five-year estimates were the most accurate way to collect information for rural counties (see Table 1).

Table 1: Descriptive Statistics for Variables used in the Analysis

	<i>Mean</i>	<i>Standard Deviation</i>
Total Violent Crime	249.85	1039.32
Murder	5.12	19.51
Rape	9.10	27.66
Robbery	52.48	247.69
Assault	183.08	764.85
Firearm Prevalence	.47	.11
Residential Mobility	31.42	6.75
Ethnic Heterogeneity	.21	.15
Female Households	2.63	.75
Poverty	11.28	4.93
Population at Risk	13.78	3.41
Unemployment Rate	4.85	1.39
Population Density	365.38	2108.77

The control variables were chosen based upon their use in other analyses of crime. One control variable used in this study was region in which the county is located because the region can have a large effect on the crime found in the area. Previous studies have controlled for the South, (Blau & Blau, 1982; Gastil, 1971; Nisbett & Cohen, 1996) which has higher rates of crime than other regions of the country. Therefore, dummy variables were created to control for the region in which the county is located. Dummy variables for the Northeast, South, and Midwest were created with the West being the reference category for the analysis. Additionally, dummy variables were also created based on the Beale codes (U.S. Department of Agriculture, 2013) to indicate whether a county was rural, adjacent to an urban county, or urban, and the category of urban counties was used as the reference category.

Residential mobility was utilized as another control variable in this study because it has been demonstrated to be a key variable in lowering social capital and social disorganization, which has been shown to increase crime and other antisocial behaviors (Hemingway, Kennedy, Kawachi, & Putnam 2001; Osgood & Chambers 2000). The current analysis used the percent of the population that had moved from 2005 to 2010 as a measure of residential mobility. Osgood and Chambers (2000) have stated that ethnic heterogeneity increases crime, so this construct was included as a control variable as well.

To calculate ethnic heterogeneity, the current analysis calculated the likelihood that two randomly selected individuals from the county would have a different ethnicity. As Osgood and Chambers (2000) did, we calculated the ethnic heterogeneity measure as $1 - (\sum p_i)^2$, where p_i is the percent of households with a given ethnic group (i.e. white or nonwhite). The percent of the households with a given ethnic group is then squared and summed across the two groups. The ethnic heterogeneity measure ranges from 0 where only white or nonwhite residents reside to .5 where the county has an equal number of whites and nonwhites.

Female-headed households have also been demonstrated to have a relationship to crime (Osgood & Chambers, 2000). Thus, the percent of female-headed households was used as a control variable. The current study also utilized the percent of families below the poverty level as the poverty variable. In line with Osgood and Chambers (2000), the unemployment rate was also included as a second economic measure. A population at risk variable was also included because it has been found that youth are more likely to engage in antisocial and delinquent behavior (Regoli, Hewitt, & DeLisi, 2014; Vito & Maahs, 2012). The percent of the population that was between the ages of 15 to 24 was used as the population at risk variable. In the current analysis, the distribution of the population 15 to 24 was skewed, and the natural logarithmic transformation was used to correct for the skewed distribution. The population density was also included in the model, which is in line with the analysis done by Osgood and Chambers (2000) and has been demonstrated to have a relationship to crime. The distribution of the population density was skewed. The natural logarithmic transformation was used in the current analysis to correct for the skewed distribution. The current study tested for multicollinearity and did not have experience any issues with this assumption. Table 2 provides the correlations for the variables used in the analysis.

Table 2: Correlation Matrix

	Violent Crime	Murder	Rape	Robbery	Assault	Firearm Prevalence	Residential Mobility	Ethnic Heterogeneity	Female Households	Poverty	Population at Risk	Unemployment Rate	Population Density
Violent Crime	1.00												
Murder	.91	1.00											
Rape	.87	.89	1.00										
Robbery	.96	.94	.92	1.00									
Assault	.99	.87	.83	.92	1.00								
Firearm Prevalence	-.15	-.13	-.16	-.16	-.15	1.00							
Residential Mobility	.15	.18	.20	.14	.15	-.12	1.00						
Ethnic Heterogeneity	.24	.29	.24	.24	.23	-.01	.28	1.00					
Female Households	.11	.19	.14	.13	.10	.08	.20	.58	1.00				
Poverty	.01	.06	-.01	.02	.01	.27	-.10	.34	.56	1.00			
Population at Risk	.06	.07	.07	.05	.06	-.09	.51	.21	.11	.09	1.00		
Unemployment Rate	.11	.15	.10	.11	.10	.04	-.02	.27	.41	.41	.04	1.00	
Population Density	.41	.42	.41	.48	.37	-.21	.09	.17	.10	.01	.03	.05	1.00

