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Determinants of Crime in Chicago

BY

Ross Olson

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THESIS ADVISOR _____

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HONORS COORDINATOR _____

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DEPARTMENT CHAIR _____

Determinants of Crime in Chicago

Ross Olson

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Abstract

This paper addresses occurrences of violent crime and their determinants in the city of Chicago using data collected at daily intervals for a period of two years. The economics of crime, in particular the price that crime imposes on society, is briefly explored along with a discussion of general policy techniques that aim to reduce the occurrence of violent crime. The empirical analysis addresses temperature, holidays (both official federal holidays and informal “party” holidays), weekends, unemployment rate, and seasonal trends. Relationships are examined between these variables and total crime, as well as with each component of violent crime: aggravated assault, sexual assault, robbery, and murder. It is hypothesized that through analyzing these independent variables and reacting accordingly by implementing change in policy, especially through increasing police presence, crime would likely be deterred to a greater extent.

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Introduction

Violent crime is an uncomfortable reality. Walls on the streets of Chicago plastered with the faces of those lost to violence and crime are a testament to this discomfort. A discussion of violence is one aspect of our society that would be more pleasant to hide away from rather than think about. However, one of life's challenges is to address problems and not to tuck them away to deal with later or worse, let someone else deal with them. This paper will not claim that crime can be "solved". This paper will explore data in an attempt to explain the basic determinants of when and why violent crimes occur within the city of Chicago. The costs of crime will be explored, first from a general economic vantage point before turning to the specific cost of crime in Chicago. Following these costs, policy solutions will be highlighted with an emphasis on increased police presence for use in deterring violent crime. Literature reviewed will help select variables that could show a relationship with violent crime. Ultimately, regressions utilizing daily data collected on violent crime and select variables such as temperature, unemployment, holidays, and weekends will result in evidence that can be used to implement targeted policies of crime deterrence. It is found that each of the selected independent variables has a significant relationship with either the total reported instances of daily violent crime, one type of violent crime¹, or both.

Chicago has been historically perceived as a crime hot spot. Part of this reputation is due to the public perception in regards to real and dramatized depictions of organized crime but also due to more recent news reports detailing gun violence and gang crimes in the Windy City. Yet contrary to public perception, crime in Chicago has seen steady decrease- violent crime is at a forty year low (Papachristos, 2013). Still, hundreds of Chicagoans lost their lives to violence in

¹ Aggravated assault, sexual assault, robbery, and murder

2013 and perhaps the most publicized of these deaths was fifteen-year-old Hadiya Pendleton who was shot and killed about a week after performing at the Presidential Inauguration (Corley, 2013). If anything, her death finally communicated very clearly to the city, to the state, and to the country that violent crime fails to discriminate. Violent crime is still happening in Chicago and it is unwise to expect complete disappearance. One method of understanding why crime happens is to look for patterns that might help explain behaviors and motivations behind the violence. So, rather than dust off our hands and claim that decreases will continue, it becomes imperative to study crime in an attempt to prevent it. While some may say that one violent crime or one death is too costly, we still must attempt to remain grounded and consider the costs of these crimes from an economic perspective. The following section addresses the general economic ideas behind crime.

Cost of Crime

All crimes impose a cost on society. The cost of violent crimes can be especially steep and in most cases are particularly challenging to estimate. Applying an economic lens to crime typically requires analyzing the social cost of crime. But what is this social cost? *Crime and Punishment: An Economic Approach*, a seminal economic study of crime by Gary Becker (1968) presents the underlying normative argument that “the social costs associated with crime are the sum of the direct costs of victimization (and the threat of victimization) and the indirect costs of efforts to control and prevent crime” (p.4).

Crime can be defined as a non-market good because it is not traded in a free market (Chalfin, 2013). Therefore, it is difficult to determine the price of crime. Whereas the selling price of a market good or service can be determined through the costs of production and consumer demand, crime lacks a tangible market in which to determine its price. Carnis (2004)

communicates the theory that the true price of a good is contingent on an agreement that is voluntary. “Consumers do not demand crime” and while purchasing a market good or service is voluntary, being victimized is not (Chalfin, 2013, p.2). Therefore, we must infer the cost by looking at alternative data that serves as proxy for estimating the cost (monies awarded via the Criminal Justice System, medical expenses, individuals avoiding high crime areas, etc.).

