An Exploratory Analysis of Guns and Violent Crime in a Cross-National Sample of Cities

Irshad Altheimer
Wayne State University

Abstract

This study examines the relationship between gun availability and crime in a cross-national sample of cities. Data from the International Crime Victimization Survey are used to examine three competing hypotheses. The results of the limited information maximum least squares regression analyses suggest that gun availability influences rates of assault, gun assault, robbery, and gun robbery. These findings suggest that increasing city levels of gun availability in this cross-national sample of cities increases the likelihood that violent crimes are committed and that guns are involved in these crimes. Importantly, these findings do not suggest that increasing gun availability reduces crime.

Key Words: gun availability, assault, robbery, homicide, crime reduction

INTRODUCTION

The relationship between guns and violent crime is an intensely debated topic. Competing theoretical claims have emerged that view guns as a cause of violent crime, a mechanism to reduce violent crime, or totally unrelated to violent crime. Myriad criminological studies have been published over the years concerning this relationship, but no clear consensus has emerged. For example, some studies have found a significant relationship between gun availability and homicide (Cook & Ludwig, 2006; Hoskin, 2001; Kleck, 1979; McDowall, 1991) while others have not (Kleck, 1984; Kleck & Patterson, 1993; Magaddino & Medoff, 1984). Additionally, at least one controversial study has found that increasing gun availability will reduce crime (Lott, 2000), but this study has come under considerable scrutiny, and its results have been challenged (Ludwig, 1998; Maltz & Targoniski, 2002; Martin & Legault, 2005; Rubin & Dezhbakhsh, 2003; Zimring & Hawkins, 1997). As such, the debate about the relationship between guns and crime at the macro level rages on.

A body of cross-national research has emerged that attempts to inform the debate about the relationship between gun availability and violent crime. Most of this research has found a significant association between gun availability and violence (Hemenway & Miller, 2000; Hoskin, 2001; Killias, 1993; Killias, van Kesteren, & Rindlisbacher, 2001; Krug, Powell, & Dahlberg,

Altheimer—An Exploratory Analysis of Guns and Violent Crime in a Cross-National Sample of Cities. (2010) *Southwest Journal of Criminal Justice*, Vol. 6(3). pp. 204–227.

1998; Lester, 1991). Although findings from these studies have increased knowledge on this topic, our understanding of it is incomplete because many questions about the relationship between guns and violent crime at the cross-national level have gone unanswered. For instance, virtually all of the existing cross-national studies on this topic have examined homicide as the dependent variable. As such, little is known about how gun availability and violent crime operate in a cross-national context when crimes besides homicide are considered. Additionally, most studies have examined data from Western Developed nations and examined the nation state as the unit of analysis. This has limited what is known about the nature of the gun/crime relationship when levels of analysis besides the nation are explored and when data from nations besides Western Developed nations are examined. Further, only one existing cross-national study has accounted for potential simultaneity between gun availability and crime (Hoskin, 2001), thereby begging the question of whether significant associations between gun availability and crime indicate that gun availability affects crime or vice versa?

There are both theoretical and empirical justifications for addressing the questions raised above. First, theorists on both sides of the gun/crime debate have argued that gun availability can influence crimes other than homicide. For example, Lott (2000) has suggested that increasing gun availability can reduce overall levels of crime by enabling potential victims to deter or disrupt the actions of potential aggressors. Second, there is a small body of empirical research that has shown that gun availability is associated with crimes other than homicide. For instance, Cook (1979) found that gun availability was highly correlated with gun robbery in a sample of American cities. Third, there is evidence that some predictors of crime operate differently to influence crime at different levels of analysis (Land, McCall, & Cohen, 1990). All of the previous cross-national research on gun availability and violent crime has examined nation-level data. Thus, it is plausible that the significant association between gun availability and violent crime that has been found at the nation level does not hold at the city level. Finally, there is some evidence that the effects of some macro-predictors on crime vary across different types of societies. For example, Rosenfeld and Messner (1991) found that the effect of economic inequality on homicide is not generalizable across different types of societies. Economic inequality, one of the most powerful predictors of homicide in Western Developed nations, was not found to influence homicide in a sample of small, non-industrial societies. Existing research that has examined the relationship between gun availability and crime using cities as the level of analysis primarily has focused on the United States (Fischer, 1969; Kleck & Patterson, 1993; McDowall, 1991). It is plausible that the findings from these studies are not generalizable to different social settings.

Taken together, these points suggest that research that explores the association between guns and crime at a level of analysis that has not previously been explored, for types of crime that have not yet been examined, and using data that have not previously been considered is warranted. Towards that end, the objective of this paper is to explore the association between gun availability—as measured by household gun ownership levels—and assault, gun assault, robbery, and gun robbery in a cross-national sample of thirty-nine cities primarily located in nations in transition and developing nations. Using data from the International Crime Victimization Survey (ICVS), this study employs limited information maximum least squares regression analysis to test three competing hypotheses that account for the relationship between gun availability and rates of crime.

THEORY

No dominant theoretical perspective exists that explains the relationship between gun ownership and crime. The basis for such a perspective, however, has been proposed by Kleck and McElrath (1991) who suggest that weapons are a source of power used instrumentally to achieve goals by inducing compliance with the user's demands. The goals of a potential gun user are numerous and could include money, sexual gratification, respect, attention, or domination. Notably, most of these goals can be achieved by brandishing a gun but not necessarily discharging one. Unlike most criminological research, which assumes that the possession of weapons is inherently violence enhancing (i.e., Zimring, 1968; 1972), Kleck (1997) suggests that guns can confer power to both a potential aggressor and a potential victim seeking to resist aggression. When viewed in this manner, several hypotheses can be derived concerning the relationship between gun availability and crime. This first is that increasing gun availability increases total rates of crime and rates of gun crime. The second is that increasing gun availability reduces crime rates. A third hypothesis is that gun availability and crime are unrelated.