Results

All Counties

The first negative binomial regression model was conducted with all counties in the model. Table 3 illustrates the results of the regression analysis. Firearm prevalence is significantly related to total violent crime ($B = .600$, $p < .05$). With each unit increase in firearm prevalence, the expected count of the violent crime index increases by .600. This also indicates that the percent change in the total violent crime is an 82% increase for every unit increase in firearm ownership. The prevalence of guns does significantly increase the violent crime in the county. This finding is consistent with previous research on firearm prevalence and crime both in the United States (Azrael, Cook, & Miller, 2004; Branas et al., 2009; Cook & Ludwig, 2006; Cummings et al. 1997; Miller, Azrael, & Hemenway, 2001; Ruddell & Mays, 2005; Siegel, Ross, & King III, 2013) and internationally (Hemenway & Miller, 2000; Killias, van Kesteren, & Rindlisbacher 2001).

Firearm prevalence is also significantly related to homicide ($B = 1.708, p < .001$). With each unit increase in firearm prevalence, the expected count of homicides increases by 1.708. Thus, as firearm prevalence increased, homicide increased. Moreover, firearm prevalence was significant and positive for rape ($B = .920, p < .01$), robbery ($B = 1.052, p < .001$), and assault ($B = .497, p < .05$). For each unit increase in firearm prevalence, there would be .920 more rapes, 1.052 more robberies, and .497 more assaults. Again, the results of the current analysis demonstrate that the prevalence of firearms increases all violent crimes.

Due to space constraints the results for the control variables will not be discussed in detail. However, Table 3 illustrates that the control variables are significant are in the expected directions. For example, population density was significant and positive in every regression analysis conducted. As the population density increased, violent crime increased.

Urban Counties

Next, as discussed above, the current analysis removed rural counties to control for the problems with county-level data. Table 4 illustrates the results of the negative binomial regressions with rural counties removed. Firearm prevalence was significant and positive for total violent crime ($B = 1.610, p < .001$). With each unit increase in firearm prevalence, the expected count of the violent crime index increases by 1.610. Once again, the analysis demonstrates that firearm prevalence increases violent crime in the county. Moreover, as in the regressions with all counties, firearm prevalence was significant and had a positive association with homicide ($B = 3.178, p < .001$), rape ($B = 1.838, p < .001$), robbery ($B = 2.196, p < .001$), and assault ($B = 1.469, p < .001$). With each unit increase in firearm prevalence, homicide would increase by 3.178, rape would increase by 1.838, robbery would increase by 2.196, and assault would increase by 1.469. The results of the current analysis demonstrate that the prevalence of firearms does increase violent crime in urban counties.

Table 4: Negative Binomial Regression Analysis for Types of Crime in Urban Counties

	<i>Total Violent Crime</i>	<i>Homicide</i>	<i>Rape</i>	<i>Robbery</i>	<i>Assault</i>
Northeast	-.867*** (.177)	-.748*** (.205)	-.523** (.183)	-.732*** (.182)	-.922*** (.175)
South	-1.868*** (.120)	-1.629*** (.137)	-1.612*** (.125)	-1.975*** (.126)	-1.878*** (.120)
Midwest	-1.409*** (.140)	-1.358*** (.165)	-.762*** (.148)	-1.479*** (.146)	-1.455*** (.141)
Residential Mobility	.022** (.007)	.018* (.009)	.032*** (.008)	.023** (.007)	.021** (.007)
Ethnic Heterogeneity	2.539*** (.352)	4.009*** (.426)	1.976*** (.382)	3.055*** (.369)	2.393*** (.353)
Female Households	.119 (.080)	.035 (.092)	.166 (.086)	.255** (.088)	.093 (.081)
Poverty	.035** (.012)	.060*** (.015)	.024 (.013)	.037** (.012)	.036** (.012)
Population at Risk (log)	.539 (.551)	-.455 (.638)	.080 (.590)	.967 (.587)	.483 (.549)
Unemployment Rate	-.021 (.034)	.003 (.042)	-.107** (.038)	-.052 (.037)	-.011 (.034)
Population Density (log)	1.675*** (.080)	1.715*** (.100)	1.443*** (.087)	2.284*** (.088)	1.572*** (.080)
Firearm Prevalence	1.610*** (.413)	3.178*** (.519)	1.838*** (.463)	2.196*** (.452)	1.469*** (.412)

