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The Determinants of Crime in the United States: Testing Rational Choice Crime Theory

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I. Introduction

The relationship between labor market conditions and the crime rate is a highly important topic of discussion that holds policy relevance for countries around the world. Article 3 of the United Nations' Universal Declaration of Human Rights states that "everyone has the right to life, liberty and security of person", and high crime rates, particularly violent crime, directly violate these fundamental human rights. According to the Federal Bureau of Investigation's annual Crime in the US report, in 2015, an estimated 1,197,704 violent crimes were committed in the United States. In the same year, property crimes resulted in losses estimated at 14.3 billion. Although the US witnessed a rapid decline in the rates of violent crime in the 1990s, these figures, coupled with incarceration rates among the highest in the world, demonstrate that crime reduction is still very much an ongoing process. Understanding the determinants of crime from an economic, demographic and sociological perspective is key to lowering the incidence of crime in the US. This research adds to the vast body of crime literature by asking an age-old research question and adapting an empirical approach to the 21st century– what determines the rates of violent and non-violent crime in the United States?

The aim of this research is to test the crime theory proposed in Becker (1968) and built upon by Ehrlich (1973) and Cantor and Land (1985), with particular interest in unemployment's role as an explanatory variable for various measures of crime. This rational choice theory of crime is discussed below in greater detail, and suggests that high rates of unemployment lead to high crime rates. In the decades following the development of rational choice crime theory, time-series and cross-sectional data using primarily macroeconomic variables was the most common approach to modeling the determinants of crime. Surveys of the economics of crime literature conducted by Box (1987), Chiricos (1987) and Freeman (1994) reveal that early studies modeling

the determinants of crime, particularly the crime-unemployment relationship, often yielded mixed results with varying levels of robustness and inherent bias. Recently, more-robust panel model analysis has been used to empirically test the rational choice framework for analyzing crime. The research conducted by Blackmore (2003) is the most successful use of panel data in the 21st century for its considered use of a combination of economic, demographic and social variables to model the determinants of crime in all nine provinces of South Africa.

This research is designed to replicate the results of Blackmore (2003) by applying the same interdisciplinary approach to testing rational choice crime theory to the United States. Data from all 50 states and the District of Columbia are used to model the determinants of four different measures of crime– the murder rate, the aggregate violent crime rate, the larceny-theft rate and the burglary rate, from the years 2000 to 2014. The final econometric model includes nine independent variables, chosen with the support of rational choice crime theory and the precedent set by previous literature.

The contributions of this work are threefold. This research is the first of its kind to use panel analysis on the state level to model the determinants of multiple measures of crime in the 21st century United States. Secondly, no other econometric model in the United States includes an interdisciplinary panel approach to testing rational choice crime theory on the caliber of the Blackmore (2003) analysis of crime in South Africa. Finally, this research adds an inequality variable that was previously missing from panel analyses of crime, including Blackmore (2003), and due to the challenges presented by data availability on the state level, novel measures of some key independent variables are tested. In addition, an unconventional, non-linear relationship between income-related variables and crime is tested with successful results due to the unique effects of the 2008 financial crisis.

The results of this study support a hypothesis that unemployment is insignificantly related to crime in all cases, with the exception of violent crime. Unemployment is found to have a significant, negative relationship with violent crime, supporting the theory of a strong opportunity force effect of unemployment as described by Cantor and Land (1985). In addition, heavy support for the inclusion of demographic variables, most notably the proportion of females to males, is found. Income-related variables were found to have significant, non-linear relationships with all measures of crime, highlighting the importance of taking the effects of the 2008 financial crisis into account when analyzing the determinants of crime in the time period studied. Generally, rational choice theory provides a suitable framework for modeling crime, though data limitations prevent a more robust analysis of the determinants of crime on the state level.

Section II provides a brief overview of the analytical framework employed in this research. Section III reviews the literature on the determinants of crime and the crime-unemployment relationship in the United States and abroad. Section IV provides a detailed account of the methodologies used in this research, including an overview of the independent variables used and their respective data sources. Section V highlights the important results for each category of crime as it relates to the previous literature. Finally, section VI discusses the limitations of this research, as well as possible avenues for future research of the crime-unemployment relationship on the state level.