Hypothesis 1: Increasing Gun Availability Increases Crime.

Theoretical perspectives have emerged that suggest that gun availability increases both total crime rates and gun crime rates. The facilitation and triggering hypotheses focus primarily on the effects of gun availability on total crime rates, while the instrumentality hypothesis focuses primarily on the substitution of guns for other weapons during the commission of a crime and the implications that this has for gun crime rates.

The *facilitation* hypothesis suggests that increasing gun availability can increase total rates of assault and robbery when the availability of a gun provides encouragement to someone considering an attack or to someone who normally would not commit an attack. This encouragement is derived from the fact that the possession of a gun can enhance the power of a potential aggressor, thereby ensuring compliance from a victim, increasing the chances that the crime will be successfully completed, and reducing the likelihood that an actual physical attack (as opposed to a threat) will be necessary. This is particularly important in situations when the aggressor is smaller or weaker than the victim. In such cases, the aggressor's possession of a gun can neutralize the size and strength advantage of an opponent (Cook, 1982; Felson, 1996; Kleck, 1997). Guns can also facilitate crime by emboldening an aggressor who would normally avoid coming into close contact with a victim or using a knife or blunt object to stab or bludgeon someone to death. An additional way that guns can increase crime is by *triggering* aggression of a potential offender. This "weapons effect" is said to occur because angry people are likely to associate guns with aggressive behavior (Berkowitz & Lepage, 1967). Similarly, it has been suggested that the presence of a gun is likely to intensify negative emotions such as anger (Berkowitz, 1983).

When applied to the macro-level, the facilitation and triggering hypotheses suggest a positive association between gun availability and both the gun violence rates and total violence rates. Gun availability would be expected to have a positive association with gun assault and gun robbery because greater access to guns would lead more citizens of a respective city to believe that a crime can be successfully facilitated if a gun is used. Additionally, gun availability is expected to be positively associated with overall levels of assault and robbery because the availability of guns will trigger aggression among citizens of a respective city and encourage individuals who normally would not commit a crime to do so.

The weapon instrumentality hypothesis suggests that gun availability can increase the likelihood that gun crimes are committed. This occurs when increasing gun availability increases the likelihood that an aggressor substitutes a gun for another weapon or no weapon at all during the commission of a crime. The end result is the intensification of violence (Cook, 1991; Zimring & Hawkins, 1997). The basic premise of the weapon instrumentality perspective is that the use of a gun during the commission of an assault or robbery (1) increases the likelihood of death or serious injury; (2) provides aggressors with the opportunity to inflict injury at long distances; and (3) makes it easier to assault multiple victims than the use of other weapons that are commonly used to commit violent crime (i.e., knife or bat).

When applied to the macro-level, the weapon instrumentality hypothesis suggests that gun availability will be positively associated with gun violence. Increasing gun availability levels in a city will lead more city residents to substitute guns for other weapons during the commission of aggressive acts. In such situations, these crimes may be more likely to lead to death or violent injury. Notably, the weapon instrumentality hypothesis does not suggest that increasing gun availability increases total rates of assault and robbery. From this perspective, the substitution of a gun for another weapon does not necessarily increase the likelihood that an assault or robbery will be committed (although it may increase the likelihood that a homicide is committed), but it does increase the chances that the crimes that are committed involve guns.

Hypothesis 2: Increasing Gun Availability Reduces Crime

Another perspective on this issue suggests that the availability of guns actually can reduce levels of crime (Cook, 1991; Kleck, 1997; Lott, 2000; Lott & Mustard, 1997). From this perspective, increased levels of gun availability empower the general public to disrupt or deter criminal aggression (Cook, 1991; Kleck, 1997). Kleck (1997) suggests that gun availability can disrupt criminal aggression in two ways. First, an armed victim can prevent the completion of a crime by neutralizing the power of an armed aggressor or by shifting the balance of power in favor of the victim when confronted by an unarmed aggressor (Kleck, 1997; Kleck & Delone, 1993; Tark & Kleck, 2004). Second, an armed victim can use a weapon to resist offender aggression and avoid injury (Kleck, 1997).

Increased levels of gun availability may also reduce crime by deterring potential aggressors (Kleck, 1997; Wright & Rossi, 1986). Aggressors may refrain from committing crime due to fear of violent retaliation from victims. This deterrence can be both specific and general. For instance, a criminal may refrain from committing future attacks because they were confronted with an armed victim during a previous experience. Alternatively, an aggressor may refrain from committing a criminal act if they believe that a large proportion of the pool of potential victims is armed (Rengert & Wasilchick, 1985). When applied to the macro-level, this perspective suggests that gun availability should be negatively associated with both gun crime and crime. This is because in cities where residents have greater access to guns, potential victims will be better able to deter or disrupt the acts of criminal aggressors.

Hypothesis 3: Increasing Gun Availability does not Influence Crime

The third perspective discussed here suggests that gun availability has no overall effect on levels of crime (Kleck, 1997). The absence of an effect can be the result of two things. First, gun availability simply may not influence crime. From this perspective, the use of a gun simply may reflect an aggressor's greater motivation to seriously harm a victim (Wolfgang, 1958). If

true, lack of access to a gun will simply cause an aggressor to substitute another weapon to achieve a desired outcome. Second, an effect between gun availability and crime may not be detected because defensive gun use may offset the effects of guns being used for criminal aggression (Kleck, 1997). That is, any relationship might be cancelled out by offsetting or opposite effects. When applied to the macro-level, this perspective suggests that changes in the gun availability of a respective city will not influence or be associated with crime in that city.