*p < .05; **p < .01; ***p < .001; Unstandardized Coefficients (Standard Error)

Conclusion

The relationship between firearm prevalence and crime has been a difficult area for researchers to examine. The lack of a database (which is illegal in the United States) and no accurate count of the prevalence of firearms in an area make analysis difficult. Furthermore, scholars have suggested that a firearm can be used for protection and decrease crime. At the same time, other scholars have argued that firearms are more deadly and would result in increased homicide and violence. To attempt to investigate the

role that the prevalence of firearms play in crime accurate proxies for firearm prevalence have been discovered by researchers (Azrael, Cook, & Miller, 2004; Cook, 1979; Cook & Ludwig, 2006; Duggan, 2001; Hemenway and Miller, 2000; Krug, 1968; Ruddell & Mays, 2005; Siegel, Ross, & King III, 2013). In fact, Moreover, Azrael, Cook, and Miller (2004) illustrated that suicide by firearm was the most accurate proxy for firearm prevalence. Past research analyses that utilized proxies for firearm prevalence have demonstrated that increased firearm prevalence was correlated with increased violent crime (especially homicide) as well as suicide. The current analysis further provided evidence that increased firearm prevalence increased violent crime. This finding would lend support to the weapon instrumentality effect.

By using suicide by firearm as a proxy for firearm prevalence, the current analysis demonstrated that in 1,997 counties across the United States, as firearm prevalence increased, so did violent crime. Furthermore, the analysis illustrated that as firearm prevalence increased, homicide, rape, robbery, and assault each increased. Therefore, it can be concluded that as firearms become more plentiful in an area, violent crime will increase in that area. The specific reason why firearm prevalence increases violent crime is not clear but there are several viable theories. One reason that firearm prevalence could increase violent crime is that guns can be “misused by the owners or transferred to dangerous people through theft or unregulated sale” (Cook and Ludwig, 2006, pgs. 379-380). Another reason that firearm prevalence could lead to increased violent crime is that using a gun is more lethal than other weapons (i.e. weapon instrumentality effect). Cook and Ludwig (2004, pg. 590) suggested that this was the case when they stated that the common saying “guns don’t kill people, people kill people” should be amended to “guns don’t kill people, they just make it real easy.” This is due to gun being more fatal than knives or other methods of violence against another individual. Moreover, Cheng and Hoekstra (2013) and McClellan and Tekin (2012) have demonstrated that changing laws that make the use of guns more acceptable in certain situation does increase the level of homicide in that area.

The current analysis differs and adds to the current literature on firearm prevalence and crime in a number of ways. Other studies on firearm prevalence and crime examined states (Hemenway et al. 2001; Miller et al. 2002; Siegel et al. 2013) or countries (Hemenway and Miller 2000; Hoskin 2001; Krug et al. 1998). Other scholars have used panel and survey data (Branas et al. 2009; Cummings et al. 1997; Killias 1993; Killias et al. 2001) or examine the effect of firearm laws (Ruddell & Mays 2005). The current analysis used a large number of counties (1,997). Secondly, the current analysis used negative binomial regression analysis. Osgood (2000) demonstrated that negative binomial regression is the proper statistical method to use when examining crime in rural areas. Counties with small population could see a large increase in crime with one additional occurrence. A large

urban areas would not experience the same large increase with one additional increase in crime. Therefore, counties with small populations could have significantly higher crime rates than more heavily populated areas even though more crimes had occurred in the more heavily populated area. Negative binomial regression uses counts as the dependent variable to take away the large rate increases that small areas would experience due to a small increase in crime.

