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THE DRIVING FORCE BEHIND GUN CRIMES: A TIME SERIES ANALYSIS OF THE  
IMPACT OF GUN TYPE AND GUN DENSITY

by

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B.A. University of Central Florida, 2004

A thesis submitted in partial fulfillment of the requirements  
for the degree of Master of Arts  
in the Department of Sociology  
in the College of Sciences  
at the University of Central Florida  
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## **ABSTRACT**

Very few studies have explored the relationship between the availability of certain types of firearms and gun density on both gun aggravated assaults and gun homicides. Nonetheless, research by Koper (2001) discovered that the availability of more lethal types of firearms, not gun density, was directly related to an increase in gun homicide rates for Dallas. However, this study did not take into account certain social and economic variables that may strengthen or weaken the determined relationship. The current study uses data previously analyzed by Koper (2001) and includes social and economic variables that have been linked to lethal violence while using gun aggravated assaults and gun homicides as the dependent variables. The results will help ascertain to what extent the impact of firearm availability on gun crimes is contingent on contextual factors.

## **ACKNOWLEDGMENTS**

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## CHAPTER ONE: INTRODUCTION

The relationship between firearms and homicide remains a topic of significant interest among the general public and social scientists, particularly in the United States, where the high rate of gun homicides has been theoretically and empirically linked to gun availability (Blumstein, Rivara, & Rosenfeld, 2000; Hoskin, 2001; Messner & Rosenfeld, 2001; Zimring, 2004). According to Blumstein's (1995) analysis of data from the FBI's *Uniform Crime Reports* (UCR), there was a substantial increase in gun homicides for both juveniles (persons 18 years of age and younger) and young adults (persons 18 to 24 years of age) during the mid 1980's and early 1990's. This rise in juvenile and young adult gun homicides was coupled with a similar increase in the drug arrest rate. Thus, Blumstein hypothesized that the sudden spike in gun homicides was the result of a drug-gun connection; as illicit drug activity increased, so did the gun violence associated with it. Many researchers have supported the connection between firearms and the illicit drug trade (Riley, 1998; Wright & Sheley, 1995). Guns appear to be a common tool for drug dealers because they can not rely on legal protection; they must provide their own (Blumstein, 1995; Blumstein & Cork, 1996). If a drug-gun connection exists, gun availability could influence a criminal's potential arsenal, which, in turn, could have a considerable impact on whether or not a firearm is used in the commission of a crime or what type of firearm is used in the commission of a crime.

There is a long tradition of research on firearms and violence in the United States (Cook & Laub, 1998; Kleck, 1988; Zimring, 1972). Most of the research on the gun availability/gun homicide relationship has focused on aggregate levels (gun density) of gun accessibility as the dependent variable (Hoskins, 2001; Stolzenberg & D'Alessio, 2000). Few studies have



examined specific firearm characteristics, such as more powerful types of weaponry, that may increase the lethality of gun assaults. In an analysis of both gun type and gun density, Koper (2001) found that more powerful types of firearms increase the lethality of gun assaults, while gun density had no impact on gun homicides. The author's examination of specific gun characteristics led him to conclude that the increases in the availability of large caliber handguns, shotguns, and center-fire rifles were contributing factors to the elevation of gun homicides that occurred in Dallas, Texas, from 1980 to 1992. While Koper's (2001) study established a plausible linkage between more powerful types of firearms and the gun homicide rate, the study did not control for social and economic variables that have been linked to levels of murderous conduct. Particularly noteworthy is his failure to include a measure of illegal drug activity in his models.

In this study, I use the data for Dallas previously analyzed by Koper (2001) and build upon his research by reconstructing the original methodology but including additional variables that have been linked to violent criminality. The literature review lays the foundation for the thesis and provides an overview of scholarly literature pertaining to selected social and economic characteristics that have been shown to increase the rates of homicide, e.g., gun availability, gun type, the illicit drug trade, and unemployment. This study then examines the impact of gun density and the availability of certain types of firearms on both gun homicides and gun aggravated assaults, while controlling for illegal drug activity, unemployment rates, and population. While the main focus of this research is to assess the impact of gun type and gun density on gun homicides, the addition of gun aggravated assaults as a dependent variable will provide a more comprehensive understanding of how different firearm characteristics affect the lethality of gun assaults. The hypothesis is that the inclusion of social and economic variables

will attenuate the relationships of gun type and gun density with gun homicides that was previously reported by Koper (2001).

## CHAPTER TWO: LITERATURE REVIEW

### Firearm Availability and Lethality

In an analysis of 36 nations, Hoskin (2001) states that countries with ethnically heterogeneous populations, conservative welfare states, and mass amounts of privately- owned guns produce high rates of lethal violence. The author notes that these characteristics describe the United States, where the number of privately-owned firearms far surpasses that of other countries.<sup>1</sup> However, research on the availability of firearms and its influence on the homicide rate in the United States are inconsistent and afflicted with methodological weaknesses. Problems in the gun/homicide literature include poor validation, failure to identify a causal order between crimes and guns, and insufficient information about gun availability amidst criminals (Kleck, 2004).

Despite these inconsistencies, there seems to be two dominating hypotheses in the scholarly literature. Stolzenberg and D'Alessio (2000) refer to these opposing hypotheses as the objective dangerousness hypothesis, which suggests that crime increases with the availability of firearms, and the self-defense hypothesis, which suggests that the availability of firearms deters crime because criminals fear confrontation with an armed citizen.