PREVIOUS RESEARCH

A body of research has emerged regarding the relationship between gun availability and crime. Overall, the results of this research have been somewhat mixed (Kleck, 1997). Some studies have found support for the proposition that increasing gun availability increases crime, while others have not. Further, the manner in which guns influence crime seems to vary by the type of crime (e.g., violent crime, property crime, homicide, gun homicide).

Although scholars continue to disagree about the nature of the gun-crime relationship, there is at least some evidence that the use of guns intensifies violence; thereby suggesting a weapon instrumentality effect. For instance, several studies have found a significant positive relationship between levels of gun availability and rates of homicide (Brearley, 1932; Brill, 1977; Cook & Ludwig, 2006; Duggan, 2001; Fischer, 1969; Hoskin, 2001; Kleck, 1979; Lester, 1988; McDowall, 1991; Phillips, Votey, & Howell, 1976). To the extent that these homicides represented assaults and/or robberies where the initial intention of the aggressor was somewhat ambiguous, and an escalation in the conflict resulted in the killing of the victim, the presence of a gun during this altercation likely increased the probability of the victim's death.

The degree to which the findings from these studies reveal an instrumentality effect, however, has been challenged for several reasons. First, some of these studies failed to account for possible simultaneity between gun availability and homicide (Kleck, 1997), and the research that accounts for potential simultaneity effects has yielded mixed results. For example, four of these studies have found a significant relationship between gun availability and homicide (Cook & Ludwig, 2006; Hoskin, 2001; Kleck, 1979; McDowall, 1991) and three others have not (Kleck, 1984; Kleck & Patterson, 1993; Magaddino & Medoff, 1984). Additionally, some have argued that a statistically significant relationship between gun availability and homicide is not evidence of a weapon instrumentality effect, but instead a reflection of the greater motivation of people within certain macro-units to kill or seriously injure others (Wolfgang, 1958). Thus, some of the research examining the relationship between gun availability and homicide rates at the macro-level has suggested a weapon instrumentality effect, but these results have been challenged by alternative interpretations of the findings and conflicting results from other research.

Support for a weapon instrumentality effect also has been found in research that examines the relationship between offender possession of a weapon and the likelihood that a victim is killed during the commission of a crime (Cook, 1987; Kleck, 1991; Wells & Horney, 2002; Zimring, 1968; 1972). Zimring (1968), for example, compared the probability of homicide in assaults that involved guns to the probability of homicides in assaults that involved knives. This research indicated that "the rate of knife deaths per 100 reported knife attacks was less than 1/5 the rate of gun deaths per 100 reported gun attacks" (p. 728). Noting that 70% of all gun killings in Chicago involved single gunshot wounds to victims, Zimring (1968) interpreted

the results of this study to suggest that most homicides were ambiguously motivated assaults that resulted in a lethal outcome due to presence of a gun. Cook (1987) examined similar causal processes but focused on robberies rather than assaults. Cook found that murder robbery rates were more sensitive to variations in gun robbery rates than non-gun robbery rates. This led him to conclude that many homicides were an intrinsic by-product of robbery, where the initial intention of the aggressor was not to kill the victim, but the escalation of the conflict and the presence of a gun led to a lethal outcome.

More recently, research examining the relationship between gun possession and the outcome of a crime has been extended to also account for the probability of attack and injury. For example, Kleck and McElrath (1991) found that crimes committed with guns are less likely to result in attack or injury than crimes committed without a weapon or a weapon besides a gun, but more likely to result in death or serious injury if an attack occurred. The findings from Kleck and McElrath (1991) were substantiated by a recent study by Wells and Horney (2002), who also found that weapon instrumentality effects remained significant even after controlling for the intentions of the aggressor (see also Phillips & Maume, 2007).

Research examining weapon facilitation effects has not received much support in the research literature. A small number of experimental studies has found support for the proposition that the presence of guns elicits violent aggression (Berkowitz & Lepage, 1967; Leyens & Parke, 1975; Page & O'Neal, 1977). The results of these studies, however, have come under scrutiny. Several other studies have found no weapon's effect (Buss, Booker, & Buss, 1972; Ellis, Weinir, & Miller III, 1971; Page & Scheidt, 1971). Additionally, at least two other studies have found that the presence of a gun may inhibit, rather than facilitate, aggressive behavior (Fraczek & Macauley, 1971; Turner, Layton, & Simons, 1975). There is also some doubt about the generalizability of the findings from these experiments to real world settings. Some observers have suggested that the support for the weapon facilitation hypothesis seems to decline with increasing levels of realism in the experiment (Kleck & McElrath, 1991).

Additional evidence of lack of support for weapon facilitation effects can be found in macro-level studies that examine the relationship between gun availability and rates of violent crime. When applied to the macro-level, the weapon facilitation hypothesis suggests that macro-units with higher levels of gun availability will have higher overall rates of total violent crime (as opposed to gun crime). This proposition has not been supported in literature (Cook & Moore, 1999). Research has found that gun availability does not influence overall rates of violent crime (Kleck & Patterson, 1993).

