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Do Guns Matter? A Multi-level Cross-National Examination of Gun Availability on Assault and Robbery Victimization

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Abstract. *This study examines the relationship between city levels of gun availability and individual assault and robbery victimization. Existing theoretical approaches to guns and crime are integrated with opportunity theory to provide a richer understanding of the dynamic between guns and crime. Data for this analysis are drawn from a sample of 45,913 individuals nested in 39 cities in developing nations. Results of a multi-level, cross-national examination using hierarchical linear modeling indicate that city levels of gun availability influence individual odds of gun crime victimization, but not individual odds of overall crime victimization. This suggests that individuals who live in cities with high levels of gun availability have higher odds of being the victim of gun assault or gun robbery than individuals who live in cities with low levels of gun availability. The results, however, find little support for the proposition that city-level gun availability interacts with individual behavior to influence individual odds of assault or robbery victimization.*

Keywords: guns; violence; gun crime; opportunity theory, cross-national

Introduction

The relationship between gun availability and crime is an intensely debated topic. Competing perspectives have emerged that view guns as a cause of crime, a mechanism to reduce crime, or unrelated to crime. As a result, no consensus has materialized on this issue. The existing literature on this issue has yielded contradictory findings (Centerwall, 1991; Cook, 1987; Cook and Ludwig, 2006; Hemenway, 2004; Hoskin, 2001; Kleck, 1979; Kleck, 1984; Kleck and Patterson, 1993; Krug, K. E. Powell, and Dahlberg, 1998; Magaddino and Medoff, 1984; McDowall, 1986; McDowall, 1991; Miller, Azrael, and Hemenway 2002b; Sloan et al., 1988; Sorenson and Berk, 2001; Stolzenberg and D'Alessio, 2000). Further complicating this issue is the fact that the extent and nature of gun effects likely varies across types of crime. Research in this area has also been hampered by data limitations and methodological constraints. As a result, many questions concerning the relationship between gun availability and crime have gone unanswered.

This study aims to address three questions concerning the relationship between gun availability and two particular types of crime, assault and robbery, that have not yet been explored. First, to what extent does gun availability operate at the macro-level (specifically, in cities) to influence individual assault and robbery victimization? Existing macro-level studies have focused on the net effects of levels of gun availability on rates of crime (Hemenway, 2004; Hoskin, 2001; Kleck, 1979; Krug, Powell, and Dahlberg, 1998; McDowall, 1991; Miller, Azrael, and Hemenway, 2002a; Sloan et al., 1988; Sorenson and Berk, 2001). Significant results from these studies imply that individuals living in areas with high levels of gun availability will have a higher risk of violent gun crime victimization. This is because a larger number of residents are likely to be armed in cities with high levels of gun availability than in cities with lower levels of gun availability. Despite this assumption, the failure to explicitly examine the effects of gun availability on individual victimization raises the question of whether gun availability influences individual victimization after controlling for individual behavior. One reason for the dearth of gun research examining this issue is the fact that multi-level theoretical explanations of the relationship between gun availability and individual victimization have not yet been developed. It is proposed here that the foundation for such research has been laid by previous studies that have examined the contextual factors that influence individual victimization (Garafolo, 1987; Lee, 2000; Meithe and McDowall, 1993; Sampson and Wooldredge, 1987; Smith and Jarjoura, 1989). In an attempt to increase criminological understanding of how gun availability influences individual victimization, this study integrates existing theory on guns and crime with opportunity theory (Cohen and Felson, 1979; Hindelang, Gottfredson, and Garafolo, 1978)

Second, do city rates of gun availability interact with individual risk factors to influence individual assault and robbery victimization? Predatory crime occurs in a social

context in which victims and offenders must converge in space and time (Cohen and Felson, 1979; Hindelang, Gottfredson, and Garafolo, 1978; Meier and Meithe, 1993). In order to truly understand the nature of this process, cross-level interactions must be explored. If we assume city-level gun availability influences individual crime victimization, it is also plausible that these effects are more pronounced for individuals who exhibit certain attributes or behavior. Previous studies have explored the possibility that contextual factors interact with individual behavior to influence individual victimization (Cohen and Felson, 1979; Hindelang, Gottfredson, and Garafolo, 1978; Meier and Meithe, 1993; Meithe and McDowall, 1993). None of these studies, however, considered guns in the analysis.

Third, to what extent does city-level gun availability influence individual crime victimization in developing nations? The overwhelming majority of research on guns and crime has focused on the United States. The existing cross-national research on this issue primarily has been confined to Western developed nations (Hoskin, 2001; Killias, 1993a; Killias, 1993b; Krug, Powell, and Dahlberg, 1998). This has limited our ability to ascertain whether the findings from existing studies can be generalized to developing nations. As a result, we do not know whether gun availability predicts crime in nations with different social structures and cultures. Previous studies have found that the mechanisms through which certain predictors (i.e.,economic inequality) influence crime differ in developed and developing nations (Bennett, 1991; Rosenfeld and Messner, 1991). This suggests that explicit tests are warranted that examine the relationship between guns and crime in developing nations.

These questions are addressed using data from the 1996 and 2000 waves of the International Crime Victim Survey. Hierarchical linear modeling is used to assess the effects of gun availability on individual assault and robbery victimization in a sample of 45,913 individuals nested in the largest cities of 39 developing nations. The analyses performed here represent the first attempt to test the relationship between gun availability and crime victimization using multi-level data from a cross-national setting.

Theory

Guns and Crime

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; Zimring, 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. The first is that increasing gun availability increases total rates of crime. The second is that increasing gun availability increases gun crime. A third is that increasing gun availability reduces crime. The fourth and final hypothesis is that gun availability and crime rates are unrelated.

Increasing gun availability can increase crime in two ways. The first is *facilitation*, which occurs 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 and Lepage, 1967). Similarly, it has been suggested that the presence of a gun is likely to intensify negative emotions such as anger (Berkowitz, 1983). From this perspective, increased levels of gun availability will increase crime because individuals who feel inclined to commit a crime are likely to envision a gun as a requisite tool for successfully completing the task.

Increasing gun availability also can increase the like-

lihood that gun crimes are committed. This can intensify violence via the *weapon instrumentality effect* (Cook, 1991; Zimring and Hawkins, 1997b). The basic premise of this perspective is 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). Proponents of the weapon instrumentality effect don't necessarily suggest that the increasing gun availability increases total rates of assault and robbery. Rather, increasing gun availability increases the likelihood that guns will be used during the commission of a robbery or assault, which increases the likelihood that these crimes will result in serious injury or death. In the event that a robbery or assault escalates into physical violence, the presence of a gun gives the aggressor greater capability to inflict harm than a different weapon or no weapon at all.

A complementary perspective on this issue suggests that the availability of guns actually can reduce levels of crime (Cook, 1991; Kleck, 1997; Lott, 2000; Lott and 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 shifting the balance of power in favor of the victim when confronted by an unarmed aggressor (Kleck, 1997; Kleck and Delone, 1993; Tark and 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 and Rossi, 1986). Criminals 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, a criminal may refrain from committing a criminal act if they believe that a large proportion of the pool of potential victims is armed (Rengert and Wasilchick, 1985).

The fourth and final perspective 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 may simply 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.