Consistent with the objective dangerousness hypothesis, Blumstein and Cork (1996) suggest that the availability of firearms is linked to the increase in juvenile homicides that occurred in the mid 1980's and early 1990's. Other research also supports the connection between firearm availability and crime during this time period. Cook and Laub (1998) attribute

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<sup>1</sup> Although the United States is often cited as the country with the most privately owned firearms, there may be discrepancies between firearm categories. When compared to the United States, Kopel (1992) notes that Switzerland has higher rates of privately owned automatic firearms and greater accessibility to more serious types of weaponry such as anti-aircraft guns, yet exhibits lower gun crime rates.

the increase in violent crimes during the mid 1980's and early 1990's to an increase in gun availability within the black-market, which, in turn, led to the proliferation of the homicide rate. Specifically, the authors state that when gun violence increased as a result of the illicit drug trade, young males were more likely to carry firearms and resort to violence.

Conversely, these results which seem to support the objective dangerousness hypothesis may not be conclusive. Other research shows no relationship between overall gun density and the gun homicide rate (Koper, 2001). Stolzenberg and D'Alessio (2000) assert that inconsistent methodology has resulted in the inability to differentiate between the two opposing hypotheses. To test this hypothesis, the authors separated gun availability into two categories: (1) legal gun availability; and (2) illegal gun availability. Their results showed that legal gun availability had no significant impact on the homicide rate. In contrast, illegal gun availability had a significant impact on the violent crime rate, gun crime rate, and youth crime rate. While dismissing the self-defense hypothesis, the authors provide a more comprehensive understanding to this ongoing debate.

The research on the self-defense hypothesis and the proposed negative influence of firearm availability on criminality and homicide has been inconsistent. There is a lack of support for the argument that privately owned guns reduce criminality by invoking fear in criminals. Nevertheless, some research tentatively suggests that private gun ownership deters criminality (Kleck, 1988) and that criminals do fear confrontation with armed citizens (Wright & Rossi, 1986). However, the circumstances and localities in which crimes are manifested make deterrence via gun ownership unlikely, as the number of criminals shot by victims is not significant (Wright, Rossi, & Daly, 1983). Moreover, the self-defense hypothesis is hard to test empirically; it is difficult to ascertain how many crimes might have been deterred for fear of

victim resistance. In summary, research on gun availability and criminality has left the scholarly and law enforcement communities with ambiguous results. Perhaps a better understanding of gun availability and lethal violence can be explained by focusing on the availability of certain types of firearms, particularly firearms with greater mortality potential.

Very little research has been done to ascertain the effect of more lethal types of firearms on the homicide rate. However, studies have suggested that large caliber firearms may increase the lethality of gun assaults. DiMaio, Copeland, Besant-Matthews, Fletcher, and Jones (1982) examined the effects of velocity and caliber on human cadavers. The authors determined that larger bullets penetrate skin with greater ease, which may suggest an increase in mortality potential. Moreover, in an early analysis of Chicago firearm assaults, Zimring (1972) established a positive relationship between firearm caliber and lethality. Other research on large caliber firearms and mortality potential has reached similar conclusions (DiMaio, 1985; DiMaio et al., 1974). As a result the assumption could be made that while holding other variables constant, some firearms are more life threatening than others. Perhaps as more powerful types of firearms are used in the commission of a crime, the rates of gun homicides will increase.

In an analysis of gun type, Koper (2001) identifies several firearm characteristics that may contribute to an increase in gun homicides. In Dallas, Texas, from 1980 to 1992, there was an increase in more powerful types of firearms, which the author believes contributed to the inflation of gun homicides. Specifically, these types of firearms included large caliber handguns (larger than .32 caliber), shotguns, and center-fire rifles. Other research has shown similar results. In an analysis of juvenile homicides in Houston from 1989 to 1992, the use of high caliber handguns and automatic rifles showed a threefold increase (Brewer, Damphousse, & Adkinson, 1998). This increase in more powerful types of firearms may be the result of

criminals seeking high quality, reliable firearms, which may increase the lethality of gun assaults.

Research has established that criminals do prefer certain types of weaponry. In a survey of criminals, Wright and Rossi (1994) discovered that felons prefer large caliber handguns – defined as larger than .32 caliber. Other important characteristics are “accuracy, untraceability, and quality of construction” (p. 15). Also, it appears that the price of the gun is of little concern to felons; criminals will seek out weapons of choice. Therefore, overall gun availability may be of little concern when more powerful firearms are obtainable.

But whether the accrument of gun homicides in the 1980’s and early 1990’s is a result of overall gun availability or the availability of high lethality firearms, attention should also be directed towards social factors that led to the increase in this type of weaponry. Several researchers assert that the illicit drug trade, particularly the increase in the use of crack/cocaine, had a profound effect on the gun homicide rate (Blumstein, 1995; Blumstein & Cork, 1996; Cork, 1999).

### Illicit Drugs

The connection between involvement in the illicit drug trade and firearm carrying is solidified in multiple studies, as the former often precedes and initiates the latter (Reid, 2002; Wright & Sheley, 1995). People who buy and sell drugs can not rely on legal means for protection, therefore, guns become a necessary tool for the illicit drug trade (Blumstein, 1995; Blumstein & Cork, 1996). While, in some situations, guns may act as a deterrent for potentially violent confrontations (Kleck & McElrath, 1991), the use of guns for protection while engaging in the illicit drug trade may prove to be fatal. Research on this topic shows that people who

engage in drug deals are putting themselves at risk. Violence that occurs during drug deals often results in a lethal outcome (Weaver et al., 2004), as the majority of drug dealers carry firearms (Riley, 1998). But it is not just engaging in the illicit drug trade itself that is potentially dangerous; the use of drugs is likely to produce lethal outcomes as well.