At least two studies have found evidence to support the claim that increasing gun availability decreases crime (Lott, 2000; Lott & Mustard, 1997). These findings held under multiple model specifications, but increasingly have come under attack due to concerns about methodological weaknesses (Ludwig, 1998; Maltz & Targoniski, 2002; Martin & Legault, 2005; Rubin & Dezhbakhsh, 2003; Zimring & Hawkins, 1997). For example, two studies have taken issue with the use of state- and county-level UCR cross-sectional time series data in Lott's (2000) analysis (Maltz & Targoniski, 2002; Martin & Legault, 2005). Another study (Rubin & Dezhbakhsh, 2003) has argued that Lott's (2000) use of dummy variables to model the effects of concealed weapons permit laws was inappropriate and led to model misspecification. Finally, at least one study found that the manner in which gun availability influenced crime

was contingent upon whether gun possession was legal or illegal. Stolzenberg and D'Alessio (2000) found the illegal possession of firearms increased violent crime but legal possession of firearms had no such effect.

Cross-national research examining the relationship between gun availability and crime has been small in number but has found a significant association between gun availability and homicide (Hemenway & Miller, 2000; Hoskin, 2001; Killias, 1993; Killias et al., 2001; Krug et al., 1998; Lester, 1991). For example, Killias (1993) found a positive correlation between gun availability and national homicide rates. Of course, the primary limitation of the work of Killias and others who have used correlation coefficients to examine the relationship between gun availability and homicide is that these studies can say nothing about causal order. Therefore, a positive correlation between gun availability and homicide can be interpreted as evidence of gun availability influencing homicide, homicide influencing gun availability, or both. Hoskin (2001) accounted for potential simultaneity between gun availability and homicide by using two-stage least squares regression to examine this relationship in 36 nations. Hoskin (2001) found that gun availability influenced homicide rates at the cross-national level.

Taken together, the existing research on the relationship between guns and crime lends support to the weapon instrumentality hypothesis and to the proposition that increases in crime increase levels of gun availability. Much of this research, however, has been performed in the United States. Cross-national studies that have examined the relationship between gun availability and crime have been small in number, and the results of the studies have not been definitive. Two issues in particular have not been addressed in previous cross-national research. First, no previous cross-national study has examined whether gun availability influences crimes other than homicide. Second, the relationship between gun availability and crime victimization has not been explored when using data from cities in a cross-national sample. These issues will be addressed in this study.

METHOD

Data

Data for this study are drawn from the 1996 and 2000 waves of the International Crime Victimization Survey (ICVS).[1] This survey is administered by the United Nations Interregional Crime and Justice Institute. Originally designed to provide an alternative to official police counts of crime, the ICVS is currently the most far reaching source of comparable crime victimization data in different nations. For each wave, the ICVS provides nation-level data for developed nations and data for the largest city of nations in transition and developing nations.

This study uses only ICVS city-level data that is predominately from nations in transition and developing nations for three reasons. First, no study to date has examined the relationship between gun availability and crime in a cross-national sample of cities. Second, due to the differences in sample design, ICVS city-level data can not be used to estimate crime rates for the

1. To maximize the number of level 2 units, city level data from the 1996 and 2000 waves were pooled. The ICVS is different from more traditional longitudinal designs in that every new wave includes cities that had not previously participated in the survey. In the few cases where data were available for cities in both waves, data from the 2000 wave were taken.

nation in which each respective city belongs. As such, ICVS city-level data and ICVS nation-level data are not comparable, and analyses of ICVS data are limited to examining city- and nation-level data separately. Third, more observations are available using the city-level data from developing nations and nations in transition rather than the nation-level data from developed nations.

ICVS city-level data were collected using face-to-face interviews.[2] Interviews were translated to the local language by experts from the host country familiar with criminology, survey methodology, the local language, and English, Spanish, or French (original interviews were created in these three languages). Nations were asked to collect between 1,000 and 1,500 interviews. Most countries depended on an ad hoc (sometimes consisting of senior level students) group of interviewers for collection of data.

Sampling for the face-to-face interviews was generally hierarchical. It began with identifying administrative areas within the city, followed by a step-by-step procedure aimed at identifying areas, streets, blocks, and households. Thus, these data are expected to provide a reasonably representative city sample. A randomly chosen member of each household, above the age of 16, was interviewed and asked about his/her experiences with crime victimization. When deemed necessary, efforts were made to match interviewers and respondents in a manner deemed culturally appropriate for that specific locale.

Although they represent the best available, there are limitations to these data. For instance, despite the fact that efforts were made to standardize sampling and ensure generalizability, it is possible that certain subpopulations within each city were more likely to be interviewed than others, thereby calling into question the generalizability of the results from research using ICVS data. In fact, the United Nations Interregional Crime and Justice Institute only provides a vague description of the data collection techniques. This leads to questions about the veracity of the sampling methods. In addition, the fact that the interviews were face to face may have decreased the willingness of some respondents to admit that they owned a gun. This may be especially true in light of the fact that the United Nations Interregional Crime and Justice Institute has been a vocal advocate of international gun control. Under such circumstances, it is possible that the elite of each city were more likely to freely admit gun ownership than members of other groups. These issues may have biased the gun availability measure used here. Further, estimates of the reliability of this data are not yet available. This raises questions about the generalizability of these data. Despite these limitations, victimization surveys such as the ICVS provide the best chance for uniform and comparable crime data at the cross-national level (Bennett & Lynch, 1990). In all, the data used in this study consist of 45,913 individuals nested in 39 cities.[3] A list of the cities is provided in the Appendix.

2. Data for Ljubljana, Slovenia were collected using CATI.

3. Response rate information for data from developing nations collected in the 2000 wave are not available. According to the United Nations Interregional Crime and Justice Institute, systematic analysis of data collected in 1996 suggests that the response rates were very high. In 1996, the average response rate in African, Asian, and Latin American countries was 95%, while the average response rate in Central and Eastern European countries was 81.3%. It is not known if outside researchers have verified these response rates.