II. Analytical Framework

$$Crime_{it} = \beta_0 + \beta_1 Unemp_{it} + \beta_2 X_{1it} + \beta_3 X_{2it} + \ldots + \beta_k X_{kit} + \varepsilon_{it} \qquad \text{Equation (1)}$$

Equation (1) identifies the conceptual model of the crime-unemployment relationship used in this research. The theory and literature support a model with the measure of crime as the dependent variable and the rate of unemployment as the independent variable. Equation (1) represents a cross-sectional, time-variant model of the crime-unemployment relationship with *i* cross sections over time, *t.* $Crime_{it}$ measures the incidence of crime in the population, $Unemp_{it}$ measures the rate of unemployment in the population, and X_{kit} represents all other economic, social and demographic variables that explain variation in crime rates.

Four different measures of crime are used as dependent variables in the final econometric models. These measures include the murder rate, violent crime rate, larceny-theft rate and the burglary rate. The decision to use these measures as dependent variables is motivated by Gary Becker's rational choice crime theory. The rational choice theory of crime was first introduced by Becker in 1963 and states that criminals implicitly perform a cost-benefit analysis when making the decision of whether or not to commit a crime. Prior to Becker's theory, much of the literature studying the determinants of criminal activity assumed that criminals are, by and large, different from non-criminals due to unique motivations caused by some presumed unique family structure or upbringing. Becker instead theorizes that criminals are no different than the rest of the population, and that this cost-benefit analysis is well thought-out and driven mostly by economic factors. The availability of other, non-criminal opportunities for income, the probability of apprehension associated with committing a crime and the expected gains from the crime are all among the variables considered by potential criminals when making this decision. This theoretical framework was first tested empirically by Ehrlich (1973). Ehrlich introduced a time-series analysis of this theory and found ambiguous results regarding the unemployment rate's relationship to crime, though such time series analysis may be subject to autocorrelation and other econometric bias (Greenberg, 2001).

Cantor and Land (1985) expanded upon the Becker-Ehrlich rational choice model by introducing another component to the theory. They hypothesized that there are two conflicting forces at play when determining whether or not to commit a crime— an opportunity force and a motivational force. When one becomes unemployed, in theory, they spend more time at home, which reduces the number of burglaries, robberies and cases of aggravated assault committed. On the other hand, much in line with the Becker-Ehrlich theory, high rates of unemployment increases one's motivation to commit crime. Cantor and Land propose that these effects work against each other, and although this model leaves open the possibility that there may be a negative crime-unemployment relationship, they hypothesize that the motivational effect is indeed stronger and that the net effect of unemployment on crime is positive. Blackmore (2003) provides a more contemporary expansion of this decades-old theoretical framework by emphasizing the need to not only include economic factors, but social and demographic factors as well. Demographic factors such as the proportion of the population aged 15-24, the most likely group to commit violent crime, are often not controlled for in prior research. Similarly, since males are more likely to commit crime than females, fluctuations in the proportion of the population that is female must be controlled for as well (Blackmore, 2003). Since higher levels of education increases the number of opportunities for legitimate, non-criminal sources of income, some measure of the populations education level should also be used.

III. Literature Review

Because of the unemployment rate's role as a primary indicator of labor market conditions and the overall economic health of a nation, understanding its relationship to violent crime has been studied before, not just in the United States, but around the world. Since Becker

(1968), a vast body of literature has been developed in an attempt to establish a clear relationship between labor market conditions and crime. The importance of studying this connection is illustrated well by the research of Cornish and Clarke (1987). Cornish and Clarke's research highlights the phenomenon of crime displacement, where a targeted reduction of crimes in specific areas causes an increase in crime elsewhere. This phenomenon underscores the importance of identifying a clear relationship between macroeconomic conditions and overall crime reduction.