The hypotheses mentioned above have two limitations. First, they fail to account for a potential multi-level relationship between gun availability as a macro-level phenomenon and individual assault and robbery victimization. Thus, little is known about whether macro-level rates of gun availability influence individual crime victimization after controlling for individual characteristics and behavior. It is plausible that any effects of macro-level gun availability on victimization might be spurious. Gun availability and victimization may be correlated because both result from demographic composition variables (i.e., the number of poor or male). On the other hand, it is also plausible that gun availability will exert an effect on individual crime victimization that is independent of individual risk factors.

The second limitation is that extant theory provides little to no guidance on whether individual characteristics and behaviors interact with gun availability to influence the probability of individual crime victimization. Existing theory on the relationship between guns and crime focuses primarily on the effect of gun availability or possession on gun offending. Researchers have not yet explored the possibility that the effects of gun availability on individual crime victimization are conditioned by individual risk factors such as age, gender, and education level. The failure to consider such possibilities has limited what is known about the role that gun levels play in influencing crime victimization. In the following section, existing theory on guns and crime is integrated with opportunity theory to provide a richer understanding of the dynamic between levels of gun availability and individual assault and robbery victimization.

Opportunity Theory

Several variants of opportunity theory exist that attempt to explain crime victimization. The variants of opportunity theory of particular interest for this study are routine activities theory (Cohen and Felson, 1979) and the lifestyle/exposure theory (Hindelang, Gottfredson, and Garafolo, 1978). Although each theory is distinct, they share a considerable amount of overlap and are discussed

here as fundamental components of a broader theoretical perspective (Garafolo, 1987).

The basic premise of opportunity theory is that in order for crime to occur potential victims and motivated offenders must converge in space and time. Thus, much of the research on opportunity theory examines how the routine daily activities of individuals influence the likelihood that they will be exposed to high risk situations and environments that place them in closer proximity to motivated offenders. Cohen and Felson (1979: 593) defined routine daily activities as "any recurrent and prevalent activities which provide for basic population and individual needs." Therefore, individuals whose recurrent and prevalent activities place them in closer proximity to motivated offenders are expected to have a high risk of victimization.

According to opportunity theory, lifestyles are shaped by "individuals' collective responses or adaptations to various role expectations and structural constraints (Meier and Meithe, 1993:466)." Role expectations and cultural restraints play a critical role in this process because they express shared societal expectations about appropriate behavior for individuals with certain attributes. Adherence to societal expectations leads to the establishment of routine daily activities for these individuals, thereby influencing their risk for victimization. For example, males would be expected to have a higher risk of individual victimization than females because societies place fewer constraints on the behavior of males, thereby increasing the likelihood that males would spend more of their time in the public domain and other high risk environments than females.

One conspicuous limitation of the early work on the routine activities and lifestyle/exposure theories is the failure to explicitly specify the manner that the social environment influences the context of individual victimization. In recent years a growing number of studies have attempted to address this issue (Garafolo, 1987; Lee, 2000; Meier and Meithe, 1993; Meithe and McDowall, 1993; Sampson and Wooldredge, 1987; Smith and Jarjoura, 1989). These studies have revealed the importance of the social context in determining individual risks of victimization, but have not considered the role that gun availability plays in this process. The following section integrates aspects of the research discussed above to lay the foundation for a theoretical explanation of the relationship between city-level gun availability and individual assault and robbery victimization.

Guns, Opportunity, and Victimization

There are three ways that city-level gun availability can be conceptualized to have a direct effect on individual risk of victimization. First, higher city-level gun availability can *facilitate* individual victimization. This would occur if increasing city-level gun availability motivated city residents who normally would not commit crime to become criminal aggressors. From the perspective of opportunity theory, this facilitation effect could increase the pool of potential offenders within each respective city, thereby increasing the likelihood that victims and offenders converge in space and time. The end result of this effect would be an increased individual risk of *total* robbery and *total* assault victimization among individuals within the city.

Second, higher city-level gun availability can increase the risk of individual gun victimization. This would occur if increasing city-level gun availability increased the likelihood that potential victims came into contact with *gun-toting* criminal aggressors. Based on the findings of previous research, this would lower the likelihood that the individual victim is injured during the commission of the crime, but increase the likelihood that the victim is killed; thereby representing an *instrumentality* effect. When discussed in the language of opportunity theory, increasing gun availability may not increase the likelihood that motivated offenders and potential victims converge in space and time, but it will increase the likelihood that the motivated offender is carrying a gun. The end result of this effect would not be an increase in individual risk of total assault and total robbery, but an increased risk of individual *gun* assault and *gun* robbery victimization.

Third, increasing city-level gun availability may decrease the risk of individual victimization. This would occur if increasing city-level gun availability deterred potential offenders from carrying out criminal aggression, or if increasing city-level gun availability allowed potential victims to repel or disrupt criminal aggression. From this perspective, awareness of the fact that potential victims may be carrying a gun may cause potential offenders to lose their motivation to offend. The result of this effect would be to lower individual risk of *total* assault and *total* robbery, and *gun* assault and *gun* robbery victimization.

City-level gun availability can also be conceptualized to interact with certain individual behaviors to influence the risk of individual assault and robbery victimization. This is because certain behavior may increase or (decrease) the risk of individual victimization, and exacerbate (or moderate) the direct effects mentioned above. For example, higher city-level gun availability can interact with gender to increase the individual risk of victimization if males are more likely to frequent places where criminal victimizations occur, and as a result, are

more likely to come into contact with individuals who are newly motivated to commit a crime because of greater access to a gun. Under this example the facilitation effects explained above would be exacerbated by the fact that the victim was a male. Additionally, city-level gun availability can interact with how frequently an individual spends the evening away from home if going out nightly increases the chances that the potential victim comes into contact with an aggressor who is armed as a result of higher city-level gun availability. In this example, the instrumentality effects described above would be exacerbated by the fact that the routine activities of the victim put them in closer proximity to motivated offenders. Lastly, city-level gun availability can lower rates of victimization if knowledge of the fact that potential victims may be carrying a firearm reduces offender motivation and potential victims further reduce that risk by not partaking in certain risky behaviors (such as going out nightly). The analysis performed here explores the possibility that gun availability interacts with several important individual risk factors (as spelled out by opportunity theories) to influence individual assault and robbery victimization.

Previous Research

A body of research has emerged regarding the relationship between gun availability and crime. The majority of research on this topic supports the proposition that increased levels of gun availability increase levels of gun crime and violent crime. However, concerns about the methodological quality of some of these studies, and the existence of research that finds null effects or a negative relationship has led some to characterize the findings from this research as mixed (Kleck, 1997).

Although scholars continue to disagree about the nature of the gun-crime relationship, there is at least strong evidence that the use of guns intensifies violence; thereby suggesting a weapon instrumentality effect. For instance, several macro-level studies have found a significant positive relationship between levels of gun availability and rates of homicide (Brearley, 1932; Brill, 1977; Centerwall, 1991; Cook and Ludwig, 2006; Duggan, 2001; Fischer, 1969; Hemenway and Miller, 2000; Hemenway, 2004; Hoskin, 2001; Kaplan and Geling, 1998; Killias, 1993ab; Killias, 1993ba; Kleck, 1979; Krug, Powell, and Dahlberg, 1998; Lester, 1988; McDowall, 1991; Miller, Azrael, and Hemenway, 2002b; Phillips, Votey, and Howell, 1976; Sloan et al., 1988; Sorenson and Berk, 2001). 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 three reasons. First, some of these studies failed to account for possible simultaneity between gun availability and homicide (Kleck, 1997).[1] Second, several other studies have found no such relationship between gun availability and homicide (Bordua, 1986; Kleck, 1984; Kleck and Patterson, 1993; Magaddino and Medoff, 1984). Additionally, some have argued 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).