Measures

Endogenous variables.

Five endogenous variables were used in the analysis performed here: assault, gun assault, robbery, gun robbery, and gun availability. Assault was measured by asking respondents if they had been personally attacked or threatened by someone in a way that really frightened them, either at home (not including domestic violence) or elsewhere, such as in a pub, in the street, at school, on public transport, on the beach, or at their workplace during this year or the last year? Gun assault was measured by asking all respondents who had reported being the victim of an assault if a gun was present during the commission of the crime. Robbery was measured by asking the respondents if anyone had taken something from them, by using force, or threatening them, in this year or the last year? Gun robbery was measured by asking respondents who had reported being victims of a robbery if a gun was used during the commission of the crime. The four crime variables were operationalized by dividing the number of individuals in each city who reported being the victim of each of these crimes during this year or the previous year by the total number of respondents in the city and multiplying that number by 100,000. An analysis of the distribution of these variables reveals that each was skewed. As such, these variables were transformed. The natural log of assault and robbery and the base log of gun assault and gun robbery were used in this analysis.

Gun availability was operationalized as the percentage of respondents in each city who reported owning a firearm. This measure was created by aggregating the number of individuals in each city who reported owning a firearm and dividing this number by the total number of respondents for each city. An analysis of the distribution of this variable revealed that it was skewed. To control for this, the natural log of gun availability was used in the analyses performed here. The use of aggregated survey measures of gun ownership such as this one is common in research examining the relationship between firearms and crime. A recent study by Kleck (2004) found that aggregated survey measures of gun ownership provide a relatively reliable indicator of gun availability for macro-level aggregates. Despite this fact, this measure has some limitations. First, this measure only taps one of the three dimensions of gun availability. This measure does not assess gun law regulations or informal transfer of gun ownership. It is assumed here that a high level of gun ownership indicates high levels of overall gun availability in each respective city. Another limitation of this measure is that, for some cities, the number of gun owners was quite small. This could be due to some respondents being reluctant to report that they owned a gun. If this is so, it would underestimate any association between gun availability and crime. A third limitation is that this measure of gun availability may be biased if only the wealthiest residents of these cities were most likely to be interviewed. Fourth, this measure of gun availability does not distinguish between types of firearms. This is problematic because the type of gun counted in the gun availability measure may not be the type of gun commonly used in criminal activity. Thus, it is possible that measurement error is a problem with this indicator of gun availability.

Overall, gun ownership across the sample of cities was relatively modest. On average, 9.3% of respondents in each city reported owning a gun. There was, however, some interesting variability. For instance, only about 1.5% of residents in Seoul, Korea reported owning guns. On the other hand, 18.3% of residents in Johannesburg, South Africa, and 29.3% of residents of Asuncion, Paraguay, reported owning guns. Importantly, because we are unable to distinguish

between gun types, it is impossible to determine if the guns measured here represent guns commonly used in crime, or guns commonly used for other activities, such as hunting. Rates of all of the endogenous variables are reported in the Appendix.

Exogenous variables.

Exogenous variables were included in consideration of (a) the factors that influence crime at the macro-level, (b) the variables that can serve as instruments to gun availability, and (c) the challenges associated with performing analyses with small samples, most notably maximizing degrees of freedom and minimizing multicollinearity. In all, seven exogenous variables were included in this analysis. Five of these were posited to influence crime. These were unemployment, family disruption, age structure, sex ratio, and percent of residents who go out nightly.

Unemployment was operationalized as the percentage of respondents in each respective city who reported not having a job. *Age Structure* was operationalized as the percentage of the population of each city between the ages of 16 and 34. This measure was included as a control because previous research has found that nations with large cohorts of youth have higher levels of violent crime (Gartner, 1990; Pampel & Gartner, 1995). *Sex Ratio* represents the number of men per one hundred women in the population. This variable was operationalized by dividing the number of men surveyed in each city by the number of women surveyed and multiplying that number by 100. This measure was included as a control because previous research has found it to be associated with violent crime at the macro-level (Avakame, 1999; Messner & Sampson, 1991).

Family disruption represents the percentage of respondents in each city who where divorced. This variable was included in the analysis because previous research has found family disruption to be an important predictor of crime at the macro-level (Sampson & Groves, 1989). *Out nightly* represents the percentage of respondents in each city who reported that they go out almost every day. This measure was included because previous research suggests that crime victimization increases when the proportion of the population involved in activities outside of the home increases (Andresen, 2006; Cohen & Felson, 1979).

The two instruments posited to influence gun availability were concern about crime and percent of high income residents. These variables were included because previous research has found that both influence gun ownership levels (Cao et al., 1997; Kleck & Gertz, 1998; Lizotte & Bordua, 1980; McDowall & Loftin, 1983). *Concern about crime* was operationalized as the percentage of respondents in each city who believed that it was very likely that their houses would be broken into. *High income* was operationalized as the proportion of residents in each city who were in the top 25% income bracket for each respective city.

Analytic Technique

This study attempts to examine the relationship between firearm availability and crime in a cross-national sample of cities. OLS regression can not be used to test this relationship because non-recursive models violate the OLS assumption of no correlation between explanatory variables and disturbance terms. As such, using OLS to test such models would lead to biased and inconsistent estimators (Gujarati, 1978). This study used limited information maximum likelihood (LIML) regression to account for variable simultaneity. LIML is a form of two-stage least squares regression (2SLS) that takes into account the presence of weak instruments. There are

many different approaches to the derivation of 2SLS estimators, but all of these approaches are equivalent (Fox, 1979). In this paper, the standard approach outlined by Berry (1984; see also Gujurati, 1979; Hoskin, 2001) was used in the analysis.