Using data from six U.S. cities, Riley (1998) reports that, as more criminals tested positive for cocaine use, the homicide rate increased. In addition, an examination of toxicology reports in New York City from 1996 to 2000 reveals that the majority of adolescents who were killed had alcohol and/or illicit drugs in their body at the time of death (Amolat, Gill, & Lenz, 2003). Goldstein, Brownstein, and Ryan (1992) report similar findings. They state that the drug-homicide relationship is the result of both the psychopharmacological effects of drugs/alcohol on the perpetrator, victim, or both and the violent acts surrounding drug deals, particularly those involving crack cocaine. These findings support the popular assumption that the sudden increase in the dealings of crack cocaine (in the mid 1980's) led to an increase in gun toting males, that in turn, positively affected gun homicides (Blumstein, Rivara, & Rosenfeld, 2000). In contrast, other research reports no such connection between crack cocaine and homicide. In a comprehensive study of 142 U.S. cities from 1984 through 1992, Baumer, Lauritsen, Rosenfeld, and Wright (1998) assert that there is no crack-homicide relationship when controlling for age composition and race. Therefore, the connection between crack cocaine and the homicide rate has yet to be determined.

Despite the limited availability of research, there appears to be a three-way relationship between illicit drugs, gun use, and homicide. Research on the popular theory that crack cocaine is responsible for the increase in gun homicides during the 1980's and early 1990's has been ambiguous. However, regardless of the crack/cocaine homicide relationship, the literature

supports a connection between the illicit drug trade/use and homicide. If an increase in the illicit drug trade led to the increase in gun homicides, what initiated the increase in the illicit drug trade?

### Unemployment

During periods of increased unemployment, individuals with little education and minimal job skills are susceptible to criminal activity (Ralston, 1999). Unemployment has been linked to several types of crime, particularly homicide (Ousey, 1999; Messner, Raffalovich, & McMillan, 2001; Lester & Kryszynska, 2004), illicit drug use (Reid, Aitken, Beyer, & Crofts, 2001), and the illicit drug trade (Fagan & Chin, 1991). Nonetheless, the effects of unemployment on illicit drug involvement and homicide may not be a relationship of causality. It has been noted that with regards to homicide, the effects of unemployment are not definitive and appear to be indirect (Smith, Devine, & Sheley, 1992).

The idea of an indirect linkage between unemployment and homicide is addressed in multiple studies. In an analysis of male joblessness, Sampson (1987) articulates that while unemployment has no direct effect on the homicide rate, male joblessness increased family disruption which, in turn, positively affected juvenile homicides. This association between joblessness, family disruption, and homicide is noted by others as well (Almgren, Guest, Immerwahr, & Spittel, 1998). In addition to homicide, the effects of unemployment on a deteriorated familial environment may predict illicit drug involvement.

Research shows that unemployment has a profound effect on illicit drug involvement. Bellair and Roscigno (2000) established a relationship between adolescent drug use, violent behaviors at school, and parental unemployment at home. According to their analysis,



unemployment is indicative of a decrease in familial well-being which increases the likelihood of drug use and violence. Reid, Aitken, Beyer, and Crofts (2001) report similar findings. In a study of drug-related behaviors in ethnic minority communities, unemployment was one of several components that increased the likelihood of illicit drug trade involvement and use. For that reason, unemployment appears to precede both drug-related and violent behaviors.

In conclusion, there appear to be several components that impact the homicide rate. The increase in gun homicides in the mid 1980's and early 1990's led researchers to focus on the potential impact of heightened firearm availability. Although research on firearm availability has been inconclusive, Stolzenberg and D'Alessio (2000) provided some insight into this ongoing debate with their study of the effects of illegal and legal gun availability. Yet, very little has been done to ascertain the impact of certain types of firearms on the gun homicide rate. Another factor that seemed to have plagued the violent populous during this time period was an increase in the illicit drug trade, which many have theorized led to the proliferation of firearm use. And, while unemployment may not have a direct effect on homicide, its negative effects on family and community life seem to be correlated with illicit drug involvement and homicide.

### The Present Study

This study contributes to the research tradition examining the relationship between gun availability and gun homicides. Previous literature has established a correlation between more lethal types of firearms and gun homicides (Koper, 2001; Zimring, 1972); however, social and economic variables that may have affected the determined relationship were omitted from the analyses. In addition, the author is not aware of a study that analyzes the impact of gun type and gun density on multiple measures of gun crimes. A more comprehensive understanding of the

relationship between firearms and lethal violence will be assessed by using multiple violence measures – gun homicides and gun aggravated assaults. Lastly, the author’s hypothesis is that the inclusion of social and economic variables will attenuate the previously determined relationship that more lethal types of firearms contribute to the lethality of gun assaults (Koper, 2001; Zimring, 1972).

## CHAPTER THREE: DATA AND METHODOLOGY

### Data

To examine the effects of gun type, gun density, and social and economic variables on gun crimes, data were obtained from the Inter-University Consortium for Political and Social Research (ICPSR), the Bureau of Labor statistics (BLS), and the Texas Department of Public Safety (DPS). Data from the ICPSR were gun data from the Dallas Police Department (DPD) and various measures of lethal violence, which included gun homicides and gun aggravated assaults, from the FBI's Uniform Crime Reports (UCR)<sup>2</sup> and Supplemental Homicide Reports (SHR) from 1980 to 1992. The DPD confiscated approximately 58,000 guns from 1980-1992 and grouped them based on firearm type, caliber, and type of firing mechanism. "The data include guns seized in association with arrests or other incidents as well as guns which were found or voluntarily turned in by citizens" (Koper, 2001, p. 17). To assess the impact of social and economic variables, population data were obtained online (<http://www.economagic.com>), unemployment levels were gathered from the Bureau of Labor Statistics (BLS), and drug arrests were obtained through the Department of Public Safety (DPS) of the State of Texas from 1980-1992.