Fundamentally we encounter another problem in our estimation because the costs and gains of a purchase are contingent on how much an individual values money (Rothbard, 1993). Different people will attribute different prices to violence inflicted upon them.

Violent crime presents additional complications on estimating the cost of crime. Perhaps the most relevant example is provided through murder. How much value do we assign to human life? Again, we can only infer the price by considering the potential costs resulting from the lost life (familial suffering, lost productivity or wages, medical expenses, etc.). Other violent crimes may not result in the loss of life but still impose physical and mental anguish on victims that is extremely difficult to quantify. Estimating these costs is subject to individual normative perceptions of how close the selected “proxies” get to “a market based decision regarding individual’s demand for public safety” (Chalfin, 2013, p. 2).

The costs of crime are also determined by public spending on police forces, courts, and correctional supervision. Crimes require investigation which can lead to arrests and trial and incarceration. The burden for these expenses shift to the government and thus taxpayer money is spent on public resources addressing the crime at each step. Violent crime has extensive tangible costs through the criminal justice system yet calculations suggest that 75% of the total cost of violent crime can be attributed to pain, suffering, lost productivity and other such costs incurred by the community and neighborhoods in which crime occurs (Chalfin, 2013).

A study conducted in 2012 (Shapiro & Hassett) calculates the cost of violent crimes amongst several different cities. This study defines tangible costs as “medical, property, and work- or productivity-related costs borne by surviving victims and by victims of homicide; the costs of policing, courts, and correctional facilities for those who commit violent crimes; and the value of the work or productivity-related losses of those arrested for violent crimes”(p.31). Indirect or intangible costs are calculated from jury award data in an attempt to put a market value on pain and suffering. This approach to calculating indirect costs is supported by the theory that a jury imposes society’s normative values to compensate a victim that has been injured (Roman, 2009). The study concedes that while the estimates are the most reliable currently available, the tangible and intangible costs (and therefore the total cost) are most likely higher due to “substantial underreporting of most types of violent crime” (Shapiro & Hassett, 2012). For the purpose of this paper, we will first examine the calculations on the costs imposed on Chicago as a result of violent crime.

Shapiro & Hassett (2012) reported that Chicago faces more than \$1.1 billion per year in tangible costs of violent crime and over \$4.2 billion per year in intangible costs of violent crime. This amounts to \$1874 per resident per year in the city of Chicago. What are the benefits to reducing crime in Chicago? A reduction of violent crime by 10% allows for a conservative estimate² of \$110 million dollars in direct savings or \$531 million dollars in benefits for the city of Chicago. Furthermore, it is calculated that forgone tax revenue³ on income of victims and perpetrators due to violent crime in Chicago amount to \$18 million (Shapiro & Hassett, 2012).

² Benefits of lower violent-crime rates are conservative because they do not include a range of secondary benefits associated with reduced crime (increased tourism, higher property value, general improvement to economic and business environment, etc.)

³ 3.3% tax of household income

Combining this forgone revenue with other direct costs incurred by the city government, a 10% reduction in crime will allow for a \$24 million savings in the Chicago municipal budget.

The cost of crime is significant and important yet calculating the costs incurred by the victims and society due to violent crimes can be difficult, sometimes existentially so. The easiest component of these costs to calculate are tangible yet determining the cost of pain and suffering is not as straight-forward. These problems exist purely because crime is a non-market good. Normative methods of estimation provide the best calculations for the total cost that crime imposes. Estimations amount to substantial costs imposed on not only the victims of violent crimes but also the taxpayers who shoulder the burden of direct, tangible costs associated with crime. Evidence suggests that a reduction in crime can amount to substantial savings and when considering all of the additional benefits that reduction in crime entails it becomes increasingly attractive to adjust policy in order to negatively affect the rate of crime.