A number of studies conducted in post-WWII United States have contributed to a heightened level of interest in the social consequences of macroeconomic policy. Following the introduction of rational choice crime theory first proposed in Becker (1968), Brenner (1976) stimulated interest in the crime-unemployment relationship by finding that over a six-year period of study, a one percent increase in the unemployment rate is responsible for an in increase in the number of homicides by approximately 648. Results showing a significant, positive relationship between violent crime and unemployment are rare, and Brenner's findings are criticized because non-economic variables are not controlled for in his analysis (Cantor and Land, 1985). Brenner's importance in stimulating interest in the relationship between macroeconomic conditions and social concerns is notable, though his analysis relies strictly on time-series data and only contains data on GNP Per Capita and Consumer Price Index in addition to Unemployment as independent variables. In a large-scale survey done of British and American studies on both the relationship between crime and unemployment and the relationship between crime and inequality, a strong crime-inequality relationship was clear, but the unemployment-crime relationship remained ambiguous (Box, 1987). Similarly, in a review of 68 studies, Chiricos (1987) finds that less than half find significant effects of unemployment on aggregate crime rates (Raphael and Winter-Ebmer, 2001). Wage levels, including the minimum wage, may instead be more closely related to

crime rates than employment prospects (Gould et. al, 2002). Gould et. al. (2002) references the rational choice framework for analyzing crime developed by Becker (1968) and Ehrlich (1973), focusing primarily on the opportunity costs associated with finding work in the legal sector. These researchers use wage, measured in the log weekly retail wage of non-college-educated males, to capture the opportunity cost of choosing criminal activity as an alternative to finding a paying job. Using both county-level panel data and individual data, Gould et. al. (2002) concludes that both unemployment and wage are significantly related to property crime, though wage more-significantly explains variation in violent crime than the unemployment rate. In addition, since long-term trends in wages may be observed where no such trends in the unemployment rate exist, the direction of wages for unskilled workers over time may be the best predictor of overall crime trends. Although wage levels proved to be a more significant variable in capturing variation in the rates of violent crime, this may be a result of the limitations of UCR (Uniform Crime Reporting) data, which only records the most serious offense if multiple crime types were committed in the same incident. As a result, violent crime may appear to be significantly motivated by pecuniary concerns when, in reality, violent crime happens to often coincide with self-enriching acts of non-violent crime (Gould et al, 2002).

A state-level panel analysis of the crime-unemployment relationship from 1971-1979 in the United States conducted by Raphael and Winter-Ebmer (2001) finds a significant positive relationship between unemployment and non-violent crime, with considerably weaker results for violent crime, supporting the hypothesis that violent crime is not often motivated by pecuniary concerns. This study uses state-level data using age demographic variables and average income per worker (personal income divided by employment) in addition to the unemployment rate to study crime. An unexpected negative relationship was found between unemployment and rape, as well as unemployment and murder, though the researchers assume that this relationship is

zero due to the unobserved effects of omitted variables. Income, similar to the results obtained by Gould et. al. (2002), was significant and negatively related to both violent and non-violent crime.

Considering the survey of the literature conducted by Box (1987), Chiricos (1987) and others, the results of these studies identify a clear lack of consensus on the crime-unemployment relationship, with a connection between unemployment rates and violent crime proving particularly difficult to establish. Greenberg (2001) calls into question the efficacy of time-series research done on the topic of crime and unemployment in the decades following the development of rational choice crime theory. Greenberg supports the theoretical framework of Cantor and Land (1985), but claims that analysis limited to time-series data may not yield reliable results. With a large body of literature that yields significant but unreliable results supporting a positive crime-unemployment relationship, as well as a large body of literature that finds no significant relationship at all between crime and unemployment and even some that find a negative relationship, a need for stronger empirical analysis of this relationship has arisen.

Recently, models using panel data have been the most common approach used to analyze the crime-unemployment relationship. Panel analysis of theft crime in Iran over a period of nine years conducted by Maddah (2013) yielded significant positive results, though this analysis only controlled for poverty levels, population density and ratio of males aged 15-24 in each province. As a result, the model explained only 20% of the variation in theft rates and omitted variable bias was likely present. In a similar approach taken by Papps and Winkelmann (1999), panel data was used to analyze a range of crimes in New Zealand provinces from 1984 to 1996, and evidence of a significant positive effect of unemployment on crime was found here as well. This study successfully uses the clearance rate of each crime type as a significant proxy variable for the probability of apprehension associated with criminal activity. The level of income in each