Support for a weapon instrumentality effect also has been found in research examining 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 and Horney, 2002; Zimring, 1968; Zimring, 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. Zimring (1968:728) found 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." Noting that 70 percent of all gun killings in Chicago involved single gunshot wounds to victims, Zimring (1968) interpreted the results of this study to suggest that the most homicides were ambiguously motivated assaults that resulted in a lethal outcome due to the 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 (for a detailed review see Kleck, 1997). 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.

Support for instrumentality effects have also been found in case-control studies (Bailey, et al., 1997; Cummings and Koepsell, 1998; Dahlberg, Ikeda, and Kresnow, 2004; Kellerman et al., 1993; Wiebe, 2003a; Wiebe, 2003b). With a few notable exceptions (see Cummings and Koepsell, 1998), most of these studies found a strong association between having a gun in the home and the risk of homicide. For instance, Kellerman et al. (1993) found that keeping guns in the home was associated with a higher risk of homicide victimization. Additionally, Weibe (2003a) found that keeping a gun in the home increased the risk of unintentional gunshot fatality. It should be noted, however, that skepticism about these findings has emerged. Cummings and Koepsell (1998) point out that methodological limitations associated with case control studies make it difficult to draw definitive conclusions from the results.

Research examining weapon facilitation effects has received less attention and, overall, has not received much support in the research literature. A small number of experimental studies have found support for the proposition that the presence of guns elicits violent aggression (Berkowitz and Lepage, 1967; Leyens and Parke, 1975; Page and O'Neal, 1977). The results of these studies, however, have come under scrutiny. Several other studies have found no weapons effect (Buss, Booker, and Buss, 1972; Ellis, Weinir, and Miller III, 1971; Page and Scheidt, 1971). Additionally, at least two other studies have found that the presence of a gun may inhibit, rather than facilitate, aggressive behavior (Fraczek and Macauley, 1971; Turner, Layton, and Simons, 1975). There is also some doubt about whether the findings from these experiments will have the same outcome when applied 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 experiments (Kleck and 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 cross-national level, the weapon facilitation hypothesis would suggest that macro-units with higher levels of gun availability will have higher rates of violent crime (as opposed to gun crime or homicide). This proposition has not been supported in literature (Cook and Moore, 1999). Research has found that gun availability has not been found to influence overall rates of violent crime (Kleck and Patterson, 1993).

At least two studies have found evidence to support the claim that increasing gun availability decreases crime (Lott, 2000; Lott and Mustard, 1997). These findings held under multiple model specifications, but increasingly have come under attack due to concerns about methodological weaknesses (Duggan, 2001; Ludwig, 1998; Maltz and Targoniski, 2002; Martin and Legault, 2005; Rubin and Dezhbakhsh, 2003; Zimring and Hawkins, 1997a). 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 and Targoniski, 2002; Martin and Legault, 2005). Another study (Rubin and Dezhbakhsh, 2003) has argued that the Lott's (2000) use of dummy variables to model the effects of concealed weapons permit laws was inappropriate and led to the model misspecification. Finally, at least one study found that the manner in which gun availability influences crime was contingent upon whether gun possession is legal or illegal. Stolzenberg and D'Alessio (2000) found that the illegal possession of firearms increased violent crime but that legal possession of firearms had no such effect.

Cross-national research on guns and crime has been small in number and has yielded contradictory results (Hemenway and Miller, 2000; Hoskin, 2001; Killias, 1993a; Killias, 1993b; Killias, van Kesteren, and Rindlisbacher, 2001; Kleck, 1997; Krug, Powell, and Dahlberg, 1998). Most of this research has involved the analysis of correlation coefficients using data from a relatively small number of countries. Consequently, results from this research are extremely sensitive to the influence of outliers. As a result, the omission or inclusion of one or two nations can tremendously change the results. This has led some, such as Kleck (1997), to conclude that cross-national research provides no evidence of an association between gun availability and violent crime, while others contend otherwise (Hemenway and Miller, 2000; Hemenway, 2004). It appears that this issue will not be addressed until cross-national multivariate analyses examine the relationship between gun availability and crime. Hoskin (2001) found that gun availability significantly influenced homicide at the cross-national level, and that these effects held when controlling for potential simultaneity between gun availability and homicide. However, more research is needed on this issue before definitive conclusions can be drawn.[2]

Despite the gains made by previous macro-level research that examines the relationship between gun availability and crime, several important issues have not been adequately addressed. First, no study to date has

examined whether the level of gun availability within a macro-unit accounts for crime victimization among the *individuals* residing in those macro-units. Second, no study to date has tested the possibility that city levels of gun availability interact with individual risk factors to influence the risk of individual assault and robbery victimization. Third, the relationship between gun availability and crime victimization in developing nations has not been explored. Fourth, no cross-national study has examined whether gun availability influences crimes other than homicide. These issues are addressed in this study.

Methodology

Data

Data for this study are drawn from the 1996 and 2000 waves of the International Crime Victimization Survey (ICVS).[3] 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 and reliable source of comparable crime victimization data in different nations. For each wave, the ICVS provides nation-level data for developed nations and city-level data for the largest city of the developing nations included in the sample.

This study uses only ICVS city-level data from predominately developing nations for several reasons. First, due to the differences in sample design, ICVS data cannot be used to compare variation in crime victimization between developed and developing nations. Analyses of ICVS data are limited to examining developed and developing nations separately. As such, researchers must choose between examining the ICVS nation-level data—which focuses primarily on Western developed nations—or ICVS city level data—which focuses on cities in developing nations. Second, hierarchical linear modeling (HLM) requires a large to moderate number of level 2 (macro-level) observations to perform a multilevel analysis. More level 2 observations are available using the city-level data from developing nations rather than the nation-level data from developed nations. Third, the theoretical arguments made in this study pertaining to the relationship between guns and crime are more likely to operate at the city-level, rather than the national level. Fourth, no study to date has examined the relationship between gun availability and individual crime victimization in cities in developing nations.

ICVS city-level data were collected using face to face interviews.[4] 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 1000 and 1500 interviews. Most countries depended on an ad hoc group of interviewers (sometimes consisting of senior level students) 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 in to question the generalizability of the results from research using ICVS data.[5] 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, thereby underestimating the level of gun availability in these cities. In all, the data used in this study consist of 45,913 individuals nested in 39 cities in developing nations.[6] A list of the cities included in these data is provided in Appendix A.

Measures

Dependent Variables. Four dependent variables are analyzed: *gun assault*, *assault*, *gun robbery* and *robbery*. Examining the factors that influence individual risk of overall assault and robbery, as well as the individual risk of gun assault and gun robbery, allows for a more precise test of the propositions mentioned above. Respondents were asked if they had been a victim of these crimes in this year or in the previous year. Because violent victimization was a rare phenomenon, these dependent variables were dichotomized with one or more victimization being coded as 1 and no victimization being coded as 0. Descriptive statistics for these measures, and other variables used in this study are reported in Table 1. Appendix A reports the number of respondents that reported being a victim of these crimes in each city.