Crime Deterrence through Policy

Economic analysis can provide substantial evidence and suggestions for policy change. The most prominent economic models concerning crime dictate that criminal behavior is a result of choices influenced by perceived consequences (Cook, Machin, Marie, & Mastrobuoni, 2012). A change in these consequences or changes in the likelihood of facing consequences should therefore result in a change in behavior. As a caveat, these policies only work in the case where people are rational and consider consequences before acting.

There is no perfect action plan or model to deterring crime. Policy must be analyzed not only in relation to the idea of “crime as choice” but also in relation to the added costs of such policies and the benefits they impart. Essentially “crime policy should focus both on making criminal opportunities less tempting and on making the law-abiding life more rewarding” (Cook &

Ludwig, 2011, p.63). One way to make crime less tempting is through harsher punishment.

Harsher punishment usually translates to less leniency and longer prison sentences if convicted.

The risk of committing crime rises while those who have committed crime are removed from the population; the benefits are two-fold. However, the increased likelihood of incarceration has earned the United States the top spot in total incarceration: one percent of the adult population is behind bars (Cook & Ludwig, 2011). Are the benefits reaped from this policy worth the costs of maintaining such a large prison population?

Another side of crime deterrence policy is making lawful life more attractive. Policies that provide for greater economic opportunity through education, training, or job growth allow for a more comfortable lifestyle and cause crime to become less worthwhile by increasing its opportunity cost. Yet again, the marginal benefits of such measures must placate the marginal costs imposed.

A third avenue for deterring crime is through increasing the probability of punishment by increasing the level of police protection. Klick and Tabarrok (2010) communicate three primary reasons why an increased police presence increases the likelihood of punishment. First, more police on the street mean more chances that an officer will observe a crime themselves. Further, the cost for either victims or third parties that would report a crime decreases (due to the availability of officers), causing an increase in the likelihood of arrest. Lastly, more police would ideally lead to more detective work. An increase in the quality and quantity of detective work not only increases the chance of arrest but also the chance of prosecution and conviction. The idea of increased police presence is the most practical applied policy that results from examining daily data on crime. Like the previous methods discussed, the costs of such a program must not be dismissed. Increased police presence may provide the most flexible option for deterring crime

because this policy can be more targeted, both in relation to a location that may require more police and times when increased police presence is warranted.

Literature Review

Numerous studies detail correlation between variables and crime at various time intervals. However, analysis focusing on daily data has been lacking. The following review details numerous studies that focus on all crimes and violent crime.

Perhaps the most relevant piece of literature to analyzing daily determinants of crime in Chicago is *Crime and Demographics: An Analysis of LAPD Crime Data*, an approved Master's thesis by Bianca Chung (2011) in the field of statistics. The paper allows for some similarities to be drawn between crime in Los Angeles and Chicago. Chung does not differentiate between violent and non-violent crimes and instead picks fourteen categories from homicide to kidnapping and vandalism. Meticulous detail is communicated through an analysis of when crime occurs, not only when considering the day of the week but the time of day a particular crime is likely to occur. Chung finds that Sundays and Saturdays have less crime than weekdays. Also, Chung does not observe a pattern for all crime types over the year but does note higher reported homicides numbers in July and August.

Particularly of interest is Chung's discussion of holiday's impact on crime. Because holidays have different ways of celebration it became important to analyze which holidays stood out as being particularly prone to criminal behavior. The statistical results, analyzed through kernel smoothing, were inconclusive but did show some decline in the week prior to Monday holidays such as Martin Luther King Day, Memorial Day, and Labor Day. Thanksgiving and Christmas experienced sharp decline in total crime.

A discussion of how holidays are celebrated was never addressed in Chung's work. This could provide answers to how these holidays actually affect crime. In particular, a distinction between holidays that are days of remembrance or spiritual and holidays that are more social could provide some evidence of correlation between crimes on a given day. Furthermore, because the nature of violent crimes is not necessarily consistent with all crimes, different results may be expected when non-violent crimes are excluded from the analysis.