province was also significant and negatively related to all crime types, as well as overall crime, supporting the opportunity cost effect of high wages found by Gould et. al. (2002) and Raphael and Winter-Ebmer (2001). However, this study lacks any measure of inequality, education, urbanization or demographic characteristics that would likely further help explain variation in the crime types studied. Finally, a panel data approach analyzing the effect of unemployment on crime in Italian provinces from 2000-2005, a nation that faces high levels of unemployment, found a significant relationship between unemployment and all categories of crime (Speziale, 2014). This study benefits by constructing a variable that measures the ratio of crimes committed by someone who was never caught to the total number of crimes in each category. This variable serves as an attempt to model the inefficiency of the Italian justice system, and a significant positive relationship is found among most crime types, suggesting that successfully getting away with crime may motivate one to commit crime repeatedly. Conviction rate is also used to measure the probability of apprehension, and similar to Maddah (2013), the ratio of males aged 15-24 is used as well.

The panel analyses of Maddah (2013), Papps and Winkelmann (1999) and Speziale (2014) highlight the need for research that isolates an accurate crime-unemployment relationship by including more explanatory variables. The most comprehensive study focusing on the determinants of crime in South Africa found that the unemployment rate is among the variables with the most significant relationship to crime, along with level of education, degree of urbanization and income per capita (Blackmore, 2003). This panel model analysis of crime in South Africa conducted by Blackmore (2003) uses a combination of social, demographic and economic variables to establish a clear, positive relationship between unemployment and multiple types of crime. This approach to modelling the determinants of crime has only recently been employed,

and revisiting this model by applying the same approach to the United States in this research may provide a fresh perspective on an age-old research question.

South Africa is a nation with macroeconomic and social conditions that are drastically different than the United States, with extremely high levels of both crime and unemployment. In addition, there are other conditions unique to South Africa that make the crime-unemployment relationship from Blackmore (2003) a particularly interesting point of comparison to the United States. South Africa is urbanizing at a rate much faster than the United States, and with rapid urbanization comes issues of urban unemployment, the growth of informal, hard to police settlements, and the prevalence of gangs (Blackmore, 2003). These factors may explain the significant, positive relationship between urbanization and crime found in South Africa, though similar effects of highly urbanized areas in the United States may be observed. Income per capita is used as an opportunity cost variable with successful results, though as Blackmore explains, this variable does not capture variation within the level of income in each province, i.e. inequality. Largely due to South Africa's apartheid past, widespread inequality still exists in the nation. This issue of inequality is closely tied to the nation's unemployment rate as well. Unemployment is very unevenly distributed among age groups, gender, skill categories and ethnic groups— it is disproportionally higher in youth, women and black members of the population (Bernard, 2009). Not only has a relationship between unemployment and crime been observed, a close relationship between unemployment and inequality has been seen before as well, with unemployment having been recently found to cause the bulk of earnings inequality in South Africa (Tregenna, 2011). Crime is also closely linked to wage inequality in South Africa, with burglary rates 20-30% higher in police jurisdictions that are the wealthiest of their neighbors (Demombynes and Ozler, 2002). With these conditions in mind, applying the same economic, demographic and social framework for studying the crime-unemployment relationship in the context of the United States makes for

an interesting comparison. The model constructed by Blackmore (2003) successfully explained over 95 percent of the variation in the fifteen crime types studied, making this study the most successful panel analysis of crime conducted in the past decade. Much of this research is devoted to replicating these results in the context of the United States by using often entirely different measures of key independent variables due to data availability at the state level, as well as the addition of a basic measure of income inequality and a poverty variable, both missing from the analysis conducted by Blackmore (2003).

Although the purpose of this research is to understand the relationship between the unemployment rate and both violent and nonviolent crime, the model used contributes to the vast body of literature on the determinants of crime as a whole. As Blackmore (2003) demonstrates, in order to isolate the unemployment-crime relationship, it is necessary to build a model with independent variables that capture as much variation in the rate of crime as possible. While Blackmore (2003) provides a strong example of the use of panel data to model crime, the literature provides further points of reference for the inclusion of some common variables in determinants of crime models.