The Dallas gun data set had been previously reconfigured into a time series data base. The data set included both bimonthly and quarterly data. As Koper (2001) notes, the quarterly data base had lower rates of missing information. Therefore, this study will use the quarterly data set, and the social and economic variables will be transformed into quarterly data.

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<sup>2</sup> The homicide data excluded justifiable homicides and negligent manslaughters.

## Measures

### Dependent Variables

To examine the effects of gun availability on gun crimes, two dependent variables are used: gun homicides and gun aggravated assaults. The data for gun homicides and gun aggravated assaults are from the UCR and SHR and are specific to Dallas. As Koper (2001) notes, Dallas homicide levels are similar to those of many other metropolitan areas throughout the United States during the 1980's and early 1990's and experienced a rise in homicides that is largely accredited to an elevation in gun homicides.

### Independent Variables

Very few studies have examined the effects of gun type and gun density on gun crimes. Koper's (2001) previous analyses of the Dallas gun data set suggested that the increase in more powerful types of firearms positively impacted gun homicides in Dallas; however, his analyses had limitations. The gun categories created by Koper (2001) were not mutually exclusive<sup>3</sup> and many of the results were interpreted from bivariate regressions, which introduced omitted variable bias. In addition, the study did not include any social or economic variables that have previously been linked to crime. Thus, to control for these limitations, the gun variables created are mutually exclusive, and additional variables (that have been linked to crime) are included in the models for the present inquiry.

Koper (2001) hypothesized that the combination of both large caliber and semiautomatic firing capabilities may increase the lethality of gun assaults. Thus, to examine the impact of

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<sup>3</sup> For example, Koper (2001) examined the effects of large caliber firearms, large caliber firearms with semiautomatic firing capabilities, and firearms with semiautomatic firing capabilities regardless of caliber; these categories were created for all types of firearms and handguns only. Thus, one gun category was often a subset of another gun category, for example, the large caliber handguns were a subset of large caliber firearms (which included handguns, rifles, and shotguns).

caliber and firing mechanism the gun variables are<sup>4</sup>: low caliber handguns, low caliber semiautomatic handguns, large caliber handguns, large caliber semiautomatic handguns,<sup>5</sup> rifles, semiautomatic rifles, shotguns, and semiautomatic shotguns<sup>6</sup>. In addition, to assess the impact of overall gun availability, a variable was created for gun density.<sup>7</sup>

These variables differ from Koper's (2001) in several ways. Koper (2001) did not measure the effects of low caliber firearms or semiautomatic low caliber firearms on gun homicides. Therefore, it could not be ascertained whether the effects of firing mechanism on lethality is similar for low caliber and large caliber firearms. Koper (2001) also collapsed rifles, shotguns, and large caliber handguns into the same variable. Grouping rifles, shotguns, and large caliber handguns together does not allow for the researcher to determine, specifically, what type of firearms, if any, contribute to greater lethality.

As noted earlier, Koper (2001) theorized that the inclusion of social variables may change the bivariate relationship. Therefore, several variables are included that have been previously linked to crime. As detailed above, unemployment and illicit drug trade involvement have been linked to various types of crime. Unemployment levels are obtained from the BLS and measured as the percentage of the population, 16 years of age and older that is currently seeking employment.

Blumstein et al. (2000) suggested that the increase in juvenile homicides during the 1980's and early 1990's was a combination of an increase in illicit drug trade involvement and

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<sup>4</sup> For a comprehensive description of gun variables see table 1 in the appendix.

<sup>5</sup> To remain consistent with previous literature (Koper, 2001; Wright & Rossi, 1994), low caliber handguns included handguns that were .32 caliber and lower. In contrast, high caliber handguns included those firearms that had a caliber larger than .32. Moreover, the data set did not include categories for nonsemiautomatic weaponry.

However, the gun categories were *total* and *semiautomatic*. Therefore, by simply subtracting the *semiautomatics* from the *total*, we were able to create categories for nonsemiautomatic firearms based on type and caliber/gauge.

<sup>6</sup> Koper (2001) notes that shotguns and rifles are believed to be highly lethal based on velocity (rifles) and the type of ammunition (shotguns) used by these types of weaponry.

<sup>7</sup> Gun density was the total number of all handguns, shotguns, and rifles.

an increase in the use of firearms. To examine the effects of illicit drug trade activity, drug arrests are used as a proxy variable and are disaggregated into juvenile (17 years of age and younger) and adult arrests (18 years of age and older). However, arrest data has biases that have been previously identified and are worth noting. Steffensmeier and Allan (1988) articulate that arrest data bias “may stem from administrative practices, availability of jail facilities, or discrimination in the enforcement of criminal sanctions” (p. 57). Unfortunately, data restrictions inhibit a measure that is comprehensive and unbiased. Therefore, drug arrests are assumed to be an adequate measure of illicit drug activity in Dallas from 1980 to 1992, and previous research has used drug arrests as a measure for illicit drug activity (Blumstein, 1995; Blumstein et al., 2000).

#### Control Variable

Population change may be of consequence when using time series data to analyze crime (Rattner, 1990). Increases in population have been previously linked to homicide because it reduces physical distances between people and increases the likelihood of conflict (Chamlin & Cochran, 2006). Because this study analyzes trends in crime over a period of time, it is necessary to regulate fluctuations in the populace. To control for the effects of population, all variables are divided by the population for the given time period (except unemployment which is already per capita); thus, all independent variables and dependent variables are per capita<sup>8</sup> and measured per 100,000 population.

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<sup>8</sup> Monthly population rates for Dallas from 1980 to 1992 were unobtainable. However, it was possible to estimate quarterly data based on yearly population data and yearly percent increase.