Limitations exist when doing any research in the social sciences. One of the limitations of the current analysis is the lack of accurate firearm ownership information. More accurate information could begin to clear some of the confusion as to the exact extent and direction of firearm ownership and crime. Illegal transfer and purchase of guns is difficult to measure when criminologists are not sure of the extent of legal firearm ownership.

Another limitation of the current analysis is the use of UCR data. Crime data at the county-level has been criticized for a number of reasons discussed previously (Kaylen & Pridemore, 2011; Lott & Whitley, 2003; Maltz & Targonski, 2002; Wiersema, Loftin, & McDowall, 2000). We ran two separate analyses to attempt to identify the effect that rural counties may have had on the findings. Both negative binomial regressions found that increased firearm prevalence increased violent crime, homicide, rape, robbery, and assault. Previous research on firearm prevalence and violent crime using different levels of analysis has found the similar results. Thus, it is a consistent finding that firearm prevalence does increase violent crime.

References

- Azrael, D., Cook, P. J., & Miller, M. (2004). State and local prevalence of firearms ownership measurement, structure, and trends. *Journal of Quantitative Criminology*, 20(1), 43-62.
- Barnett, C., & Menken F. C. (2002). Social disorganization theory and the contextual nature of crime in nonmetropolitan counties. *Rural Sociology*, 67(3), 372-393.
- Blau, J. B., & Blau, P. M. (1982). The cost of inequality: Metropolitan structure and violent crime. *American Sociological Review*, 47(1), 114-29.
- Branas, C. C., Richmond, T. S., Culhane, D. P., Ten Have, T. R., & Wiebe, D. J. (2009). Investigating the link between gun possession and gun assault. *American Journal of Public Health*, 99(11), 2034-2040.

- Cheng, C., & Hoekstra, M. (2013). Does Strengthening Self-Defense Law Deter Crime or Escalate Violence? Evidence from Expansions to Castle Doctrine. *Journal of Human Resources, 48*(3), 821-854.
- Cook, P. J. (1979). The effect of gun availability on robbery and robbery murder: A cross-section study of fifty cities. In Haveman, R. H., and Zellner, B. B. (eds.), *Policy Studies Review Annual, 3*. Beverly Hills, CA: Sage.
- Cook, P. J., & Ludwig, J. (2004). Principles for effective gun policy. *Fordham Law Review, 73*, 589-613.
- Cook, P., & Ludwig, J. (2006). The social costs of gun ownership. *Journal of Public Economics, 90*, 379-391.
- Cook, P. J., & Ludwig, J. (2009). Firearm violence. In M. Tonry (Ed.), *The Oxford handbook of crime and public policy*. New York: Oxford University Press.
- Cummings, P., Koepsell, T. D., Grossman, D. C., Savarino, J., & Thompson, R. S. (1997). The association between the purchase of a handgun and homicide or suicide. *American Journal of Public Health, 87*(6), 974-978.
- Cutright, P., & Fernquist, R. M. (2000). Effects of societal integration, period, region, and culture of suicide on male age-specific suicide rates: 20 developed countries, 1955-1989. *Social Science Research, 29*(1), 148-172.
- Deller, S. C. & Deller, M. A. (2010). Rural crime and social capital. *Growth and Change, 41*(2), 221-75.
- Duggan, M. (2001). More guns, more crime. *Journal of Political Economy, 109*(5): 1086-1114.
- Flavin, P., & Radcliff, B. (2009). Public policies and suicide in the American states. *Social Indicators Research, 90*(2), 195-209.
- Gastil, Raymond D. (1971). Homicide and a regional culture of violence. *American Sociological Review, 36*, 412-27.
- Hemenway, D., Kennedy, B. P., Kawachi, I., & Putnam, R. D. (2001). Firearm prevalence and social capital. *Annals of Epidemiology, 11*(7), 484-490.
- Hemenway, D., & Miller, M. (2000). Firearm availability and homicide rates across 26 high income countries. *The Journal of TRAMA Injury, Infection, and Critical Care, 49*(6), 985-988.
- Kaylen, M. T., & Pridemore, W. A. (2011). A reassessment of the association between social disorganization and youth violence in rural areas. *Social Science Quarterly, 92*(4), 978-1001.