Freeman (1994) makes the point that throughout the late 1980s and early 90s, crime rates continued to climb despite heavily increasing rates of incarceration, which should in theory have a deterrent effect on potential criminals. Freeman hypothesizes that the crime rate climbed in this period as a result of rising inequality and falling real income levels for the less-educated. He also questions the effect that joblessness has on the rate of crime, citing the fact that research demonstrating a significant and positive crime-unemployment relationship using time-series data is unreliable and subject to issues of economic bias. A positive crime-unemployment relationship is seen more demonstrably in cross-sectional data, though Freeman argues that inequality may be the more important macroeconomic variable to focus on. Freeman's primary motivation for

surveying the determinants of crime literature was to understand why the rapidly-rising rates of incarceration have not had a negative impact on crime in the late 1980's/early 1990s, and in addition to the strong effect of lowered economic opportunities and rising inequality for working class men during this time period, the rise of drug trafficking and gang culture may have played a part. This paper suggests that incarceration rates and a social variable that measures drug use may both be important additions to determinants of crime models. Chiricos (1987) shares Freeman's skepticism regarding the importance placed on joblessness in studies related to the economics of crime. In his survey of the current economics of crime literature, he reports that less than half (48%) of studies using post-1970s data found a significant and positive crime-unemployment relationship.

Freeman's interest in the crime-inequality relationship is noteworthy, especially considering that inequality and crime both increased by considerable margins in the United States from the 1970s to the 2000s (Buonanno, 2003). Kelly (2000) hypothesizes that in areas with high levels of inequality, the poorer demographic has a relatively higher propensity to commit crime because the expected gains from committing crime are large. In his empirical analysis of urban counties in the United States, he finds no significant effect of inequality on property crime but a strong, significant effect of inequality on violent crime. In contrast, police presence and poverty levels were found to be insignificantly related to violent crime but significant and positively related to property crime. Inequality is measured by calculating a Gini coefficient at the county level using a ratio of mean to median household income. A Gini coefficient is also calculated for educational attainment, because a separate measure of inequality that is not derived from income helps separate inequality's impact on crime from the poverty rate's impact. In addition to inequality, the crime model employed by Kelly (2000) controls for police activity, measured in percent expenditure on police services, the poverty rate of people aged 18 to 65, unemployment as a

percentage of the male labor force that is unemployed, race, family structure, population turnover and age structure. Of these variables, population turnover and family structure are the most unconventional measures of deprivation used. Population turnover measures the fraction of families in a given area that lived somewhere different five years ago, while family structure measures the percentage of families headed by a single female. Both of these variables help isolate inequality's impact on crime by partially controlling for instability at the community and household level. The nature of inequality's relationship with crime, according to Kelly (2000), seems to be in contrast with the unemployment rate's relationship with crime, as numerous studies have found a significant link between unemployment and property crime but less have shown any significant unemployment-violent crime relationship. In addition, as mentioned earlier, Steven Box's 1987 survey of British and American studies found a strong, positive crime-inequality relationship, though the relationship between crime and unemployment among studies was much more ambiguous, supporting Freeman's claims that inequality may be more important to consider.

In addition to inequality, levels of education have been a common addition to models in economics of crime studies. In South Africa, a significant, negative relationship between crime and completion of grade 12 was found by Jonck et. al. (2015). These results relied on cross-sectional data with little controls, and were likely biased by the effects of apartheid on both educational attainment levels and crime in South Africa. In a recent panel data analysis of the effects of educational attainment on crime in both developed and developing nations, a significant, negative relationship was found, though in the same study, a negative relationship between the youth unemployment rate and crime was found as well (Gonzalez, 2015). Blackmore (2003), a major precedent to this research, however, found no significant relationship between education levels and crime. In an examination of the determinants of crime literature conducted by Freeman