## Time Series Analysis

The Dallas gun data set and additional variables used in this study are in time series. Time series data contains certain components that are problematic and must be identified and modeled correctly to insure a robust analysis. Time series regression models assume that the data are nonstochastic, has a zero mean, a constant variance, and are non-autoregressive (Ostrom, 1978). That is, time series data must be stationary; the mean, variance, and autocorrelation remain constant. And, because most time series data are not stationary, testing for stationarity must be done prior to the analysis of the data (Cromwell, Labys, & Terraza, 1994).

To identify stationarity for the dependent variables, the author inspected the autocorrelation (ACFs) and partial autocorrelation functions (PACFs) associated with the correlograms and identified an autoregressive (AR) process of one. The presence of a first order AR process suggests that the variance is not constant, which results in a t-ratio that is no longer valid (Ostrom, 1978). Furthermore, a Dickey-Fuller test was used to determine the presence of a unit root, or stochastic process. Results indicate that there is the presence of a unit root in the dependent variables, which violates the assumption that the data must be nonstochastic. Thus, the author can determine from the correlogram and Dickey-Fuller test that the dependent variables are not stationary and must be altered. A common transformation to achieve stationarity in time series data is to first difference the data (Cromwell, Labys, & Terraza, 1994). However, visual inspection of the graphed dependent variables indicates the presence of a trend (i.e., growth). If a trend is present it is a common practice to remove the trend from both the dependent and independent variables prior to first differencing (Ostrom, 1978).

To remove the trend from both the independent and dependent variables the author used a Hodrick-Prescott filter (Hodrick & Prescott, 1997). The Hodrick-Prescott (HP) filter is a smoothing method in long term trends and is a two sided linear filter:

$$\text{Min}_{\{g_t\}_{t=1}^T} \left\{ \sum_{t=1}^T c_t^2 + \lambda \sum_{t=1}^T [(g_t - g_{t-1}) - (g_{t-1} - g_{t-2})]^2 \right\}$$

Where  $y_t = g_t + c_t$  is the time series data, composed of a growth component ( $g$ ) and a cyclical component ( $c$ ). The  $c_t$  are deviations from the growth component,  $g$ , and in the Hodrick-Prescott (1997) paper, they assume that in the long run their average is near zero. Also,  $\lambda$  is a “positive parameter that penalizes variability in the growth component series” (p. 3). In the paper, it is recommended that the value of 1600 is used for  $\lambda$  for quarterly data. Therefore, the above equation allows for the determination of the growth components,  $g_t$ . By using the HP filter, the trend can be removed from the data. This is done through a process of applying the filter, and then first differencing. After this process, the data used in the analysis are expressed as a percentage deviation from the trend.

Once the trend was removed using an HP filter and the data was first differenced, a correlogram, Dickey-Fuller test, and visual inspection of the graphed dependent variables were used to identify stationarity. The results from the tests indicate the data had been properly transformed and stationarity was achieved. Now one can proceed to the Box-Jenkins identification approach.

The Box-Jenkins approach is based on identifying the orders of the autoregressive (AR) and moving average (MA) components of the time series. Based on this identification, one can properly model and forecast the variable from a pure reduced form time series perspective. The



author estimated an ARMA (p, q) with orders  $p= 1, 2, 3$ , and  $q=1, 2, 3$  and all possible combinations in between. The reason for the upper bound of 3 on the orders is that most sociological and economic variables can be well represented by a low order ARMA (Ostrom, 1978). To select between competing Box-Jenkins models, a Schwarz information criterion (SIC), Hannan-Quinn information criterion (HIC), and Akaike information criterion (AIC) are used (Cromwell, Labys, & Terraza, 1994). While it may not be necessary to use three criteria for the determination of the model order, using three criteria will provide a robust identification of the ARMA components (Cromwell, Labys, & Terraza, 1994). Results from the Schwarz criterion, Hannan-Quinn criterion, and Akaike criterion indicate that the dependent variable gun homicides is best modeled as MA(2) and the dependent variable gun aggravated assaults is best modeled as AR(2).

By identifying the second-order autoregressive components for gun aggravated assaults, it signals that two lagged components must be included in the regression. The moving average component which was identified in the gun homicide data is not usually a problem once other variables have been included in the model. Now that the time series components of the data have been identified and controlled for I proceed to the structural approach wherein I combine the components with the variables that were suggested by the literature to test the hypothesis. Controlling for the autoregressive and moving average components identified by the Box-Jenkins models, an Ordinary Least Squares regression will be used on the data to estimate the coefficients (Ostrom, 1978).

## CHAPTER FOUR: RESULTS

Tables 3 through 6 show the results of the OLS regressions and residual analyses necessary for the time series models. Of the four models, only the regressions (Tables 4 and 6) that use gun aggravated assaults as the dependent variable are significant ( $p < .01$ ). The regressions that use gun homicides as the endogenous variable are not significant and, thus, must be interpreted with caution.

The impacts of the availability of types of firearms, adult and juvenile drug arrests, and unemployment on gun homicides are presented in Table 3. The results show that there are discrepancies between gun categories; however, only low caliber handguns without semiautomatic firing capabilities are a significant predictor of gun homicides at  $p = .048$ . Interesting enough, low caliber handguns without semiautomatic firing capabilities produce a negative relationship as the regression coefficient is  $B = -.174$ . In addition, the availability of more powerful types of firearms do not contribute to an increase in gun homicides. These findings support the initial hypothesis that the inclusion of social and economic variables will attenuate the relationship found by Koper (2001). Not only did it weaken the relationship between more lethal types of firearms and gun homicides, this study is able to expose a possible connection between less lethal types of firearms and lethality. Moreover, the measures of the illegal drug trade and unemployment on gun homicides are not significant. Thus, it seems that the availability of more powerful types of firearms, the illicit drug trade, and unemployment do not adequately predict an elevation in the gun homicide rate. In contrast, an inverse relationship exists between low caliber handguns without semiautomatic firing capabilities and gun homicides.