Independent Variable. *Gun availability* is opera-

Table 1. Descriptive Statistics

	Mean	Standard deviation	Minimum	Maximum
City-level variables				
Gun availability	9.33	7.56	.86	29.30
Economic inequality	9.50	6.79	2.60	32.10
Sex ratio	83.18	20.11	36.86	134.80
Age structure	45.16	14.03	24.12	76.45
Individual-level variables				
Male	.44	.50	.00	1.00
16 to 34	.44	.50	.00	1.00
Low income	.19	.39	.00	1.00
Single	.30	.46	.00	1.00
Neighborhood cohesion	.35	.48	.00	1.00
Out nightly	.13	.33	.00	1.00
College education	.42	.33	.00	1.00
Work/school	.57	.49	.00	1.00
Gun owner	.09	.50	.00	1.00
Gun robbery	.01	.49	.00	1.00
Robbery	.05	.28	.00	1.00
Gun assault	.01	.26	.00	1.00
Assault	.07	.10	.00	1.00

tionalized as the percentage of respondents in the city who reported owning a firearm. This measure was created by aggregating the number of individuals in each city that reported owning a firearm and dividing this number by the total number of respondents for each city. The use of aggregated 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 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 gun availability in each respective city. Another limitation of this measure is that, for some cities, the number of gun owners was quite small. 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 percent of respondents in each city reported owning a gun. There was, however, some interesting variability. For instance, only about 1.5 percent of residents in Seoul, Korea reported owning guns. On the other hand, 18.3 percent of residents in Johannesburg, South Africa and 29.3 percent of residents of Asuncion, Paraguay reported owning guns. Levels of gun ownership for each city are also reported in Appendix B.

Control Variables. Several standard control variables were included in this study. At the city level, *economic inequality* was operationalized as the ratio of income or consumption of the richest 20 percent to the poorest 20 percent for the nation in which the city was located. This variable was included because previous research has found economic inequality to be the most robust predictor of crime at the cross-national level (Braithwaite and Braithwaite, 1980; Krahn, Hartnagel, and Gartrell, 1986; Messner, 1980; Messner, 1989; Messner and Rosenfeld, 1997; Rosenfeld and Messner, 1991; Unnithan, et al., 1994). Data for this measure were taken from the *World Development Report 2000.* A nation-level indicator of economic inequality was used because reliable city measures of economic inequality were not available for the cities included in this study. It was assumed that the level of economic inequality at the national level served as a reasonable proxy of the actual level of economic inequality for cities within those respective nations.

Sex ratio and age structure were also included as controls because previous macro-level and cross-national research has found these variables to significantly influence crime (Avakame, 1999; Messner, 1989; Pampel and Gartner, 1995). *Sex ratio* was an indicator of the number of men per 100 women in the population. This measure was operationalized as the proportion of men surveyed in each city divided by the proportion of women surveyed in each city, multiplied by 100. *Age structure*

represents the proportion of people in each city between the ages of 16 and 34.

Individual-level control variables were included in this study in consideration of the individual-level risk factors that increase the likelihood of crime victimization (Hindelang, Gottfredson, and Garafolo, 1978). *Age* was included as a control variable because research has found that younger people are more likely to be the victims of violent crime. Individuals between the ages of 16 and 34 were coded 1 for the age variable and individuals ages 35 and above were coded 0. *Male* was included as a control because men have been found to be much more likely to be victims of violent crime than women. Males were coded 1 for this variable and females were coded 0. Research has found that individuals who are single are more likely to be the victims of crime because they spend less time under the guardianship of others (Hindelang, Gottfredson, and Garafolo, 1978). *Single* was operationalized so that individuals who were never married and not cohabiting were coded 1 and all other individuals were coded as 0. A control variable was also included for the respondent's income level. Individuals whose income was below the twenty-fifth percentile for the nation in which they lived were considered *low income* and were coded as 1. All other respondents were coded 0 for the low income measure.

Education level was also included as a control variable in this analysis. Individuals with at least some college education were coded 1 and individuals without any college education were coded 0 (Meithe, Stafford, and Long, 1987). *Out nightly* was an indicator of how often the respondent reported going out in the evening. Individuals who reported going out every night were coded as 1 and all other respondents were coded as a 0. *Neighborhood cohesion* measured the level of social support the individual received from the community in which they lived. Individuals who reported that the people in their community mostly help each other were coded as 1 and all other respondents were coded as 0. This item was included because Lee (2000) found that people who live in neighborhoods which they perceive to be cohesive have lower rates of violent victimization. *Work/school* was coded so that individuals who reported working or going to school (as opposed to being unemployed or staying home) were coded as 1 and all other respondents were coded as 0. *Gun Owner* was an indicator of whether or not the respondent owned a gun. Gun owners were coded as 1 and respondents who did not own a gun were coded as 0.

Analytic Technique

Hierarchical linear modeling (HLM) is used to perform the analyses in this study. HLM is ideal because it accounts for the non-independence of observations nested within cities (Hox 2002; Raudenbush and Bryk, 2002). This technique calculates coefficients as a function of the city context, thereby allowing the researcher to ascertain the manner that both city-level and individual-level factors influence individual crime victimization. In addition, HLM allows for the partitioning of variance among within-city and between-city components. Furthermore, HLM makes it possible to explore for cross-level interactions between city-level and individual-level processes. One limitation of HLM is that is that it can not test for simultaneity between independent and dependent variables.[7] As a general rule, research using nested or hierarchical data structures assumes that level 2 effects influence level 1 individual outcomes, but level 1 effects, when taken in isolation, do not account for variation in level 2 outcomes. This assumption, however, is not sufficient to rule out simultaneity between city levels of gun availability and individual victimization.

Initially, attempts were made to compensate for this limitation by performing a supplementary path analysis. Unfortunately, path analysis cannot test reciprocal relationships with a model that includes dichotomous dependent and independent variables because this causes the model to become internally inconsistent (Maddala, 1983). As such, this study is unable to test for a reciprocal effect between gun availability and crime victimization. Despite this limitation, this study is the first to examine the relationship between city-level gun availability and individual crime victimization. Further, the research performed here represents the best available option when considering the current methodological constraints. Greater explanation of the HLM models tested here are included in Appendix C.

Results

Table 2 reports the results for the HLM analysis with gun robbery included as the dependent variable. Column 1 of Table 2 presents the results from the unconditional model. This model is estimated without any level 1 or level 2 predictors and is useful for estimating the average log odds of gun robbery victimization across cities (γ_{00}) and assessing the magnitude of between city variation in gun robbery victimization (τ_{00}) (Raudenbush and Bryk, 2002). The average log-odds of gun robbery victimization across cities is -5.453. This translates to an odds ratio of .004; thereby suggesting that in a city with a typi-

Table 2. Multi-level Estimates for Gun Availability and Other Variables on Gun Robbery Victimization

	Model 1 (baseline model)		Model 2 (full model)	
	B	*Odds ratio*	*B*	*Odds ratio*
Intercept	-5.453 **	.004	-6.260 **	.002
City-level variables				
Gun availability	—	—	.054 *	1.055
Economic inequality	—	—	.128 **	1.137
Sex ratio	—	—	.019 *	1.020
Age structure	—	—	.005	1.005
Individual Level Variables				
Male	—	—	.841 **	2.319
16 to 34	—	—	.181	1.198
Low income	—	—	.152	1.165
Single	—	—	.242 *	1.274
Neighborhood cohesion	—	—	-.231 *	.794
Out nightly	—	—	.056	1.057
College education	—	—	.325 **	1.383
Work/school	—	—	.047	1.048
Gun owner	—	—	.211	1.235
Intraclass Correlation	.422			

* p < .05 ** p < .01

cal gun robbery rate the expected odds of individual gun robbery victimization is .004.