(1994), Freeman states that a disproportionate number of prisoners in the United States are high school dropouts, supporting a hypothesis first proposed by Becker (1968) that education increases the legal opportunities for income available to an individual, thereby reducing one's propensity to engage in criminal activity. This prisoner characteristic also suggests that high school graduation rates may prove to be an accurate explanatory variable at the state level. Kelly (2000) uses the percentage of people over the age of 25 with a college degree as an education variable, finding that college has a significant negative relationship with violent crime but no significant relationship with nonviolent, or property crime. Considering Blackmore's results regarding education, the findings of Kelly (2000) support a hypothesis proposed by Blackmore that property crimes may at least partially be motivated by greed, not need. In other words, a college education and the subsequent benefits in employment opportunities and higher income levels offered as a result should theoretically have a deterrent effect on property crimes since a "need" to commit crime is eliminated, though this effect is unobserved in both Blackmore (2003) and Kelly (2000).

Probability of apprehension is a key component to Becker's original theoretical framework, and as a result, attempts to model this variable are common throughout the literature. Blackmore (2003) suggests measuring the probability of apprehension using data on the clearance rate of all crime types studied. The clearance rate is the proportion of crimes that are successfully charged. Citing an empirical analysis of crime conducted by Fox (1978), the clearance rate is expected to be inversely related to the crime rate. Blackmore uses data on South Africa's expenditures on total protective services as an additional measure of police manpower. In theory, an increase in expenditures on total protective services as a percentage of GDP should mean a higher probability of apprehension for all crime types. In practice, Blackmore found that this hypothesis was true for only five of the fifteen crime types analyzed. This result may be due

to possible corruption within the South African Police Service, so including this variable in the model for the United States may yield better results. However, Kelly (2000) points out issues of endogeneity associated with using police expenditures to measure the deterrent effect of probability of apprehension on crime, because police expenditures are often higher in areas with high crime rates. Kelly (2000) uses a police expenditure variable despite this implicit endogeneity, assuming that police expenditure is determined independent of crime rates, finding that police expenditure is more negatively related to property crimes than violent crimes. Kelly (2000) goes on to reference ways of getting around the issue of endogeneity in this variable by using instruments, such as an income per capita instrument in Ehrlich (1973) or an electoral cycle police recruitment instrument in Levitt (1997) to find more significant negative impacts of police presence on crime. In a study of the determinants of bank robberies in the United States using state-level panel data, Samavati (2006) uses the number of police officers per 1000 residents as a proxy for the probability of apprehension, as clearance rate data were unavailable at the state level, with insignificant results. This level of insignificance may be the result of endogeneity discussed by Kelly (2000), but it is also likely due to the lack of important demographic explanatory variables in this model.

Demographic variables have consistently proven to be linked strongly with crime. The proportion of the population that are males of a specific age group, usually between the ages of 15 and 24, is a common variable to add, as this age group is the most likely group to commit violent crime. A higher proportion of males in this age group should correspond with higher rates of crime, and this is found to be true in the panel analysis conducted by Blackmore (2003). This variable was also included in the analysis conducted by Kelly (2000). Gender is generally included in the literature as a variable closely related to crime, and the proportion of the population that is female is the most common gender variable to use. Recently, Cook et. al. (2014) studied the

effects of gender asymmetry specifically on the crime-unemployment relationship in the US, finding that female unemployment exhibited significant opportunity effects on aggregate violent crime but not male unemployment (i.e. a negative relationship with violent crime in line with the opportunity force theory of Cantor and Land). In other words, the results of Cook et. al. supported the theory of Cantor and Land that in some instances, the unemployment rate may have a negative relationship with crime, assuming that as a result of unemployment, one spends more time at home, thus reducing the opportunities for criminals to commit crime. The robustness of Cook et. al.'s analysis is questionable, though separating and comparing the effects of male and female unemployment on crime is a worthwhile line of research to consider continuing.