The relationship between crime and weather as well as crime and time of year has been addressed by several pieces of research. In the field of criminology, McDowall, Loftin, and Pate (2012) explore seasonality and temperature in an analysis of crime over U.S. cities. They determine that temperature variations do account for rape and assault but that environmental factors did not account for any other crimes. Furthermore, winter months proved to be the least criminally active months and crimes tended to peak in July or August. Robberies, however, were reported to have peaked in December. The speculative explanation for these seasonal trends are summer vacations and the holiday season in December.

Higher air temperatures and the likelihood of aggressive behavior, especially violent crime has also been explored (Anderson, 1987). Not only have violent crimes been found to be more prevalent in hotter quarters and hotter years, hotter cities experienced more instances of violent crime. More broadly, Anderson and Anderson (1984) showed linear correlation between ambient temperature and aggressive behavior, arguing against research suggesting a curvilinear model of temperature and aggression.

The literature concerning temperature and seasonality suggests that environmental and cultural factors may be at work in determining crime. Speculation that summer vacations increase the likelihood of crime presents an interesting question: does tourism affect crime in

Chicago? Early research on crime and tourism suggests a very weak relationship if one exists at all (Pizam, 1982). Also, it is relevant to consider the holiday season in regard to cultural behavior that might be influencing crime, especially robbery, in Chicago.

Unemployment and crime has also seen some significant analysis. Most studies have found significant relationships between an increase in unemployment and an increase in crime (Raphael and Winter-Ebmer, 2001; Lee & Holoviak, 2006; Buonanno, Drago, & Galbiati, 2014). Particularly, significant positive impact of unemployment on both property crime and rape has been reported, suggesting potential relationships between not only two types of violent crime, sexual assault and robbery, but also that there exists a strong relationship between unemployment among young men and crime (Lee & Holoviak, 2006)⁴.

Data and Methodology

The analysis of possible correlation between select daily determinants and violent crime in the city of Chicago is conducted using time-series data. Daily data from January 2, 2012 to December 31, 2013, a total of 728 Days, is utilized. While this two year period consisted of 731 days, three dates had to be dropped to avoid outliers. These dates contained extreme outliers that were not likely to have occurred on the particular date. This is likely due to dates being used as placeholders for crimes that were reported but had no date associated with them. These outliers concerned the reported number of sexual assaults and were possibly reported anonymously or via mandate and were thus assigned a generic date⁵. No other variable exhibited this behavior.

The model in this study will attempt to draw from a select number of possible independent variables while incorporating seasonality and a daily time trend. Because each component of

⁴ Lee and Holoviak's research focuses primarily on South Korea, Japan, and Australia

⁵ January 1, 2012; January 1, 2013; and August 1, 2012

violent crimes may show different correlations with the independent variables, each component will later be separated and regressed against the independent variables.

The two primary models are as follows:

1. $Term_t = \beta_0 + \beta_1 temp_t + \beta_2 unem_t + \beta_3 holi_t + \beta_4 wknd_t + \beta_5 spring_t + \beta_6 summer_t + \beta_7 fall_t + \beta_8 t + \varepsilon_t$
2. $Term_t = \beta_0 + \beta_1 temp_t + \beta_2 unem_t + \beta_3 pholi_t + \beta_4 wknd_t + \beta_5 spring_t + \beta_6 summer_t + \beta_7 fall_t + \beta_8 t + \varepsilon_t$

Variables

Prior to examining empirical results, a discussion of each variable used in the above models is warranted. Model one utilizes federal holidays while model two utilizes party holidays. These variables will be described in more detail shortly. These holidays have been initially selected because they have the clearest definition as days recognized by the federal government⁶. However, because it is strongly suspected that federal holidays are uncorrelated with violent crime, model two drops most federal holidays and incorporates the more rambunctious celebrations defined as party holidays.⁷

Total Crime.

Total crime serves as the dependent variable in models 1 and 2. Total crime is the sum of aggravated assault, sexual assault, robbery, and murder. These four crimes constitute violent crime. This data was collected from the City of Chicago Data Portal. The dataset reflects reported incidents of crime that occurred in the City of Chicago. Data is extracted from the Chicago Police Department's CLEAR (Citizen Law Enforcement Analysis and Reporting) system.