The variance in city average log odds of gun robbery is 2.403. Knowledge of the variance between cities in city average log odds of gun robbery also makes it possible to calculate the intra-class correlation. This statistic represents the proportion of the variance in the outcome that is between groups.[8] The intra-class correlation is .422. An intra-class correlation of this size is quite substantial for an HLM model. This suggests that 42 percent of the variation in the odds of individual gun-robbery victimization is explained by city-level factors. Importantly, this also suggests that the odds of gun robbery victimization vary across cities.

Column 2 of Table 2 reports the coefficients for the full model with gun robbery as the dependent variable.

Table 3. Odds Ratios for Models Examining the Cross-level Interactions that Influence Gun Robbery Victimization

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	.002 **	.002 **	.002 **	.002 **	.002 **
City-level variable					
Gun availability	1.094 **	1.104 **	1.096 **	1.085 *	1.100 **
Individual Level Variables					
Male	2.373 **	2.520 **	2.372 **	2.377 **	2.368 **
Single	1.411 **	1.410 **	1.440 **	1.415 **	1.415 **
Neighborhood cohesion	.799 *	.799 *	.799 *	.727 **	.801 *
College	1.405 **	1.400 **	1.406 **	1.396 **	1.454 **
Cross-level interactions					
Gun availability x male	—	.986	—	—	—
Gun availability x single	—	—	.995	—	—
Gun availability x neighborhood cohesion	—	—	—	1.028*	—
Gun availability x college	—	—	—	--	.990

* p < .05 ** p < .01

Gun availability significantly influences individual gun robbery victimization. Holding constant all other predictors in the model and the random effect, a unit increase in gun availability increases the odds of gun robbery victimization by 1.055 times or 5.5 percent. These results can also be interpreted in reference to changes in the odds of victimization with a standard deviation change in the independent variable. The standard deviation of gun availability is 7.6. Therefore, holding constant all other predictors in the model and the random effect, a 1 standard deviation increase in gun availability is associated with a relative odds change of 1.504 or a 50.4 percent increase in the odds of gun robbery victimization.

Several of the control variables included in this analysis are significantly associated with individual gun robbery victimization. At the city level, a unit increase in economic inequality increases the odds of individual gun robbery victimization by 13.7 percent. In addition, the sex ratio significantly influences individual gun robbery victimization. A unit increase in the number of males per 100 females increases an individual's odds of gun robbery victimization by 2.0 percent. At the individual level, the odds of being a victim of gun robbery are 131.9 percent higher for males than females, 27.4 percent higher for singles than non-singles, 38.3 percent higher for people who are college educated, and 20.6 percent lower for individuals who report living in a neighborhood with high levels of cohesion.

Table 3 reports the odds ratios for the models that explored the possibility that the gun availability interacts with individual risk factors to influence individual gun robbery. Initially, attempts were made to run these models with all of the variables from the full model reported in Table 2. However, problems associated with model-fit and multicollinearity were encountered. In an attempt to isolate the effects of a cross-level interaction on individual gun robbery victimization, a series of reduced models were examined. In each of the models gun availability was included as the level 2 indicator and the individual risk factors that significantly influenced gun robbery victimization in the full model reported in Table 2 were included as level 1 indicators. Model 1 of Table 3 reports the baseline reduced model without any interaction terms included. A cross-level interaction term between gun availability and one of the individual risk factors is examined in each of the following models. Gun availability significantly interacts with neighborhood cohesion to influence individual gun robbery victimization, but this finding is somewhat counterintuitive. This finding suggests that as gun availability increases, the risk of gun robbery victimization increases at a higher rate for individuals living in neighborhoods with high levels of cohesion than for individuals living in neighborhoods with lower levels of cohesion.

Table 4. Multi-level Estimates for Gun Availability and Other Variables on Robbery Victimization

	Model 1 (baseline model)		Model 2 (full model)	
	B	*Odds ratio*	*B*	*Odds ratio*
Intercept	-3.238 **	.039	-3.502 **	.030
City-level variables				
Gun availability	—	—	.018	1.011
Economic inequality	—	—	.057 *	1.058
Sex ratio	—	—	.000	1.000
Age structure	—	—	.011	1.011
Individual Level Variables				
Male	—	—	.195 **	1.215
16 to 34	—	—	.247 **	1.280
Low income	—	—	-.017	.983
Single	—	—	.248 **	1.281
Neighborhood cohesion	—	—	-.207 **	.813
Out nightly	—	—	.113	1.120
College education	—	—	-.048	.953
Work/school	—	—	.048	1.049
Gun owner	—	—	.138	1.148
Intraclass Correlation	.200			

* $p < .05$ ** $p < .01$

Table 5. Multi-level Estimates for Gun Availability and Other Variables on Gun Assault Victimization

	Model 1 (baseline model)		Model 2 (full model)	
	B	*Odds ratio*	*B*	*Odds ratio*
Intercept	-5.229 **	.005	-6.038 **	.002
City-level variables				
Gun availability	—	—	.083 **	1.086
Economic inequality	—	—	.048	1.049
Sex ratio	—	—	.000	1.000
Age structure	—	—	.013	1.013
Individual Level Variables				
Male	—	—	.874 **	2.397
16 to 34	—	—	.174	1.190
Low income	—	—	.470 **	1.599
Single	—	—	.130	1.139
Neighborhood cohesion	—	—	-.039	.962
Out nightly	—	—	.381 **	1.464
College education	—	—	.151	1.164
Work/school	—	—	-.104	.902
Gun owner	—	—	.398 **	1.489
Intraclass Correlation	.299			

* $p < .05$ ** $p < .01$

Table 4 reports the results for the HLM analysis with robbery included as the dependent variable. Column 1 of Table 4 tests the unconditional model. These findings suggest that for a city with a typical robbery victimization rate, the expected odds of an individual being a victim of robbery are .039. The intra-class correlation is .200. This suggests that 20 percent of the variance in the log odds of individual robbery victimization is explained by city-level processes.

Column 2 in Table 4 reports the results for the full model with robbery victimization as the independent variable. Gun availability does not significantly influence individual robbery victimization. Several of the control variables included in the model, however, are significantly associated with individual robbery victimization. At the city level, economic inequality exhibits significant effects on robbery victimization. For every 1 unit increase in economic inequality the odds of robbery victimization increase by 1.058 or by 5.8 percent. At the individual level, males have 21.5 percent higher odds of being victims of robbery than females, individuals between the ages of 16 to 34 have 28 percent higher odds of being victims of robbery than individuals 35 and older, and singles have 28.1 percent higher odds of being a robbery victim than someone who is married, widowed, or cohabiting. Additionally, the odds of individual robbery victimization are 18.7 percent lower for a person who reports living in a neighborhood with high levels of cohesion than someone who does not report living in such a neighborhood. In addition to the models reported in Table 4, additional models were run that examined the possibility that gun availability interacts with individual risk factors to influence overall robbery victimization. None of these models yielded statistically significant relationships.