Finally, some measure of the income level is almost always included in the determinants of crime literature. Income is expected to be negatively related to crime, as an increased level of income means that the opportunity cost of committing crime is higher than an individual with a low legal income. Gould et al (2002) noted that labor market prospects for young, unskilled men, the most likely demographic to commit crime, fell dramatically in the 80s and improved in the 90s, while crime showed a reverse pattern. In an attempt to establish a causal relationship between these two trends, this research represents the most successful expansion of the economics of crime literature to include a heightened focus on wages in crime determinant models. The results indicate that changes in wages are a much stronger and more reliable explanation for crime variation in this period than unemployment fluctuations. In the case of South Africa, Blackmore (2003) uses income per capita as an income variable. Contrary to what one may expect, income per capita was found to have a significant, positive relationship to nearly all crime types studied, proving to be an important variable to include in a crime model. An issue with using income per capita as an income variable is that is does not show the distribution of income among the population. Since income inequality is closely linked with crime as demonstrated by the literature,

increased incomes for the wealthy (hence an increase in income per capita) may explain this positive relationship.

Drawing from the rational choice theory of crime developed by Becker (1968) and expanded upon by Cantor and Land (1985), the macroeconomic variables that capture most of the variation in crime have been well-defined. Still, until the late 90s and early 2000s, the use of interdisciplinary, more nuanced models of crime were rare, as were the use of panel models that add a level of robustness that was missing from previous research. This research will focus on combining the various additions made by newer, interdisciplinary approaches to modeling the determinants of crime and applying it to the United States and South Africa. The aim is to provide a new perspective on the crime-unemployment relationship while answering a number of other fundamental questions related to the fight to ensure the fundamental human right of safety against violent crime. Is there safety in numbers when it comes to police officers and a large police budget? Should crime reduction be a higher-profile point to make in the debate to raise the minimum wage? Are higher rates of violent crime a side-effect of the widening gap between the wealthy and the rest of us? Do macroeconomic conditions impact the crime rate among men and women differently? These questions have been asked before and answered with varying degrees of success, and this research represents a novel addition to the ever-evolving literature on the economics of crime.

IV. Methodology

Data and Variables:

Following the precedent set by contemporary studies on the determinants of crime and the Becker (1963)-Ehrlich (1978) rational choice crime theory, this research uses a combination of economic, social and demographic variables in order to build an unbiased model that captures as much variation in the rate of crime as possible, given the available data. This research is the first of its kind to perform a state-level analysis of multiple measures of crime in the United States using post-1990s data. In addition, some novel measures of key explanatory variables for Income, Inequality, Education and Probability of Apprehension are tested. Four different measures of crime serve as dependent variables to be regressed against nine independent variables using data from all 50 states and the District of Columbia.

Two measures of violent crime and two measures of nonviolent crime are used as dependent variables in this research– the Murder Rate ($Murder\_Rate_{it}$), the Total Violent Crime Rate (V_Crime_{it}), the Larceny-Theft Rate ($Larc\_Theft_{it}$) and the Burglary Rate ($Burg\_Rate_{it}$). Annual data for these variables were gathered from the Uniform Crime Reporting Statistics published by the US Department of Justice and are measured in incidence per 100,000 members of the population in each state. The Violent Crime Rate is defined by the US Department of Justice as the aggregate number of murders, non-negligent manslaughters, forcible rapes, robberies, and aggravated assaults per 100,000 members of the population. Larceny-Theft is defined as the unlawful taking, carrying, leading, or riding away of property from the possession or constructive possession of another. Burglary is defined as the unlawful entry of a structure to commit a felony or theft. The Larceny-Theft Rate and the Burglary Rate were chosen because these crime-types are the two most common types of property crime in the United States.

The independent variables used in the final models are the Unemployment Rate ($Unemp_{it}$), Real Personal Income (RPI_{it}), the Poverty Rate (Pov_Rate_{it}), Income Inequality ($Inequality_{it}$), Percentage Female Population ($Gender\_Ratio_{it}$), Police Officers per 100,000

members of the population ($Police_{it}$), the Averaged Freshman Graduation Rate ($Grad\_Rate_{it}$), the proportion of the population that is male aged 15-24 (Age_Ratio_{it}) and the percentage change in GDP ($lnGDP_{it}$).