⁶ New Year's Day, Birthday of Martin Luther King, Jr., Washington's Birthday, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day, and Christmas Day

⁷ New Years Eve, New Years Day, St. Patrick's Day, Cinco de Mayo, Memorial Day, Independence Day, Labor Day, and Halloween.

Aggravated assault.

Data on aggravated assault was collected from the City of Chicago Data Portal. The FBI's Uniform Crime Reporting (UCR) Program defines aggravated assault as "an unlawful attack by one person upon another for the purpose of inflicting severe or aggravated bodily injury". The UCR Program further specifies that this type of assault is usually "accompanied by the use of a weapon or by other means likely to produce death or great bodily harm". Attempted aggravated assault that involves the display of—or threat to use—a gun, knife, or other weapon is included in this crime category because serious personal injury would likely result if the assault were completed. When aggravated assault and larceny-theft occur together, the offense falls under the category of robbery.

Sexual assault.

Data on sexual assault was collected from the City of Chicago Data Portal. This variable is distinct from the FBI's definition of a violent crime as Chicago includes most sex offenses (not just forcible rape) under this category, including those where men are victims. Attempts or assaults to commit rape by force or threat of force are also included.

Robbery.

Data on robbery was collected from the City of Chicago Data Portal. The FBI defines robbery as "the taking or attempting to take anything of value from the care, custody, or control of a person or persons by force or threat of force or violence and/or by putting the victim in fear" (n.d.).

Murder.

Data on murder was collected from the City of Chicago Data Portal. The FBI defines murder as

the willful (nonnegligent) killing of one human being by another. The classification of this offense is based solely on police investigation as opposed to the determination of a court, medical examiner, coroner, jury, or other judicial body. The FBI does not include the following situations in this offense classification: deaths caused by negligence, suicide, or accident; justifiable homicides; and attempts to murder or assaults to murder, which are scored as aggravated assaults (n.d.).

Temperature.

Temperature is recorded as the daily mean temperature as measured at Chicago Midway Airport (“Weather History for Chicago, Midway, IL” n.d.). This variable was selected in order to determine if environmental conditions could account for any of the variability in daily violent crimes. Based on previously discussed literature, temperature is expected to be positively significant with total crime and all four categories of violent crime. However, because murder and robbery have previously shown little correlation (McDowall, et al., 2012) with increased air temperature, there may not exist a significant correlation between one or both of those violent crime categories.

Unemployment.

Data on unemployment rate for the Chicago Metropolitan Statistical Area was collected from the Bureau of Labor Statistics. Data is monthly and is not seasonally adjusted; all daily observations for any given month share the same unemployment rate. Unemployment was selected to serve as an overall indicator of economic health and the health of the labor market. It is hypothesized that higher unemployment will lead to more instances of robbery due to a greater number of situations involving theft as a way to support oneself as well as the opportunity cost of being involved in criminal activity being reduced. Aggravated assault, murder, and sexual assault

are not expected to have significance with unemployment. However, literature suggests that sexual assault and unemployment are slightly significant (Lee & Holoviak, 2006). Because only one of the four categories of violent crime is hypothesized to be significant, it is unlikely that unemployment is significant with total crimes.

Holiday.

Holidays are included using dummy variables constructing to designate federal holidays. These days are the conventional definition of holiday. It is unclear what effect these federal holidays have on violent crime. People not working and students out of school could result in more people staying home, possibly reducing crime, or facilitate more interactions among people which would elevate the chance of violent crime.

“Party” holiday.

Dummy variable associated with holidays that are more social and typically involve the consumption of alcohol. The day after was also included to capture early morning (after midnight) activity that carries over from the holiday celebration when constructing this dummy variable. It is unclear whether these party holidays will have an effect on aggravated assault, robbery, or murder. However, a strong positive correlation among sexual assault is expected. Alcohol can alter a person’s mental state and thus could result in someone predisposed to sexual aggression committing a sex crime that they might not have committed if they had been in a normal state of mind. Research has been conducted that supports this idea for men who have been surveyed after committing sexual assault (Abbey, 2011).

