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Hot crime: economic analysis and insight into the relationship between a city's latitude and its rate of violence

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**Hot Crime: Economic Analysis and Insight into the Relationship between a City's
Latitude and its Rate of Violence**

By

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Advisor: Dr. Robert Stapp

**An Honors Thesis in partial fulfillment of the requirements for the degrees Bachelor of
Science in Business Administration in Business Economics and Marketing**

**Sam M. Walton College of Business
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Abstract

Every day in America, a case of violent crime makes headlines across the television, newspapers, websites, and social media. These tragedies deeply affect those directly involved and the communities in which the crimes take place. Not only are individuals physically and mentally affected by violent crime, but communities and cities suffer an economic loss from rising violent crime rates. Reducing the current rates of violent crime (robbery, assaults, rapes, and murders) can reduce costs for cities and taxpayers, while ultimately improving the quality of life for Americans. Research into what affects violent crime rates lead to discoveries that unemployment, gun ownership, and more interestingly, temperature, were some of the factors that affects a city's violent crime rate. This study aims to expound on the temperature variable by examining a previously unstudied variable – latitude – on a city's violent crime rate. This study aims to conduct an economic analysis through multi-variable regressions in support of the hypothesis that the latitude of a city does in fact have significance in a city's violent crime rate. Thirty seven major American cities were analyzed and the results are presented in this paper.

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Dedication

I would like to dedicate this thesis to several people. Most importantly, this thesis is dedicated to my mother, Kim Piepenbrok, and late father, David Piepenbrok. I thank the both of you for always encouraging me to pursue academics and dedicate my time and effort to them. Because of your motivation, I had the drive to go for the A's and honors instead of settling for lower grades. Thank you for showing me the world, teaching and listening to me, and ultimately leading me to place curiosity and knowledge at the top of my priorities list. Your continued support throughout my academic career allowed for me to explore the world and receive an excellent education, an incredible blessing that many never see. I feel an immense gratitude toward you for this.

I also would like to dedicate this thesis to all of the people in the world that make research a part of their career. Your hard, dedicated work is often not glorified, but so many major decisions are based upon the work you do. This thesis has given me the utmost respect for all that you do. Thank you for your curiosity and your passion toward our world.

Lastly, I would like to thank Winston and Bella for keeping me company and keeping me focused on the long nights of work on this project. Merci, mes amours.

I. Overview

According to Federal Bureau of Investigation Crime Statistics, in 2012 an estimated 1,121,462 violent crimes occurred within the United States. Defined by the Federal Bureau of Investigation's Uniform Crime Reporting Program, violent crime is categorized by four offenses. These offenses include aggravated assault, robbery, forcible rape, and murder (or non-negligent manslaughter). While the United States had seen a continuous downward trend in violent crime over that past decade (In 2011, a 3.8 percent decrease after having dropped by 6 percent in 2010 and 5.5 percent in 2009, according to F.B.I. data), in 2012 the United States saw a 1.2% uptick in violent crime rates, the first increase since 2006. The 2012 National Crime Victimization Survey by the Bureau of Justice Statistics found that 26 of every 1,000 people experienced violent crime, a 15% increase in how many people reported being victims of rape, robbery or assault. Property crime — burglary, theft and car theft — rose 12% (Leger). In a 2013 interview conducted by USA Today, James Alan Fox of Northeastern University in Boston said, ““We've plateaued. At this point, I don't think we're going to see any more decreases in crime. The challenge will be making sure crime rates don't go back up... You don't solve the crime problem. You only control it. When you let up on the gas, bad things will happen. This plateauing and inching up a bit is just a warning to us that we have to keep on investing in crime prevention and crime control” (Leger). It is the recent upward trend in violent crimes that draws more attention to the issue and leads to questions of what are factors that are influencing violent crime rates. Overtime, violent crime has been associated with a multitude of variables. Among the most noted include: socio-economic conditions, individual characteristics (psychological/behavioral), family structure, and population density (Grabmeier).