Table 4 contains the results for the influence of gun types, the illicit drug trade, and unemployment on gun aggravated assaults. There are similarities between this model and the model presented in Table 3. In comparison, the availability of more powerful types of firearms is not a significant predictor of gun aggravated assaults. In contrast, in the present model, none of the regression coefficients associated with the gun variables are significant. Furthermore, adult drug arrests, juvenile drug arrests, and unemployment did not have a significant impact on gun aggravated assaults. The only regression coefficients that produce significance are the lag variables that were input in the model to control for the autoregressive process of two. The variable that controlled for a lag of one is highly significant at  $p=.007$  and the variable that controlled for a lag of two is significant at  $p=.034$ . The lag variables indicate that at a given time the current level of gun aggravated assaults is associated with the previous levels of gun aggravated assaults at two lags; what happened two quarters ago. For gun aggravated assaults, it looks as if violence breeds more violence.

The impact of gun density, the illicit drug trade, and unemployment on gun homicides and gun aggravated assaults are displayed in Tables 5 and 6. In Table 5, none of the predictor variables, gun density, proxy measures for the illicit drug trade, and unemployment, are significant. Yet, the impacts of gun density and the illicit drug trade on gun aggravated assaults are significant (see Table 6). The coefficient for gun density is positive and moderately significant ( $p=.072$ ). And, while adult drug arrests are not significant, juvenile drug arrests are moderately significant at  $p=.098$ . The regression coefficients associated with juvenile drug arrests indicate a negative relationship. This is a surprising result, given that drug arrests are a proxy measure for the amount of current illicit drug activity and an inverse relationship is not expected. Also, consistent with the other models in Tables 3 through 5, unemployment is not

significant. As with the model presented in Table 4, which also had gun aggravated assaults as the endogenous variable, both lag variables are significant: lag of one ( $p=.006$ ), and lag of two ( $p=.076$ ) indicating a trend that violence is preceded by violence.

There are some consistencies between the models that are worth noting. Unemployment, adult drug arrests, and firearms that are considered to be highly lethal are not significant in any of models. This leads to the conclusion that juveniles and adults engaged in the illicit drug trade and the availability of more powerful types of firearms were not a contributing factor to the increase in gun homicides that occurred in Dallas from 1980-1992. However, the increased availability of less lethal types of firearms, particularly low caliber handguns without semiautomatic firing capabilities, led to a decrease in gun homicides. An additional inverse relationship is also apparent between juvenile drug arrests and gun aggravated assaults, indicating that as juvenile illicit drug activity increased, the rates of gun aggravated assaults decreased. Moreover, gun density does not predict the levels of gun homicides but appears to have a moderately positive impact on gun aggravated assaults.

Lastly, when using a time series approach it is important to examine the residuals of the regressions to make certain that autocorrelation is not present and the results are substantial. To test for autocorrelation, analysis of the Durbin-Watson statistic and Ljung-Box Q statistic are used. The Durbin-Watson statistic is used to detect first-order processes. As displayed in all of the Tables, results indicate that first-order autocorrelation is not problematic; the Durbin-Watson statistic is within the appropriate region (Ostrom, 1978). To test for first-order and higher-order autocorrelation processes, the Ljung-Box Q statistic associated with the correleograms is used. The results indicate that no autocorrelation exists as the values are nonsignificant. The results from the Durbin-Watson statistic and Box-Ljung Q statistic indicate that the time series

components have been properly controlled for and autocorrelation is not problematic. Therefore, the results are interpretable.

## **CHAPTER FIVE: DISCUSSION AND CONCLUSION**

Koper's (2001) study of the impact of both gun type and gun density suggested that an increase in more powerful types of firearms, not gun density, contributed to an elevation in gun homicides in Dallas from 1980-1992. However, many of his results were interpreted from bivariate regressions and lacked explanatory power because he did not take into account additional social and economic variables that have been linked to criminality. To expand upon Koper's (2001) research, this study restructured firearm categories and included additional variables and controls that have been suggested to positively impact the rates of murder: drug arrests for juveniles and adults, unemployment, and population. Results with these variables reversed Koper's (2001) conclusion that more powerful types of firearms increase gun homicides, but substantiated the finding that gun density is not an adequate predictor of gun homicides. In contrast, when examining the impact of gun density on gun aggravated assaults there appears to be a positive relationship. The identification of the relationship between gun density and gun aggravated assaults leads to some interesting conclusions about gun availability.

The present analyses suggests that the availability of more powerful types of firearms does not impact gun homicides or gun aggravated assaults once additional factors have been accounted for. Unexpectedly, an increase in the availability of low caliber handguns without semiautomatic firing capabilities led to a decrease in gun homicides. The assumption could be made that most firearms have similar levels of lethality except for low caliber handguns without semiautomatic firing capabilities. Low caliber handguns without semiautomatic firing capabilities may be considered less lethal because of a combination of both smaller ammunition and an inability to fire multiple rounds in rapid succession; a finding that may influence the

number of wounds a victim receives. This conjecture takes into account not only the size of the bullet but also the firing mechanism. Then why would not there be a difference between firing mechanisms for larger more powerful types of firearms?

Larger caliber firearms may not need the ability to fire multiple rounds in rapid succession to have an effect on lethality. In comparison to less lethal types of firearms, the mere stopping power of a larger size projectile alone may increase the likelihood of death. Nevertheless, low caliber handguns, which lack stopping power when compared to their larger counterparts, may require an increased number of wounds to induce a deadly outcome. For that reason, it looks as if semiautomatic and nonsemiautomatic large caliber handguns, semiautomatic and nonsemiautomatic shotguns, semiautomatic and nonsemiautomatic rifles, and semiautomatic low caliber handguns have similar levels of lethality. The only category of firearms that have less of an effect to produce a deadly outcome are low caliber handguns without semiautomatic firing capabilities. In conclusion, the increase in the availability of less lethal types of firearms, which potentially controls what type of gun a criminal acquires, may decrease the occurrence of a gun assault resulting in death, thus reducing the rates of gun homicide.