Table 5 reports the HLM results with gun assault victimization as the dependent variable. Column 1 in Table 5 reports the results from the unconditional model. In a city with average gun assault victimization the expected odds of an individual being a victim of gun assault are .005. The intra-class correlation is .299, thereby suggesting that nearly 30 percent of the variance in individual gun assault victimization is accounted for by city-level processes.

Column 2 of Table 5 reports the full model with gun assault included as the dependent variable. These results show that the level of gun availability has a significant positive association with individual gun assault victimization. Holding constant all other predictors in the model and the random effect, a unit increase in gun availability increases the odds of individual gun assault victimization by 1.086 times. These results suggest that a 1 standard

Table 6. Odds Ratios for Models Examining the Cross-level Interactions

	Model 1	Model 2	Model 3	Model 4
Intercept	.003 **	.003 **	.003 **	.003 **
City-level variable				
Gun availability	1.107 **	1.115 **	1.103 **	1.116 **
Individual-level variables				
Male	2.381 **	2.534 **	2.378 **	2.369 **
Low income	1.530 **	1.533 **	1.416 *	1.517 **
Out nightly	1.553 **	1.551 **	1.561 **	1.988 **
Gun owner	1.491 **	1.493 **	1.492 **	1.497 **
Cross-level interactions				
Gun availability x male	.990	—	—	—
Gun availability x low income	—	1.019	—	—
Gun availability x out nightly	—	—	.958 **	—

* $p < .05$ ** $p < .01$

deviation increase in gun availability is associated with a relative odds change of 1.872 or an odds increase of 87.2 percent.

Several of the control variables included in this model are significantly associated with individual gun assault victimization. At the individual level, the odds of gun assault victimization are 139.7 percent higher for males than females, 59.9 percent higher for individuals who are low income, and 46.4 percent higher for individuals who report going out nightly. The results also suggest that individual gun ownership is positively associated with the odds of gun assault. These results, however, should be viewed cautiously because it is plausible that there is a reciprocal relationship between *individual* gun ownership and *individual* victimization that is not accounted for in this analysis.

Table 6 reports the odds ratios for the models that explore the possibility that gun availability interacts with individual risk factors to influence individual gun assault victimization. Model 4 in Table 6 shows that gun availability interacts with *out nightly* to influence gun assault victimization. As shown in Figure 1, it appears that going out nightly increases the risk of individual gun assault in cities with average and low levels of gun availability. On

Figure 1. Cross-level Interactions for the Effects of Gun Availability and Nightly Behavior on Odds of Gun Assault Victimizations

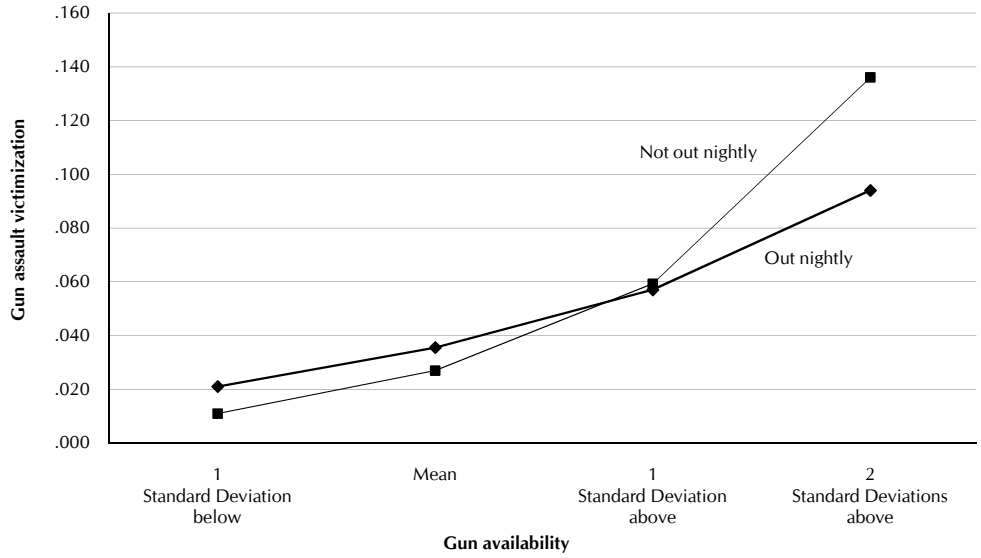

Table 7. Multi-level Estimates for Gun Availability and Other Variables on Assault Victimization

	Model 1 (baseline model)		Model 2 (full model)	
	B	*Odds ratio*	*B*	*Odds ratio*
Intercept	-2.686 **	.068	-3.134 **	.043
City-level variables				
Gun availability	—	—	.012	1.013
Economic inequality	—	—	.028 *	1.028
Sex ratio	—	—	.002	1.002
Age structure	—	—	.018 **	1.018
Individual Level Variables				
Male	—	—	.348 **	1.417
16 to 34	—	—	.350 **	1.419
Low income	—	—	.195 **	1.215
Single	—	—	.320 **	1.378
Neighborhood cohesion	—	—	-.184 **	.832
Out nightly	—	—	.336 **	1.399
College education	—	—	-.135 **	.874
Work/school	—	—	-.010	.990
Gun owner	—	—	.199 **	1.220
Intraclass Correlation	.117			

* $p < .05$ ** $p < .01$

the other hand, individuals in cities with high levels of gun availability have a lower risk of gun assault victimization if they go out nightly.

Table 7 reports the results of the HLM analysis with assault included as the dependent variable. The results from the unconditional model are reported in Column 1 of Table 7. In a city with an average rate of assault victimization the expected odds of victimization are .068. The intra-class correlation suggests that 11.7 percent of the variation in individual-level assault victimization is explained by city-level processes.

Column 2 of Table 7 reports the HLM results of the full model with assault included as the dependent variable. These results show that gun availability does not influence individual assault victimization. Several of the control variables included in this analysis, however, are significantly associated with individual assault victimization. One unit increase in economic inequality is associated with a 1.028 relative odds increase of assault victimization. This corresponds to a percentage increase of 2.8. In addition, the odds of individual victimization are higher in nations with a larger percentage of the population between the ages of 16 to 34. At the individual level, the odds of assault victimization are 41.7 percent higher for males than females, 41.9 percent higher for individuals between the ages of 16 to 34, 21.5 percent higher for individuals with low incomes, 37.8 percent higher for singles, and 39.9 percent higher for individuals who report going out nightly. Furthermore, the odds of assault victimization are 16.8 percent lower for individuals who report living in a neighborhood with high levels of cohesion and 12.6 percent lower for individuals with a college education.

In addition to the models reported in Table 7, several models were run that examined the possibility that gun availability interacts with individual risk factors to influence overall assault victimization. Only one of these interactions was found to be significant; gun availability interacts with neighborhood cohesion to influence individual assault victimization. This finding, however, is counterintuitive because it indicates that individuals in neighborhoods with high levels cohesions have a higher risk of gun assault victimization than individuals in neighborhoods with low levels of cohesion. The implications of these findings are discussed below.