This research seeks to investigate if there is evidence linking a city's latitude to its violent crime rate. Investigating and understanding the causes of violent crime is important on several levels. If there is a strong correlation between violent crime and a city's latitude it can have a significant impact on the political, economic, operational, and community levels of government. On the political level, violent crime statistics provide quantification for the success or failure of criminal justice policies associated with a specific city. The results of this research affect crime policies in the sense that municipal and state governments can gage their gun laws accordingly and policies affecting unemployment rates, which correlate with violent crime. Important information can be gained and help guide in the allocation of city, state, and federal resources on the operational level. Economically, city and state governments can gage the allocation of tax dollars for police employment, police force violent crime units, and research in city planning based on population density. Finally, development, implementation, and success measurement of social crime prevention initiatives can be used by safety and security practitioners at the community level, and cities can evaluate the necessity for surveillance, including neighborhood watches and street mounted cameras.

II. Literature Review

While no scholarly evidence could be found directly relating violent crime rate to latitude, an ample amount of evidence showed a connection between temperature and reported violent crime. Simister and Cooper of the University of London report in their paper *Thermal Stress in the USA: Effects on Violence and Employee Behaviour* [sic] that

violent crime was temperature induced and most closely tied to temperature extremes. Among this research they found southern cities in the United States exhibited significantly higher violent crime rates than their northern counterparts. However, the common theme across all studied areas from Alaska to Phoenix to Los Angeles is that there was indeed a spike in violent crime whenever the temperature increased. However, the temperature at which violent crimes increased was not fixed at a particular temperature. The two concluded the length of day is not a determinant of crime, but rather the overall high temperature results.

Reported in *Heat and Violence*, researcher Craig Anderson found similar links. In his summary of laboratory studies of aggressive behavior, in affectively neutral and positive circumstances, hot temperatures cause increases in aggression. Recent lab studies showed that even in affectively negative circumstances, heat causes increases in initial retaliatory aggression. When studying data of geographic regions, he found even when controlling for population, socioeconomic status, and “Southernness” (characteristics unique to the South – more gun ownership, more people identifying as religious, lower education rates), the southern cities were still more consistently violent compared with cooler cities in the north. Both of these studies acknowledged the “heat hypothesis.” This hypothesis asserts that temperature can directly impact aggressive behaviors and motives, leading increased hostility between individuals ultimately resulting in violence. Even as early as the 1700s, Montesquieu recognized the relationship between heat and aggression stating, “You will find in the northern climates peoples who have few vices, enough virtues, and much sincerity and frankness. As you move toward the countries of the south, you will believe you have moved away from morality itself: the liveliest passion will increase crime.”

Taking these findings into account, it is clear that there is a link between violent crime

rates and temperature. However, Simister and Cooper and Anderson examined only three cities and this study will look at a broad selection of United States cities to analyze if there is a link between latitude and violent crime rates.

III. Hypothesis

The purpose of this study is to determine if the latitude of a city has any effect on its violent crime rates. As stated, temperature has been cited as a relevant indicator of violent crime rates and examined in numerous papers. The average temperature of a particular region is directly affected by its corresponding latitude. Scientific theory accepts that regions closer to the Earth's equator receive more direct sunlight than the Earth's poles, therefore resulting in a warmer ambient air and ground temperature. As latitude increases one is moving further away from the equator. This results in an obvious cooler ambient air and ground temperature. Acknowledging the direct relationship between latitude and temperature, I hypothesize that the latitude of a particular city in the United States will have a significant impact on its individual violent crime rate, particularly that cities with lower latitudes will have higher violent crime rates. This relationship is expected to be negative because latitude increases as one moves north.

IV. Methodology:

By creating a multiple variable regression this paper aims to find a negative correlation between a city's latitude and the corresponding violent crime rate. From past

studies various indicators have displayed significance in explaining violent crime rate. As a result, the paper will include population, population density, State Brady Rating score, and unemployment rate in addition to latitude when attempting to explain a city's violent crime rate. Table 1.1 (below) lists the six variables and their respective data source that are used in the regression model discussed within this paper.