Regarding the impact of gun density on gun crimes, it appears to have no effect on gun homicides but to moderately influence gun aggravated assaults. This indicates that while gun availability impacts the number of shootings, it does not contribute to mortality. Additional research on the lethality of gun assaults shows that there are a multitude of variables that influence a fatal outcome. Medical research shows that the path of the bullet, organs affected, proximity of the gun assault, and a person's control over their firearm contribute to the lethality of gun assaults (Beaman, Annest, Mercy, Kresnow, & Pollock, 2000). In addition, victim-

offender relationships (Felson & Messner, 1996), victim-offender characteristics, and circumstances involved in violent encounters all influence lethality (Weaver et al., 2004). Thus, the availability of firearms within a given area may not be a sufficient predictor of gun homicides, because there are other factors that must be considered when examining the lethality of gun assaults. As previously mentioned, whether or not a shooting results in death may be due to the uniqueness of the situation surrounding the event and the anatomical characteristics of the shooting itself.

According to the present analysis, unemployment is not a significant predictor of gun crimes. Additional research that has included both gun availability and unemployment in the statistical models has also reported a nonsignificant relationship between joblessness and varying measures of violent crime: including homicide (Kleck, 1979), and the violent crime rate, gun crime rate, and youth gun crime rate (Stolzenberg & D'Alessio, 2000). Despite levels of unemployment being nonsignificant, the relationship changed from negative when gun homicides is the dependent variable to positive when gun aggravated assaults is the dependent variable. The changing of the regression coefficients for unemployment is not unheard of when analyzing different types of crime. Other studies have shown that depending on what type of crime is under question, the relationship between unemployment and law-breaking behaviors change (Cantor & Land, 1985, Stolzenberg & D'Alessio, 2000). So, while in the present study the association between unemployment and gun crimes lacks explanatory power, this is not an uncommon occurrence when gun availability is included as a predictor in multivariate models.

Blumstein (1995) hypothesized that the increase in gun homicides and drug arrests for juveniles and adults established a connection between the illicit drug trade and lethal violence. The present study did not validate the drug-gun connection as the relationship between juvenile



drug arrests, adult drug arrests, and gun homicides is not significant. Interestingly enough, an increase in juvenile drug arrests led to a decrease in gun aggravated assaults when gun density is included in the model. The explanation of this phenomenon is unclear and, to the author's knowledge, is not verified in any other studies. Perhaps the nature of the drug arrest data somehow influenced the relationship between drug arrests and gun aggravated assaults. According to the Texas Department of Public Safety, even when multiple crimes are committed, the arrest is recorded as the most serious of the crimes. For example, if a juvenile is apprehended on a drug charge and a battery charge, the arrest would be recorded as the more serious of the two, and in this case battery.

The proposed weakness in the arrest data are joined with other weaknesses as well. Prior to 1990, the unemployment statistics are considered unofficial because of a change to the Current Population survey that included a restructuring of the population controls, a new regression based estimation procedure, and additional changes that may have affected the validity of the data<sup>9</sup>. Other weaknesses in the current study revolve the Dallas gun data set and statistical analyses. As Koper (2001) notes, the Dallas gun data set is unable to take into account the actual type of ammunition used. Gun caliber alone may not be a comprehensive measure of lethality given that certain types of ammunition, such as magnum rounds, may be potentially more lethal due to higher velocities. In addition, it is difficult to ascertain whether or not the guns acquired via citizens or by police officers would have or were ever involved in a crime. Lastly, although both this study and Koper's (2001) used a Box-Jenkins type analysis, there are two different approaches when modeling time series data: time series regression analysis and a Box-Jenkins

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<sup>9</sup> For a comprehensive explanation of the historical comparability of the unemployment statistics, visit the following websites: <http://www.bls.gov/lau/lausmsa.htm> and <http://www.bls.gov/lau/laumthd.htm>.

approach. Time series regression analysis is based on structural equation modeling whereas time series of the Box-Jenkins type is based on what fits the data; these two approaches have often led to opposing results (Ostrom, 1978). Thus, the present study and the Koper (2001) study are somewhat comparable because both studies used a Box-Jenkins approach to model time series; however, results may vary substantially if an alternate method is used.

Despite the weaknesses associated with data and methodology, the present study adds to the gun availability literature with a new understanding of how gun density and gun type impacts gun crimes. While the weaknesses within data sets are difficult for a researcher to control for, varying statistical analyses can be used to examine the phenomenon of how gun type and gun density influence gun crimes. For example, Ostrom (1978) comments on the strengths and weaknesses of both time series regression analysis and Box-Jenkins models. Future research should examine both approaches to modeling time series data, while replicating the measures of independent and dependent variables of previous studies, to ascertain whether or not inconsistent findings are statistical artifacts. As Kleck (2004) notes, the lack of consistency for measures of gun availability between studies has resulted in varying conclusions and ambiguous findings. With forthcoming studies, researchers should not focus so much on restructuring the measures of gun availability, but rather take varying statistical approaches, exhaust and examine the data set using multiple regression techniques, and observe and theorize about the findings.

## **APPENDIX: TABLES**

Table 1  
Description of Gun Variables

*Semiautomatic large caliber handguns* – includes all .357 caliber, .380 caliber, .38 caliber, .40 caliber, .41 caliber, .44 caliber, .45 caliber, 9 mm, and 10 mm handguns with semiautomatic firing capabilities divided by population per 100,000.