Discussion and Conclusion

This study examined the relationship between city levels of gun availability and the individual odds of assault and robbery victimization. These results suggest that city gun availability does matter when it comes to

explaining individual odds of gun victimization, but not individual odds of total robbery and total assault victimization. These results are consistent with previous macro-level research that suggests that the greater availability of guns will make it more likely that guns will be used in assaults and robberies (see Cook and Moore, 1999). It appears that in cities with high levels of gun availability, a larger number of residents have access to guns which, in turn, increases the risk of gun crime victimization for individual city residents. These results lend support to a weapon instrumentality effect rather than a facilitation effect. From these results we can conclude that assaults perpetrated in cities with high levels of gun availability *may* be more likely to end in serious injury or death than assaults carried out in cities with lower levels of gun availability. Furthermore, we can also conclude that robberies carried out in cities with high levels of gun availability *may* be more deadly and involve more lucrative targets than robberies carried out in cities with lower levels of gun availability. Stated differently, if gun availability levels influence individual odds of gun crime victimization, and the use of a gun during the commission of a crime influences the target of a crime and its outcome, then it should be safe to conclude that gun availability levels indirectly effect the target of a crime and its outcome.[9] Importantly, these results do not lend support to Lott's (2000) controversial thesis that increasing gun availability reduces crime.

The results from this study also reveal the importance of considering social context when attempting to understand individual risk of gun victimization. Level 2 indicators explained more than 30 percent of the variation in individual victimization. Although there is no way to determine the extent to which this variation was accounted for by gun availability, based on the odds ratios reported in these models, it is fair to say that it was probably substantial. Thus, it is fair to conclude that city-level gun availability is an important determinant of individual gun crime victimization.

Another important finding from this study is that individual behaviors are important predictors of individual gun crime victimization. In all of the models tested here, individual risk factors played a more important role than city-level factors in influencing victimization. This suggests that, although social context is important, individual behavior may still be the most important predictor of crime victimization. More research is needed on this issue before definitive statements can be made about the predictive power of macro-level factors, relative to individual factors, in influencing gun crime. The use of more precise macro-level measures may or may not yield increased explanatory power. Rather than pitting macro- and micro-level predictors against one another, it may be best to see each as complementary pieces of a complex puzzle.

Little support was found for the proposition that city-level gun availability interacts with individual risk factors to influence individual assault and robbery victimization. Only three of the cross-level interactions examined were found to be significant, and two of those cross-level interactions represented counterintuitive relationships. More work is needed, however, before definitive conclusions are made about the nature of this relationship.

An additional finding that emerges from this analysis is that gun availability is linked to gun crime victimization in *developing* nations. These findings reveal that the manner in which guns influence crime is not necessarily unique to the United States or a certain subset of Western developed nations. Instead, it appears that gun availability influences crime in various structural and cultural settings. This lends support to the proposition that gun availability creates conditions that lead to higher levels of gun crime across nations.[10]

Although the conclusions drawn here do provide support that guns influence crime, it should be noted that—due to limitations of multi-level analysis—this study was unable to account for a reciprocal relationship between gun availability and gun crime. As such, the results reported here should be viewed cautiously. In essence, these results suggest that more work is needed that accounts for the relationship between city-level gun availability and individual crime victimization at the cross-national level. No definitive claim can be made about this relationship until possible simultaneity effects are tested in a non-recursive model. Despite the methodological challenges encountered in these analyses, these results have implications for future research and theory on guns and crime.

First, advances in criminological theory are needed to better explain how gun availability operates at the macro-level to influence individual outcomes. This paper represented an initial attempt to integrate existing theory on guns and crime with opportunity theory to provide a richer understanding of the dynamic between guns and crime. Further development is needed with regard to the exact theoretical mechanisms that influence this process. Such an integrated theoretical perspective should be able to account for the role of the social environment in influencing how guns are used while also acknowledging the role of individual agency in influencing victimization outcomes.

The research implications of these findings closely

mirror the theoretical implications. More work is needed that explores potential cross-level interactions between gun availability and the individual risk factors associated with crime victimization. In addition, future research should look to develop macro-level indicators that distinguish between the proportion of the population that uses guns for legal purposes and the proportion of the population that uses guns for illegal purposes. Stolzenberg and D'Alessio (2000) found that illegal gun availability influenced crime but legal gun availability did not. It would be interesting to assess how legal and illegal gun availability influence individual victimization outcomes. Furthermore, future research should also explore the macro-level factors that influence the outcome of gun crimes. For example, it is plausible that gun crimes are more likely to result in death or injury in social environments with high levels of economic inequality.

The results of this study have implications for gun control policy. These results suggest that policy aimed at reducing gun levels may reduce the number of crimes committed with guns.[11] These results also suggest that reducing levels of economic inequality can decrease the motivation to commit gun violence. Finally, the results here suggest that attempts to alter risky behavior potentially could have a substantial impact on the individual crime victimization.

Endnotes

1. This is a valid criticism, but it should be noted even the studies that have controlled for simultaneity between gun availability and homicide have been unable to establish a consensus on this issue. For example, four of these studies have found a significant relationship between gun availability and homicide (Cook and Ludwig, 2006; Hoskin, 2001; Kleck, 1979; McDowall, 1991) and three others have not (Kleck, 1984; Kleck and Patterson, 1993; Magaddino and Medoff, 1984).

2. As mentioned by one of the anonymous reviewers, Hoskin (2001) may not have a valid instrumental variable. See Hemenway (2004) for a critique of studies that use two stage least squares regression to model possible simultaneity between gun availability and crime.

3. 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.

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

5. Interestingly, 42 percent of respondents had some college education. Some may find this quite surprising when considering the sample. In reality, it is likely that less than 40 percent of the populations in these large cities received some college educations. What this may suggest is that college educated individuals had a higher probability of being surveyed than those who have not gone to college. This may reflect measurement error and may limit the generalizability of these results.

6. Response rate information for data from developing nations collected in the 2000 wave are not available. Systematic analysis of data collected in 1996, however, suggests that the response rates were very high. In 1996, the average response rates in African, Asian, and Latin American countries was 95 percent while the average response rates in Central and Eastern European countries was 81.3 percent.

7. According to Joop Hox (in a personal email) M-plus can test for simultaneity in multi-level analyses but this requires a large number of groups (100 or more) at the city level.

8. The intra-class correlation traditionally has not been used for HLM analyses using non-linear link functions because the level 1 variance for these functions is heteroscedastic. Snijders and Bosker (1999) provide a formula for calculating the intra-class correlation when using a logit link. This formula is $p = \tau_{00}/(\tau_{00} + \pi^2/3)$.

9. Despite these conclusions, caution must be taken not to overstate the implications of these findings as they relate to gun assault or gun robbery outcomes. The relationship between offender possession of a weapon and the outcome of a crime is highly complex and no such tests are performed here. As mentioned above, research has found that crimes committed with guns are less likely to result in an attack but more likely to result in death or serious injury if an attack occurs (Cook, 1987; Wells and Horney, 2002; Zimring, 1968). When the findings from previous research are considered in light of the analysis performed in this study, several questions emerge. First, what will be the overall impact of decreasing city-level gun availability rates on gun robbery and gun assault outcomes? Second, to what extent will reductions in gun assault injuries be offset by increases in injuries from non-gun weapon assaults? Third, to what extent will re-

ductions in gun robbery injuries be offset by increases in non-gun robbery related injuries? Fourth, what does the relationship between other weapon availability (gun, hammer, etc.) and non-gun robbery and non-gun assault look like? These questions illuminate the importance of using caution when assessing the implications of these findings.