Table 1.1

Variable:	Source:
Brady Rating	Brady State Gun Law Scorecard
City Latitudes	National Geodetic Survey
City Population	2010 United State Census Gazetteer for Places: January 1, 2010
Crime Count	Federal Bureau of Investigation Uniform Crime Report
Population Density	2010 United State Census Gazetteer for Places: January 1, 2010
Unemployment	Bureau of Labor Statistics

The Brady State Gun Law Scorecard is a grading scale designed and implemented by the Brady Center to Prevent Gun Violence. This annual grading system reviews each state's gun restrictions and depicts a numerical value, ranging anywhere from zero up to one-hundred points, based on how strict or lax a state's gun laws may be. The higher a state's score indicates stricter legislation towards firearms. While the lower a state's score will show lenient firearm restrictions. The premise here being that states with lower Brady ratings have higher violent crime rates.

Each city's latitude location is given by the National Geodetic Survey database. This is a consistent number that shows where each city observed within this analysis is located on the globe.

The *2010 United States Gazetteer for Places: January 1, 2010*, was used to create the regression model's sample group. This sample group consists of the top forty most populated cities within the continental United States. Due to the lack of available data, I omitted Washington, D.C., Chicago, Illinois, and Indianapolis, Indiana, from the sample group – leaving thirty-seven remaining observations. The *2010 Gazetteer* also provided statistical information for each city's population density. Previous studies (Nolan) concluded that there is indeed a relationship between crime rate and population size and density.

Each city's crime counts are supported by the 2010 Federal Bureau of Investigation Uniform Crime Report. These crime counts represent the total number of murders, robberies, forcible rapes, and aggravated assaults that were reported in each city in 2010.

The Bureau of Labor Statistics *2010 Unemployment Rates for the 50 Largest Cities* report was used to obtain the unemployment rate for each city within this analysis. Previous studies (Grabmeier) have shown that much of the increase in crime over a period of 19 studied years showed that crime can be explained by falling wages and rising unemployment among men without college educations.

Table 1.2 (on the following page) shows the descriptive statistics for each variable used in the regression analysis.

Table 1.2

	Umemp (2012)	Population (2012)	Pop Den (2010)	Latitude (in degrees)	Brady Rating	Crime Rate (per 1000)
Mean	10.56	1,047,016	5,168	99.10	26	8.40
Standard	0.52	222,416	833	2.74	5	0.78
Error						
Median	9.90	620,961	3,518	97.51	8	6.66
Standard	3.18	1,352,903	5,068	16.70	31	4.75
Deviation						
Sample	10.09	1,830,347,189,488	25,685,690	278.77	975	22.59
Variance						
Minimum	6.30	420,003	956	71.02	0	1.87
Maximum	23.10	8,175,133	27,012	123.03	81	23.78
Range	16.80	7,755,130	26,056	52.01	81	21.91

V. Results

In order to better understand the data, visual aids were constructed to help emphasize any imperfections, inconsistencies or contradictions in the data. Using these aids, some potential issues were noted within the data. No variables were excluded at this point, as no information had been gathered as to their significance in the model.

After these issues were discussed, a correlation matrix (Table 2.1, on the following page) was constructed to highlight any collinearity between the various explanatory variables. Several explanatory variables were highly correlated. As can be observed in

the table below, some of these correlations were fairly intuitive, such as population and population density. Others were somewhat less obvious, such as the correlation between The Brady Gun Law Rating and the Population Density variable. Despite the high level of correlation between several explanatory variables, all of the variables in the multivariable linear regression model were included, as it was unknown which variables would yield explanatory significance.

Table 2.1

Correlation Matrix

	Crime	Unemployment	Population	Population	Latitude	Brady
Crime Rate	1.0000	0.5728	-0.1246	-0.0136	-0.2992	-0.1525
Unemployment	0.5728	1.0000	-0.0187	0.0770	0.1464	0.3693
Population	-0.1246	-0.0187	1.0000	0.7065	-0.1711	0.2908
Population	-0.0136	0.0770	0.7065	1.0000	-0.0981	0.5756
Latitude	-0.2992	0.1464	-0.1711	-0.0981	1.0000	0.3263
Brady Rating	-0.1525	0.3693	0.2908	0.5756	0.3263	1.0000

Finally, a multivariable linear regression model was created, using the data and variables previously discussed. Various single variable linear regressions were constructed to see if the variables had the same explanatory power collectively or independently. This study found that these variables collectively yielded more explanatory power than the individual component variables would on their own, due to the correlations between the explanatory variables.