Weekend.

Weekends are dummy variables equal to one if the day of the week is either Friday, Saturday, or Sunday. More crime is hypothesized to occur on weekend due to more people being off of

work and engaging in social behaviors. The expected sign of the coefficient is expected to be positive, similar to party holidays, if the variable is significant.

Seasonality and Trend.

Seasonality is tested with winter being the time of year omitted for comparison. Research suggests violent crimes decrease in the winter and spring while increasing in the summer and fall (Bianca Chung, 2011). The trend variable is also included to account for time trends in the daily time series data.

Empirical Analysis and Results

Before proceeding to regression analysis, an exploration of the data and some basic relationships warrant attention. Table 1 shows descriptive statistics. The most common occurrence of violent crime is robbery, averaging approximately 34 occurrences each day. Murder is the least common violent crime reported with a mean occurrence of 1.27. Overall, the mean occurrence rate of all violent crimes in Chicago is approximately 50 each day. Some elementary analysis comparing the mean of violent crimes with the independent variables should show whether there is a basic relationship between these variables. Table 2 details the means of the crime and the constituent components during party holidays and during weekends. This rudimentary analysis shows that crime occurrence does increase during both party holidays and the weekend suggesting a positive relationship between these variables. This basic analysis provides some insight into the correlation between violent crime and these selected variables. However, a more rigorous analysis should provide more substantial information.

Table 3 details the results of daily variables on violent crime in Chicago. Model 1, which incorporates federal holidays, shows positive correlation between temperature, weekends, and both seasonal and time trends. All significant variables show expected signs. However, as

suspected, federal holidays are not significant.⁸ Therefore, we turn to model 2 which swaps federal holidays for party holidays. Model 2 provides similar results to the first, however party holidays are significant in the new model. The results communicate that a party holiday or the day following it will result in six additional observations of violent crime. Seasonal variables and the time trend remain significant. In both models unemployment remained not significant. No violations to the assumptions of the OLS model appear to have been violated.

Violent crime is then divided into the four constituent categories. The four new models are:

3. $Agast_t = \beta_0 + \beta_1 temp_t + \beta_2 unem_t + \beta_3 pholi_t + \beta_4 wknd_t + \beta_5 spring_t + \beta_6 summer_t + \beta_7 fall_t + \beta_8 t + \varepsilon_t$
4. $Sxast_t = \beta_0 + \beta_1 temp_t + \beta_2 unem_t + \beta_3 pholi_t + \beta_4 wknd_t + \beta_5 spring_t + \beta_6 summer_t + \beta_7 fall_t + \beta_8 t + \varepsilon_t$
5. $Robb_t = \beta_0 + \beta_1 temp_t + \beta_2 unem_t + \beta_3 pholi_t + \beta_4 wknd_t + \beta_5 spring_t + \beta_6 summer_t + \beta_7 fall_t + \beta_8 t + \varepsilon_t$
6. $Mrdr_t = \beta_0 + \beta_1 temp_t + \beta_2 unem_t + \beta_3 pholi_t + \beta_4 wknd_t + \beta_5 spring_t + \beta_6 summer_t + \beta_7 fall_t + \beta_8 t + \varepsilon_t$

Table 4 shows the results of the four regressions. The regression of aggravated assault in Chicago on daily variables shows that temperature, party holiday, and weekend are positive significant determinants of aggravated assault. According to the data, an increase of the average daily temperature by 10 degrees results in one additional observation of aggravated assault. The time trend is also negatively significant.

The regression of sexual assault in Chicago on daily variables shows that temperature, unemployment, party holidays, weekend, and the fall are positive significant determinants of sexual assault. A party holiday or a weekend is expected to see about one additional instance of sexual assault. The time trend is also negatively significant.

⁸ Including the day after a federal holiday when constructing the dummy variable does not alter the significance of any variable nor does it impact the coefficients so that the interpretation would be significantly altered.