10. However, the combined sample may mask distinctions among cities. This point should be viewed cautiously until future multi-level research examines relationships between gun availability and crime across cultural or geographic distinctions.

11. This implication, however, assumes that an aggressive gun control policy will effectively remove gun access from individuals who intend to use them in a criminal manner. Kleck (1997), however, has stated that an aggressive gun control policy is more likely to impact law abiding gun owners than gun-toting criminals.

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Appendix A. Number of Respondents Reporting Victimization by Type of Crime and City

Nation	Assault	Gun assault	Robbery	Gun robbery
Albania	85	26	89	17
Argentina	105	59	88	59
Azerbaijan	21	2	17	1
Belarus	38	4	23	4
Bolivia	100	3	92	2
Botswana	158	0	52	6
Brazil	77	2	136	130
Bulgaria	49	2	32	2
Colombia	154	32	140	32
Costa Rica	61	10	78	7
Croatia	35	12	20	4
Czech Republic	96	5	30	7
Georgia	30	7	27	2
Hungary	61	3	36	0
India	59	3	22	2
Indonesia	42	0	12	1
Korea	45	0	9	0
Kyrgyzstan	151	3	39	5
Latvia	54	4	45	5
Lesotho	108	22	46	4
Lithuania	96	4	73	0
Macedonia	33	2	11	3
Mongolia	80	1	43	0
Namibia	120	10	93	12
Nigeria	110	15	87	41
Panama	59	14	31	16
Paraguay	36	6	60	2
Philippines	20	4	7	1
Poland	72	2	65	3
Romania	78	1	34	0
Russia	81	12	56	14
Slovakia	40	2	14	1
Slovenia	61	6	22	0
South Africa	194	82	144	129
Swaziland	168	16	93	10
Uganda	139	11	98	15
Ukraine	47	5	66	3
Yugoslavia	100	27	15	7
Zambia	194	7	81	7

Appendix B. Cities Included in this Study, Number of Observations, Number of Gun Owners, and Percentage of Gun Owners

			Gun owners	
City	**Nation**	**Respondents**	Number	Percent
Tirana	Albania	1,498	214	14.29 %
Buenos Aires	Argentina	1,000	283	28.30
Baku	Azerbaijan	930	8	0.86
Minsk	Belarus	1,520	84	5.53
La Paz	Bolivia	999	85	8.51
Gaborone	Botswana	1,197	48	4.01 %
Rio de Janeiro	Brazil	1,000	90	9.00
Sofia	Bulgaria	1,505	105	6.98
Bogotá	Colombia	1,016	110	10.83
San Jose	Costa Rica	701	124	17.69
Zagreb	Croatia	1,532	159	10.38 %
Prague	Czech Republic	1,500	140	9.33
Tbilisi	Georgia	1,000	69	6.90
Budapest	Hungary	1,513	73	4.82
Bombay	India	999	12	1.20
Jakarta	Indonesia	1,200	72	6.00 %
Seoul	Korea	2,011	32	1.57
Bishkek	Kyrgyzstan	1,347	147	9.84
Riga	Latvia	1,002	36	3.59
Maseru	Lesotho	1,010	152	15.05
Vilnius	Lithuania	1,526	93	6.09 %
Skopje	Macedonia	700	86	12.29
Ulaanbaatar	Mongolia	1,053	65	6.17
Windhoek	Namibia	1,061	235	22.15
Lagos	Nigeria	1,012	16	1.58
Panama City	Panama	902	106	11.75 %
Asuncion	Paraguay	587	172	29.30
Manila	Philippines	1,500	44	2.93
Warsaw	Poland	1,061	25	2.36
Bucharest	Romania	1,506	27	1.79
Moscow	Russia	1,500	121	8.07 %
Bratislava	Slovak Republic	1,105	37	3.35
Ljubljana	Slovenia	1,260	66	5.24
Johannesburg	South Africa	1,336	245	18.34
Mbabane	Swaziland	1,006	109	10.83
Kampala	Uganda	998	19	1.90 %
Kiev	Ukraine	1,000	59	5.90
Belgrade	Yugoslavia	1,094	313	28.61
Lusaka	Zambia	1,047	94	8.98

Appendix C. Explanation of Hierarchical Linear Modeling (HLM)

HLM was used in the analyses performed in this study. Below is a more detailed explanation of the HLM models examined. The discussion begins with an explanation of how HLM handles dichotomous dependent variables.

To address the dichotomous nature of the dependent variables, HLM creates a logit link function whereby the predicted values of crime victimization are constrained to lie between 0 and 1 (Raudenbush and Bryk 2002). The link function follows a Bernoulli distribution and takes the following form:

$$\text{Prob}(\text{VICTIMIZATION}_{ij} = 1|\beta j) = \varphi_{ij}$$
$$\text{Log}\,[\varphi_{ij}/(1-\varphi_{ij})] = \eta_{ij}$$
$$\eta_{ij} = \beta_{0j}$$

where i indexes individuals and j indexes city level influences, φ is the probability of victimization per trial, and η represents the log of the odds of victimization. The transformed predicted value η is now related to the predictors of the model through the linear structural model.

At the individual-level, the full model tested in these analyses is:

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\text{Male}) + \beta_{2j}(\text{Age}) + \beta_{3j}(\text{Low Income}) + \beta_{4j}(\text{Single}) + \beta_{5j}(\text{Neighborhood Cohesion}) + \beta_{6j}(\text{Out Nightly}) + \beta_{7j}(\text{College Education}) + \beta_{8j}(\text{Work/School}) + \beta_{9j}(\text{Gun Owner}).$$

Note that the individual-level model has no error term because the link function estimates the error term as part of the specification of the error distribution. When the error distribution is binomial, the residual error is a function of the population proportion π_{ij}: $\sigma^2 = (\pi_{ij}/1-\pi_{ij})$ and, as a result, is not estimated separately (Hox 2002).

The city-level model for the intercept is specified as:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Gun Availability}_j) + \gamma_{02}(\text{Economic Inequality}_j) + \gamma_{03}(\text{Sex Ratio}_j) + \gamma_{04}(\text{Age Structure}_j) + \mu_0$$

where β_{0j} is the intercept term from the individual-level equation, and μ_0 is the city-level disturbance. This city-level model has the same form as the standard HLM level two model with a normal distribution.

Combining the individual-level and city-level models presents the following mixed model:

$$\eta_{ij} = \gamma_{00} + \gamma_{01}(\text{Gun Availability}_j) + \gamma_{02}(\text{Economic Inequality}_j) + \gamma_{03}(\text{Sex Ratio}_j) + \gamma_{04}(\text{Age Structure}_j) + \gamma_{10}(\text{Male}_{ij}) + \gamma_{20}(\text{Age}_{ij}) + \gamma_{30}(\text{Low Income}_{ij}) + \gamma_{40}(\text{Single}_{ij}) + \gamma_{50}(\text{Neighborhood Cohesion}_{ij}) + \gamma_{60}(\text{Out Nightly}_{ij}) + \gamma_{70}(\text{College Educated}_{ij}) + \gamma 80(\text{Work/School}_{ij}) + \gamma_{90}(\text{Gun Owner}_{ij}) + \mu_{0j}$$

For the sake of parsimony, the individual-level (level 1) effects are constrained to be fixed across cities. The city-level variables are centered on the grand mean before being entered into the equation and the individual level variables are left in their dummy variable metric.