It can be seen on the next page in the Multivariable Linear Regression Results (Table 2.2 on the following page) the model generated an R-Squared of 0.61495. This means

that the model explains roughly 61.5% of the variation in the crime rate data. In regards to the original hypothesis, the null was rejected and the alternative hypothesis was accepted, as Latitude proved to explain a significant amount of variation in violent crime rate at all significance levels tested. This study found that for every degree of latitude north a city lies; there will be an average of 0.07 fewer incidence of violent crime. The regression model goes on to show that a city's unemployment rate and its state's Brady Rating also have a high level of significance on its violent crime rate.

The results of the regression model were surprising. The model had greater significance than its component variables, and, most importantly, the variable discussed in the original hypothesis for this study proved to be significant and relevant.

Table 2.2

Multivariable Linear Regression Results

Multivariable Linear Regression Results			
	Coefficients	Standard Error	Significance Level
Intercept	4.9944	4.1497	n/a
Unemployment	1.1290	0.1826	99.9%
Population	0.0000	0.0000	n/a
Population Density	0.0004	0.0002	n/a
Latitude	-0.0752	0.0362	95%
Brady Rating	-0.0732	0.0256	99%
<hr/>			
R Square	0.61495		
Adjusted R Square	0.55284		
<hr/>			
Observations	37		

VI. Conclusion

The analysis of this paper finds that latitude as well as unemployment, population density, and the 2011 State Brady Rating variables do have a notable impact on the violent crime rate of cities within the United States. Three of the five variables used in this model exhibited statistical significance within this research analysis and regression results. This paper's results reaffirm previous studies such as Craig Anderson's *Heat and Violence* and Simister and Cooper's *Thermal Stress in the USA*, claiming that higher temperatures correlate with an increased violent crime rate in cities, as higher temperatures will be seen at lower latitudes. The significance of these results can be explained by examining the relationships among the variables. The positive relationship between unemployment and crime rate was not surprising. This result indicates that as unemployment within a particular city increases, there is a tendency for the crime rate of that city to do the same. This relationship can be intuitively concluded from the basic notion that some individuals are more willing to commit criminal acts once they are unemployed to maintain their current lifestyle or standard of living.

The negative relationship between latitude and violent crime rate denotes there is a higher prevalence of violent crime in southern cities as opposed to northern cities. This outcome agrees with the research of Gamble and Hess indicating violent crimes are more widely reported in cities considered to be located in the southern region of the United States. It is natural to assume higher crime rates in southern cities and latitudes are simply the result of the generally warmer temperatures experienced in those locations. However, it is worth noting and exploring the research being conducted by psychologist, Craig A. Anderson. In his paper *Heat and Violence*, Anderson theorizes higher crime in the South may not be a completely direct result from warmer

temperatures, but rather from cultural influence. Yet this influence has not been clearly defined in presently available research. Scholars believe the influence, commonly denoted as “Southernness,” might originate from a number of factors. Additional research into this topic may shed light on the increased crime experienced in southern cities.

The fact that lower latitudes lead to higher violent crime rates implies southern states in the United States are subject to more violent crimes and should thus seek appropriate action in the future. For example, southern states should consider changing or implementing crime policies such as stricter gun control laws. Additionally, operational changes need to be taken into consideration in southern states such as allocating more funding, police forces, and violent crime units and urban planning. Finally, communities can benefit from this information in southern states by considering the need for more surveillance and neighborhood watches.

However, the conclusions above are subject to several limitations. As previously mentioned, the research did not account for cultural values such as “Southernness” as well as religion and political views, which could have a greater effect on violent crime rates in southern states, where there is very much a pro-gun culture. The research may have benefitted from the inclusion of additional variables. Variables we were not able to quantify or were not readily accessible, but may have offered more conclusive regression results to our study, could have included socio-economic status, divorce rates and family cohesiveness, overall effectiveness of law enforcement, major employers, and population stability.

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