The regression of robberies in Chicago on daily variables shows that temperature, party holidays, and the seasonal variables are all positively and significantly related to robbery. According to the regression, party holidays see an increase of three robbery incidents. Robberies also occur significantly more often in the fall. The time trend is also negatively significant.

The regression of murder in Chicago on daily variables show that temperature, party holidays, and weekends are all positively significant relationship with murder. The interpretation of party holidays on murder is not exact, but according to the regression a party holiday will typically see about one additional murder.

Discussion

From the results it is clear that the selected independent variables can be used to help predict when certain violent crimes in Chicago are more likely to occur. Models 1 and 2 look at all violent crimes and provide clear correlation between these crimes and the daily determinants selected. Model 1 was eventually replaced because federal holidays, while more easily defined and structured, do not have the same social atmosphere of party holidays and therefore are less likely to elicit violent crimes. The correlation of party holidays is suggested to be caused at least in part to increased alcohol consumption but also because more people are outside celebrating the holiday. An increase in the number of people in the street or outdoors celebrating can facilitate more interactions among Chicago residents and visitors. Similar to party holidays, weekends facilitate interactions among residents and visitors. Violent crimes constitute one possible type of negative interaction resulting from these scenarios.

When we look closer at the individual types of violent crime we discover even more evidence to help explain when certain crimes are more likely to occur. The two daily variables that are significantly correlated with all types of violent crime are the average daily temperature and if

the day is a party holiday. The idea that party holidays coincide with increased violent crime should allow policy makers to prepare well in advance for the possibility of increased crime. Surely this is already the case for party holidays as an increased number of people visiting and living in the city who celebrate these holidays requires a more extensive police presence. However, this police presence could be increased further so that the correlation between violent crimes and party holidays is further reduced. This increase in police presence must still take into consideration the costs of utilizing more officers and weigh it against the expected benefit of reduced crimes. Where temperature is concerned, it is difficult to enact policy that will help deter crime on hot days other than increasing the overall police presence on days forecasted to be hotter than average. It appears that early research by Anderson (1984) is supported by these regressions- hotter air temperature, even when controlling for seasonality, does appear to promote violent behavior such as violent crime.

Aggravated assault and murder each have a significant relationship with weekends and party holidays. It is more difficult to explain the rationale behind these crimes. Overall, an increased police presence should subvert the motivation to commit these crimes.

The hypothesis that unemployment would be significant with only one category of violent crime was correct. However, rather than the being the dependent variable robbery, unemployment was positive and significant in relation to sexual assault. While it was unexpected, it supports Lee & Holoviak's (2006) argument that unemployment can result in increased sexual assault. Sexual assault is also observed more often in the fall months although there is little explanation for the significance that the fall season has on sexual assault. Sexual assault may not respond as readily to increased police presence. However, other methods of deterrence, especially education and awareness, could help alleviate sex crimes.

Robbery shows a relationship that indicates increased occurrence as the year goes on. Fall sees a much larger number of robberies than winter. The only suggestion that seems viable for explaining this increase is that the holiday season, occurring in the late fall, promotes robberies one of two ways: individuals are more likely to rob in order to get money to celebrate the holiday season or the incentive to rob is increased due to victims having more new items and cash on hand to conduct holiday shopping. This could explain the increased instances of robbery occurring during November and the first half of December.

Looking at the data overall, policy must be considered that addresses ways to deter crime from happening on days where more social interactions occur. These types of interactions are promoted by party holidays and weekends. This is a common approach; more people out and about equates to more officers on the beat.

It should also be highlighted that the time trend is negatively significant on most violent crimes separately and on total crimes. This is due to decreased instances of these crimes and particularly because 2013 saw one of the best years in recent memory in relation to crime occurrence. Papachristos' (2013) analysis reports crime rates lower than they have been in 40 years for the city of Chicago. Murder appears unaffected by any trend even though homicides have also reportedly decreased.