LIML involves two successive applications of maximum likelihood regression analysis. In the first stage an instrumental variable is created to eliminate the likely correlation between firearm availability and the crime error term. This instrumental variable is created by regressing the gun availability variable on all exogenous variables in the model. That is, gun availability is regressed on the independent variables thought to influence crime and the instruments thought to influence gun availability. The value for the instrumental variable is the gun availability values predicted by the exogenous variable. The instrumental variable represents the most similar variable to gun availability that can be obtained by taking a linear combination of exogenous variables in the model. Additionally, this instrumental variable will be highly correlated with the actual gun availability values but not correlated asymptotically with the crime error term. Importantly, this instrumental variable is presumed not to be affected by crime. Stage two of LIML regression involves replacing the gun availability variable in the original equation with the predicted gun availability variable and regressing violent crime on predicted gun availability and the control variables. The estimators from this equation will be asymptotically consistent.

Regression Diagnostics

To ensure that the assumptions of the analysis were not violated, extensive diagnostics were performed. All models were examined for multicollinearity, heteroskedasticity, outliers, non-normally distributed errors, and non-linearity. Multicollinearity was viewed as problematic if VIFs exceeded four and levels of tolerance fell between .2 (see also Hamilton, 1992). Multicollinearity was not a problem in any of the models tested here. Outliers were encountered in the initial analyses performed, but the effects of these outliers were not large and decreased substantially after the gun ownership variable and the crime variables were transformed. Besides the issues mentioned above, the regression diagnostics did not detect any other problems in the models tested.

RESULTS

Results for the analyses performed in this study are reported in Tables 1 and 2 (next two pages). Table 1 reports descriptive statistics and bivariate correlations for the variables used in the analysis. These correlations suggest that gun availability is positively associated with all of the crime indicators, thereby lending support to the weapon facilitation and instrumentality hypotheses. In addition, the results from Table 1 indicate that the gun availability indicator has a significant positive association with residents' concern about crime. This suggests that residents of these cities may purchase guns when they believe that their homes are at-risk of being burglarized.

The bivariate correlations reported in Table 1 also find some notable relationships between crime and many of the exogenous variables. The age structure variable is significantly associated with three of the four crime variables. In addition, unemployment is associated with gun robbery. None of the other control variables are significantly associated with crime. Taken together, these correlation coefficients suggest that gun availability and crime are associated, but a more sophisticated analysis is needed to address issues of causality and model simultaneity.

Table 1. Correlations and Descriptive Statistics for Variables Used in this Study.

Variable	Mean	St. Dev	Correlation				
			Gun Availability	Assault	Gun Assault	Robbery	Gun Robbery
Gun Availability (log)	-2.71	.90	--				
Assault (log)	8.74	.64	.38*	--			
Gun Assault (log)	5.85	2.02	.48*	.37*	--		
Robbery (base log)	8.20	.91	.37*	.79**	.52**	--	
Gun Robbery (base log)	5.37	2.62	.39**	.46**	.50**	.54**	--
Unemployment	11.01	7.46	.15	.30	.30	.25	.34*
Sex Ratio	83.18	20.11	-.16	.23	-.18	.08	.22
Age Structure	45.16	14.03	.21	.67**	.09	.47**	.42**
Family Disruption	5.13	3.44	.14	-.08	.23	.06	.01
Out Nightly	12.39	5.27	.36*	.08	.12	.07	.41**
Concern About Crime	10.08	7.51	.53**	.49**	.43**	.41**	.39*
High Income	.28	.15	.31	.19	.18	.08	.24

*p < .05, ** p < .01

Table 2. LIML Regression of the Effects of Gun Availability on Violent Crime

Independent Variable	Stage One	Stage Two			
	Gun Availability	Assault	Gun Assault	Robbery	Gun Robbery
Gun Availability Instrument	--	.46**	1.97**	.21†	.66*
Unemployment	.00	.00	.03	.00	.02
Sex Ratio	-.01	.01**	.00	.00	.02†
Age Structure	.01	.03**	.00	.02**	.02
Family Disruption	.08†	.06*	.08	.04*	.06
Out Nightly	.03	-.04*	-.08	-.02	.02
Concern about Crime	.05**	--	--	--	--
High Income	2.05*	--	--	--	--
Constant	-4.47*	7.93**	11.50**	5.74**	1.01
r^2	.50	.55	.14	.37	.35
F statistic	4.36**	12.62**	15.52*	25.88**	26.99**

† $p < .10$, * $p < .05$, ** $p < .01$

Note: For the second stage results reported here the Wald Chi-Squared test was used rather that the F-test to evaluate model fit.

Table 2 reports stages one and two of the LIML regression analysis examining the relationship between gun availability and assault, gun assault, robbery, and gun robbery. As mentioned above, stage one of the analysis involves regressing gun availability on the exogenous predictors of crime. This is done to create an instrumental variable that is highly correlated with actual levels of gun availability but not correlated with the error terms of any of the crime indicators. Stage two of the analysis involves substituting the instrumental variable for the actual gun availability measure in an analysis of the effects of gun availability on crime. Because this study is interested in four separate crime variables, the results reported in stage two of Table 2 include models that examine the effects of the predicted gun availability variable on assault, gun assault, robbery, and gun robbery, respectively.