*Large caliber handguns* – includes all .357 caliber, .380 caliber, .38 caliber, .40 caliber, .41 caliber, .44 caliber, .45 caliber, 9 mm, and 10 mm handguns without semiautomatic firing capabilities divided by population per 100,000.

*Semiautomatic low caliber handguns* – includes all .22 caliber, .25 caliber, 6.35mm, 7.62 mm, 7.65mm, .30 caliber, and .32 caliber handguns with semiautomatic firing capabilities divided by population per 100,000.

*Low caliber handguns* - includes all .22 caliber, .25 caliber, 6.35mm, 7.62 mm, 7.65mm, .30 caliber, and .32 caliber handguns without semiautomatic firing capabilities divided by population per 100,000.

*Semiautomatic rifles* – all rifles with semiautomatic firing capabilities divided by population per 100,000.

*Rifle* – all rifles without semiautomatic firing capabilities divided by population per 100,000.

*Shotguns* – all shotguns without semiautomatic firing capabilities divided by population per 100,000.

*Semiautomatic shotgun* – all shotguns with semiautomatic firing capabilities divided by population per 100,000.

*Gun density* – all handguns, shotguns, and rifles divided by population per 100,000.

Table 2  
 Descriptive Statistics for Variables per 100,000 Population

N=52

	Minimum	Maximum	Mean	S. D.
Adult drug arrests	20.77	40.34	29.3481	5.05577
Juvenile drug arrests	8.92	35.64	17.7672	5.68636
Unemployment	.04	.09	.0630	.01218
Large caliber handguns	4.25	23.31	16.8517	4.08547
Large caliber semiautomatic handguns	2.58	149.99	50.8498	40.72200
Low caliber handguns	4.98	17.56	12.5329	2.65022
Low caliber semiautomatic handguns	2.25	23.73	11.6575	5.03781
Rifles	.36	3.39	2.1025	.66699
Semiautomatic rifles	.24	3.25	1.8698	.73404
Shotguns	1.09	11.41	6.6444	2.52802
Semiautomatic shotguns	.12	1.49	.7101	.34428
Gun density	14.20	99.99	61.7819	19.06423
Gun homicides	2.09	5.98	3.5211	.99845
Gun aggravated assaults	22.81	108.68	48.1099	21.00180

Table 3  
 Summary of Ordinary Least Squares Regression for Variables Predicting Gun Homicides

Variable	B	SE B	$\beta$
Semiautomatic large caliber handguns	.20	.068	.058
Large caliber handguns	.095	.095	.357
Semiautomatic low caliber handguns	.066	.086	.189
Low caliber handguns	-.174	.085	-.542**
Semiautomatic rifles	-.123	.286	-.078
Rifles	.142	.288	.113
Semiautomatic shotguns	.687	.523	.232
Shotguns	-.011	.161	-.020
Unemployment	-4.609	15.739	-.054
Adult drug arrests	-.049	.042	-.260
Juvenile drug arrests	-.024	.194	-.028
Adjusted R-squared	.039		
N	52		
Durbin-Watson	1.958		
Q statistics	NS		

Note. Cell entries are given as unstandardized regression coefficient, standard error, and standardized coefficient (beta).

\* $p < .10$  \*\* $p < .05$  \*\*\* $p < .01$

NS = Nonsignificant

Table 4  
 Summary of Ordinary Least Squares Regression for Variables Predicting Gun Aggravated Assaults

Variable	B	SE B	$\beta$
Semiautomatic large caliber handguns	.224	.743	.050
Large caliber handguns	.576	1.058	.166
Semiautomatic low caliber handguns	.970	.949	.215
Low caliber handguns	-1.408	.940	-.340
Semiautomatic rifles	2.187	3.131	.108
Rifles	-5.120	3.135	-.314
Semiautomatic shotguns	4.678	5.870	.122
Shotguns	2.030	1.816	.277
Unemployment	157.309	173.692	.143
Adult drug arrests	-.291	.467	-.119
Juvenile drug arrests	-1.137	2.272	-.100
Lag of one	.440	.154	.395***
Lag of two	-.361	.164	-.313**
Adjusted R-squared	.352		
N	50		
Durbin-Watson	1.640		
Q statistics	NS		

Note. Cell entries are given as unstandardized regression coefficient, standard error, and standardized coefficient (beta).

\*p < .10 \*\*p < .05 \*\*\*p < .01

NS = Nonsignificant

Table 5  
 Summary of Ordinary Least Squares Regression for Variables Predicting Gun Homicides

Variable	B	SE B	$\beta$
Gun density	.012	.011	.159
Unemployment	-5.432	13.210	-.064
Adult drug arrests	-.047	.035	-.249
Juvenile drug arrests	-.010	.165	-.011
Adjusted R-squared	.023		
N	52		
Durbin-Watson	1.750		
Q statistics	NS		

Note. Cell entries are given as unstandardized regression coefficient, standard error, and standardized coefficient (beta).

\*p <.10 \*\*p<.05 \*\*\*p<.01

NS = Nonsignificant



Table 6  
 Summary of Ordinary Least Squares Regression for Variables Predicting Gun Aggravated Assaults

Variable	B	SE B	$\beta$
Gun density	.233	.126	.230*
Unemployment	131.900	151.857	.120
Adult drug arrests	.091	.407	.037
Juvenile drug arrests	-3.431	2.029	-.301*
Lag of one	.431	.150	.387***
Lag of two	-.295	.163	-.256*
Adjusted R-squared	.296		
N	50		
Durbin-Watson	1.505		
Q statistics	NS		

Note. Cell entries are given as unstandardized regression coefficient, standard error, and standardized coefficient (beta).

\*p < .10 \*\*p < .05 \*\*\*p < .01

NS = Nonsignificant

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