- Killias, M. (1993). International correlations between gun ownership and rates of homicide and suicide. *CMAJ: Canadian Medical Association Journal*, 148(10), 1721-1725.
- Killias, M., van Kesteren, J., & Rindlisbacher, M. (2001). Guns, violent crime, and suicide in 21 countries. *Canadian J. Criminology*, 43, 429-448.
- Kleck, G. (2004). Measures of gun ownership levels for macro-level crime and violence research. *Journal of Research in Crime and Delinquency*, 41(1), 3-36.
- Krug, A. S. (1968). The relationship between firearms ownership and crime rates: A statistical analysis. *Congressional Record* (January 30): H570-72.
- Krug, E. G., Powell, K. E., & Dahlberg, L. L. (1998). Firearm-related deaths in the United States and 35 other high- and upper-middle-income countries. *International Journal of Epidemiology*, 27, 214-221.
- Lott Jr, J. R., & Whitley, J. (2003). Measurement error in county-level UCR data. *Journal of Quantitative Criminology*, 19(2), 185-198.
- Maltz, M. D., & Targonski, J. (2002). A note on the use of county-level UCR data. *Journal of Quantitative Criminology*, 18(3), 297-318.
- McClellan, C. B., & Tekin, E. (2012). *Stand Your Ground Laws, Homicides, and Injuries* (No. w18187). National Bureau of Economic Research.
- Miller, M., Azrael, D., & Hemenway, D. (2002). Firearm availability and unintended firearm deaths, suicide, and homicide among 5-14 year olds. *The Journal of TRAMA Injury, Infection, and Critical Care*, 52(2), 267-275.
- Moore, M. D., Recker, N. L., & Heirigs, M. H. Forthcoming Suicide and the creative class. *Social Indicators Research*, 119(3): 1613-1626.
- Nisbett, R. E., & Cohen, D. (1996). *Culture of honor: The psychology of violence in the south*. Boulder, CO: Westview.
- Osgood, D. W. (2000). Poisson-based regression analysis of aggregate crime rates. *Journal of Quantitative Criminology*, 16(1), 21-43.
- Osgood, D. W., & Chambers, J. M. (2000). Social disorganization outside the metropolis: An analysis of rural youth violence. *Criminology*, 38(1), 81-116.
- Regoli, R. M., Hewitt, J. D., & DeLisi, M. (2014). *Delinquency in society*, 9th ed. Sundbury, MA: Jones & Bartlett.

- Ruddell, R., & Mays, G. L. (2005). State background checks and firearms homicide. *Journal of Criminal Justice, 33*, 127-136.
- Siegel, M., Ross, C. S., & King III, C. (2013). The relationship between gun ownership and firearm homicide rates in the United States, 1981-2010. *American Journal of Public Health, 103(11)*, 2098-2105.
- Vito, G. F., & Maahs, J. R. (2012). *Criminology: Theory, research, and policy*, 3rd ed. Sundbury, MA: Jones & Bartlett.
- U.S. Department of Agriculture. (2013). Rural-urban continuum codes. U.S. Department of Agriculture. Retrieved from <http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx#.UmAjG18o5dg>.
- Wiersema, B., Loftin, C., & McDowall, D. (2000). A comparison of supplementary homicide reports and national vital statistics system homicide estimates for US counties. *Homicide Studies, 4(4)*, 317-340.

About the Authors

Matthew D. Moore is an assistant professor at Grand View University. He received his Ph.D. from Iowa State University. His research interests are in the areas of cross-national criminology, social capital, and suicide. Recent publications have appeared in *Crime & Delinquency*, *Journal of Juvenile Justice*, and *Social Indicators Research*. Email: mmoore@grandview.edu

CariAnn Bergner is a staff psychologist at Iowa State University. She received her Ph.D. from Iowa State University. Her research interests are gender, crime, and social justice. Email: cbergner@iastate.edu