I begin the discussion with the effects of gun availability on assault. The results reveal that gun availability positively influences rates of assault in this sample of cities. This finding lends support to the facilitation hypothesis. In addition, sex ratio, age structure, and family disruption were found to positively affect levels of assault. One surprising finding is that individuals who report going out on a nightly basis are *less* likely to be victims of assault. This finding is opposite of what might be expected. One potential explanation is that the violence indicator used here taps into rates of domestic assault. If this is the case, it is plausible that some residents are safer outside of the home because leaving the home provides refuge from violent domestic disputes. Overall the model is robust, with 55% of the variation in assault being explained.

The results reported in Table 2 also reveal that gun availability influences gun assault. This finding lends support to the weapon instrumentality hypothesis. As levels of gun availability increase in this sample of cities, the rate of assaults involving guns also increases. This finding suggests that increasing the availability of guns increases the likelihood that a gun, as opposed to another weapon or no weapon at all, will be used in an assault. In all, 14% of the variation in gun assault is explained in this model.

I now turn to the effects of gun availability on robbery and gun robbery. The models examined are also reported in Table 2. The results reveal that gun availability influences both robbery and gun robbery. These findings also lend support to both the weapon instrumentality and facilitation hypotheses. Age structure and family disruption influenced robbery victimization while sex ratio was found to influence gun robbery. Both the robbery and gun robbery models are relatively robust. Thirty-seven percent of the variation in robbery, and 35% of the variation in gun robbery was explained by the models examined here.

DISCUSSION

This study was the first to examine the relationship between gun availability and crime in a cross-national sample of cities. Three competing hypotheses concerning this relationship were tested using LIML regression. The results lend some support to the weapon facilitation and instrumentality hypotheses. Gun availability significantly influenced the assault, gun assault, robbery, and gun robbery rates in these cities. Notably, no support was found for Lott's (2000; see also Lott & Mustard, 1997) hypothesis that increasing gun availability reduces rates of crime.

These results suggest that cities with high levels of gun availability will be characterized by more assaults and robberies. The fact that gun availability was found to influence total violent crime rates is surprising because it contradicts what has been found in previous research (Cook, 1991). Apparently, for the cities sampled here, increasing gun availability provides an incen-

tive for city residents to commit crime that they normally would not commit if guns were not available. Perhaps citizens in cities with high levels of gun availability feel emboldened by the power advantage afforded to them by the possession of a firearm.

The significant results between gun availability and gun assault and gun robbery lend support to the weapon instrumentality hypothesis. The availability of guns seems to increase the likelihood that city residents will substitute a gun for another weapon or use a gun rather than no weapon at all. Under such circumstances, assaults and robberies that occur in cities with high levels of gun availability may be more serious or deadlier than assaults or robberies carried out in cities with lower levels of gun availability. In addition, these gun assaults and gun robberies may be more likely to involve multiple victims. Although not directly tested here, these findings may also suggest that cities with higher levels of gun availability will be characterized by higher levels of homicide. This assertion seems plausible if one considers Zimring's (1968; 1972) argument that many violent altercations involve parties whose intentions are somewhat ambiguous, but where the introduction of a gun into the equation increases the likelihood that a violent dispute leads to death rather than injury (see also Phillips & Maume, 2007). When one considers the fact that gun availability was the most important predictor of both gun assault and gun robbery levels, it seems that Zimring's (1968; 1972) hypothesis is applicable here. Although this study did not control for the intentions of the individual aggressors, the city level controls such as unemployment account for the factors that motivate people to commit crime. The fact that most of these controls were insignificant, while gun availability was significant, suggests that for this sample of cities the primary factor that determines whether a gun is used in a violent crime is the availability of guns.

Perhaps the most important finding here is that all of the processes discussed above were occurring in a diverse cross-national sample of cities. This study analyzed data from 39 cities located in nations in Africa, Asia, Eastern Europe, and South America. It is likely that the culture of each city in the sample was somewhat distinct. That is, the cultures of the cities included in the sample were different from one another and differed with the culture of most cities in Western Developed nations. Despite the cultural variation among cities, the findings reported here are similar to those of similar studies that have examined the relationship between guns and crime in the United States and cross-nationally (Bordua, 1986; Bordua & Lizotte, 1979; Clotfelter, 1981; Hoskin, 2001; Killias et al., 2001; Kleck, 1979; Krug et al., 1998; Lester, 1974; McDonald, 1999; McDowall & Loftin, 1983; Southwick Jr., 1997). This suggests that the relationship between guns and crime operates in a similar fashion across space and time, even in dramatically different cultures. The findings would be further supported if future research examining the relationship between gun availability and homicide in a cross-national sample of cities generated results that mirrored those of studies examining this relationship in the United States.

The results from this study have numerous policy implications. First, these results suggest that the availability of guns has serious implications for levels of assault and gun assault in this sample of cities. These results suggest that serious discussions about the reduction of crime in these cities must consider methods to reduce levels of gun availability. Second, the results also show that, although guns are important, violence cannot be reduced unless other social problems, such as family disruption, are addressed. Therefore, policies should be developed to strengthen families or moderate the effect that family disruption has on violent crime.

Despite the contributions made in this study, it is not without limitations. First, this study did not test for the relationship between gun availability and homicide. This is due to the fact that homicide data were not available for the sample of cities examined here. As mentioned above, this limits the extent to which the results from this study can be used to inform if and how weapon instrumentality operates in cities in a cross-national sample. Second, only a small number of respondents in each city reported being victims of gun assaults and gun robberies. In fact, none of the respondents in Bucharest, Budapest, Ljubljana, Seoul, Ulaanbaatar, and Vilnius reported being victims of gun robbery. Although the sampling procedures used to collect ICVS data were designed to generate a representative sample of the residents of each respective city, it is possible that extremely rare gun crimes were undercounted. If this was this case, it is possible that some aspect of the relationship between gun availability and gun crime was underestimated. Third, the ICVS data were collected based on convenience sampling. There is no way to determine if the sample of cities examined here represents a random sample of all cities in the world. Therefore, the results here are not necessarily generalizable to other cities.