Conclusion

Violent crime in Chicago is not going to disappear. To think so is unwise and naïve. However, violent crime is costly, both in terms of the fiscal strain put on the police and justice system and also the emotional and physical costs of those victimized by perpetrators of violence. Deterrence hinges on making the opportunity cost of committing a crime rise. This paper suggests that increased police presence is the most flexible solution to most of the relationships

discovered through regressing violent crimes on temperature, unemployment, holidays, and weekends. Even though positive relationships exist between these variables and the different aspects of violent crime, the cost of an increased presence must still be weighed against the benefits that they might impart. Can we afford to employ a large number of law enforcement and are we sacrificing our privacy or enjoyment by surrounding ourselves with law enforcement? In general, a cost-benefit analysis is warranted to determine policies that could effectively and economically deter violent crime within Chicago. Furthermore, because the data only deals with daily observations over the course of two years, long run information or patterns may be undiscovered that could help further explain violent crime occurrences. Violent crime is uncomfortable to discuss, but violent crime is a very real, very visceral problem and it deserves detailed exploration in an attempt to find any way to facilitate its reduction. This paper has looked at very basic determinants of crime but more detailed analysis and application is not only warranted.

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Tables

Table 1. Descriptive Statistics

Variable	Definition	Mean	Standard Deviation	Min / Max
Tcrm	Total Violent Crime	50.80	11.24	23 / 86
Agast	Aggravated Assault	11.47	3.93	0 / 25
Sxast	Sexual Assault	3.59	3.59	0 / 12
Robb	Robbery	34.47	8.68	13 / 59
Mrdr	Murder	1.27	1.32	0 / 9
Temp	Average Daily Temperature	53.30	19.72	6 / 94
Unemt	Unemployment Rate	8.99	0.62	8.1 / 10.3

Table 2: Basic Analysis of Summary Statistics

	Party Holiday	Not Party Holiday	Monday-Thursday	Friday-Sunday
Total Crime	56.82	50.56	49.96	51.92
Aggravated Assault	13.21	11.40	11.28	11.71
Sexual Assault	4.36	3.56	3.07	4.29
Robbery	37.11	34.37	34.40	34.56
Murder	2.14	1.23	1.20	1.35

Table 3. Summary of Regression Analysis for Variables Predicting Total Violent Crime (tcrv)

Variables	Model 1	Model 2
Temperature	0.239*** [0.030]	0.230*** [0.030]
Unemployment	0.612 [0.775]	0.951 [0.772]
Holiday	-1.783 [2.146]	
Party Holiday		6.320*** [1.760]
Weekend	2.049*** [0.689]	2.267*** [0.677]
Spring	2.172* [1.304]	2.580** [1.295]
Summer	6.223*** [1.730]	6.792*** [1.721]
Fall	8.843*** [1.542]	9.590*** [1.540]
t	-0.013*** [0.002]	-0.013*** [0.002]
Constant	32.093*** [7.292]	28.807*** [7.256]
Adjusted R-squared	0.344	0.355

N=728

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Summary of Regression Analysis for Variables Predicting Individual Components of Violent Crime

Variable	Aggravated Assault	Sexual Assault	Robbery	Murder
Temperature	0.100*** [0.011]	0.021*** [0.007]	0.092*** [0.025]	0.017*** [0.004]
Unemployment	0.062 [0.293]	0.425** [0.174]	0.582 [0.653]	-0.117 [0.109]
Party Holiday	1.459** [0.667]	1.010** [0.396]	3.016** [1.487]	0.835*** [0.249]
Weekend	0.540** [0.257]	1.254*** [0.153]	0.289 [0.572]	0.184* [0.096]
Spring	0.276 [0.491]	0.128 [0.292]	2.372** [1.094]	-0.196 [0.183]
Summer	-0.678 [0.653]	0.561 [0.388]	7.084*** [1.454]	-0.174 [0.243]
Fall	0.240 [0.584]	0.951*** [0.347]	8.587*** [1.301]	-0.189 [0.218]
t	-0.003*** [0.001]	-0.001*** [0.000]	-0.009*** [0.002]	-0.000 [0.000]
Constant	6.328** [2.751]	-1.805 [1.634]	22.765*** [6.130]	1.520 [1.025]
Adjusted R-squared	0.240	0.145	0.228	0.065

N=728

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1