A fourth limitation of this study is that the gun ownership measure used here did not distinguish between different types of guns. In the United States most crimes are committed with handguns. Shotguns and other types of firearms, on the other hand, are rarely used in the commission of crimes. If we assume that similar dynamics hold in other nations, the failure to distinguish between gun type makes it possible to falsely conclude that weapon instrumentality effects are at work when other processes are actually causing levels of violence. This is especially true in nations such as South Africa, which have both high levels of violent crime and high levels of shotgun ownership among the middle class. A fifth limitation deals with the measurement of the exogenous variables used in this study. Due to the fact that questions have been raised about sampling procedures used in the ICVS, the exogenous measures used here may have been biased.

Despite the limitations mentioned above, the analyses performed here represent the first attempt to examine the relationship between gun availability and crime in a cross-national sample of cities. Although the research is exploratory in nature, it points to the continued need to examine the relationship between guns and violent crime at the cross-national level. If future research can find similar results, while controlling for the limitations mentioned above, the results reported here will be strengthened.

APPENDIX: GUN OWNERSHIP LEVELS AND CRIME RATES FOR CITIES IN THESE ANALYSES.

City	Nation	Percent Gun Owners	Assault Rate	Gun Assault Rate	Robbery Rate	Gun Robbery Rate
Tirana	Albania	14.29	5674.23	1735.65	5941.26	1134.85
Buenos Aires	Argentina	28.30	10500.00	5900.00	8800.00	5900.00
Baku	Azerbaijan	.86	2258.06	215.05	1827.96	107.53
Minsk	Belarus	5.53	2500.00	263.16	1513.16	263.16
La Paz	Bolivia	8.51	10010.01	300.30	9209.21	200.20
Gaborone	Botswana	4.01	13199.67	0.00	4344.19	501.25
Rio de Janeiro	Brazil	9.00	7700.00	200.00	13600.00	13000.00
Sofia	Bulgaria	6.98	3255.81	132.89	2126.25	132.89
Bogotá	Colombia	10.83	15157.48	3149.61	13779.53	3149.61
San Jose	Costa Rica	17.69	8701.85	1426.53	11126.96	998.57
Zagreb	Croatia	10.38	2284.60	783.29	1305.48	261.10
Prague	Czech Republic	9.33	6400.00	333.33	2000.00	466.67
Tbilisi	Georgia	6.90	3000.00	700.00	2700.00	200.00
Budapest	Hungary	4.82	4031.73	198.28	2379.38	0.00
Bombay	India	1.20	5905.91	300.30	2202.20	200.20
Jakarta	Indonesia	6.00	3500.00	0.00	1000.00	83.33
Seoul	Korea	1.57	2202.64	0.00	440.53	0.00
Bishkek	Kyrgyzstan	9.84	10107.10	200.80	2610.44	334.67
Riga	Latvia	3.59	5389.22	399.20	4491.02	499.00
Maseru	Lesotho	15.05	10693.07	2178.22	4554.46	396.04
Vilnius	Lithuania	6.09	6290.96	262.12	4783.75	0.00
Skopje	Macedonia	12.29	4714.29	285.71	1571.43	428.57
Ulaanbaatar	Mongolia	6.17	7597.34	94.97	4083.57	0.00
Windhoek	Namibia	22.15	11310.08	942.51	8765.32	1131.01
Lagos	Nigeria	1.58	10869.57	1482.21	8596.84	4051.38
Panama City	Panama	11.75	6541.02	1552.11	3436.81	1773.84
Asuncion	Paraguay	29.30	6132.88	1022.15	10221.47	340.72
Manila	Philippines	2.93	1333.33	266.67	466.67	66.67
Warsaw	Poland	2.36	6786.05	188.50	6126.30	282.75
Bucharest	Romania	1.79	5179.28	66.40	2257.64	0.00
Moscow	Russia	8.07	5400.00	800.00	3733.33	933.33
Bratislava	Slovak Republic	3.35	3619.91	181.00	1266.97	90.50
Ljubljana	Slovenia	5.24	4841.27	476.19	1746.03	0.00

(Table continued on next page)

City	Nation	Percent Gun Owners	Assault Rate	Gun Assault Rate	Robbery Rate	Gun Robbery Rate
Johannesburg	South Africa	18.34	14520.96	6137.72	10778.44	9655.69
Mbabane	Swaziland	10.83	16699.80	1590.46	9244.53	994.04
Kampala	Uganda	1.90	13927.86	1102.20	9819.64	1503.01
Kiev	Ukraine	5.90	4700.00	500.00	6600.00	300.00
Belgrade	Yugoslavia	28.61	9140.77	2468.01	1371.12	639.85
Lusaka	Zambia	8.98	18529.13	668.58	7736.39	668.58

Note: All crime rates represent the number of crimes that occurred per 100,000 population of each city.

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BIOGRAPHICAL SKETCH

Irshad Altheimer, Ph.D., is an assistant professor in the Department of Criminal Justice at Wayne State University. His current research examines the predictors of crime at the macro-level. His previous publications have appeared in the *Journal of Research in Crime and Delinquency*, the *Journal of Criminal Justice*, the *Western Criminology Review*, and the *International Journal of Comparative and Applied Criminal Justice*.