Unemployment rate data is collected from the U.S. Bureau of Labor Statistics' Local Area Unemployment Statistics. The unemployment rate measures the unemployed percentage of the civilian labor force. According to the BLS, persons are classified as unemployed if they do not have a job, are currently available for a job, and have actively looked for work in the prior four weeks, or are waiting to be recalled to a job from which they have been laid off. The theory and literature support a hypothesis that a significant, positive relationship exists between this variable and all crime types included in the final econometric model. Following the logic of the Becker-Ehrlich rational choice theory of crime, the unemployment rate may be viewed as a macroeconomic variable that represents the availability of non-criminal forms of income. As the unemployment rate rises, the opportunity cost of choosing criminal sources of income drops, therefore an increase in crime should be observed. It is important to note that this theoretical framework, when applied to violent crime, assumes that violent crimes are, in general, closely tied with criminal activity conducted with the purpose of generating income.

Data on Real Personal Income level in each state is collected from the Annual State Income and Employment data from the United States Bureau of Economic Analysis. The BEA defines Real Personal Income as the personal income at Regional Price Parities (RPPs) divided by the national Personal Consumption Expenditures (PCE) index. State-level RPI is measured in billions of US dollars. A negative relationship is expected to be seen between this variable and all crime types. In contrast to the unemployment rate's theoretical relationship with crime, as real personal income level increases, the opportunity cost of committing a crime also increases.

Therefore, we should expect to see a lower incidence of crime with higher real personal income levels.

Poverty Rate data comes from the US Census Bureau's Historical Poverty Tables. Poverty is measured as the percentage of the population living at or below the poverty level. The poverty level is determined by the US Census Bureau, which publishes annual poverty level guidelines for various sized families. For example, the poverty level for a family of 4 units was $17,050 in 2000 and $23,850 in 2014. Samavati (2006) uses this variable in his panel data analysis of US bank robberies with insignificant results, though his model may have been prone to omitted variable bias. Like this research, Samavati justified the inclusion of poverty rate as an income variable by referencing rational choice crime theory. A negative relationship between this variable and all crime types is expected.

Income Inequality data is collected from the Frank-Sommeiller-Price Series' Annual Top Income Shares by U.S. State. The inequality variable used in this research is the percentage share of income held by the top 5% of earners in each state. This dataset was generating using individual tax filing data published by the Internal Revenue Service (IRS). Kelly (2000) uses data from urban counties in the United States to study the crime-inequality relationship. The analytical framework employed by Kelly argues that "in the economics theory of crime, areas of high inequality place poor individuals who have low returns from market activity next to high-income individuals who have goods worth taking, thereby increasing the returns to time allocated to criminal activity" (Kelly, 2000). In addition, according to strain theory, when faced with the relative success of those around them, financially unsuccessful individuals may act out of frustration of their situation and be more-induced to commit crime. The interdisciplinary model of the determinants of crime in South Africa employed by Blackmore (2003) found that inequality was among the variables most closely related to crime, and a significant, positive effect of inequality

and all crime types is expected. Following the results of Kelly (2000), a stronger relationship between inequality and violent crime is expected as compared to inequality's relationship with the two measures of property crime employed in this model.

Data on the percentage female population in each state and the proportion of the population that is male aged 15-24 is generated using population data from the US Census Bureau Population Division's annual State-Level Estimates. These variables are included following the precedent set by Blackmore (2003), who found a significant, negative relationship between the gender ratio variable and crime, and a significant positive relationship between the age ratio variable and crime. As the review of the literature reveals, demographic data has only recently found its way in panel analyses of crime but has proven to be an important explanatory variable. Since males are more likely to commit crime than females, it is important to control for differences in gender proportion from state to state.

The number of police officers per 100,000 members of the population in each state is generated using the US Census Bureau population data and the US Bureau of Justice Statistics' Expenditures and Employment Extracts. This variable serves as a proxy for the probability of apprehension associated with committing crime. Probability of apprehension is an important element of rational choice crime theory. According to Becker, the perceived chances of being caught committing a crime are factored into an individual's cost-benefit analysis when deciding whether or not to engage in criminal activity. The number of police officers per 100,000 members of the population represents each state's police presence and activity. This variable is hypothesized to be related to a potential criminal's perception of how likely it is that they will be caught engaging in criminal activity, hence a negative relationship between this variable and all crimes is expected. As mentioned by Samavati (2006), clearance rates are a more desirable

measure of the probability of apprehension, though this data is not available on the state-level during the time period studied.

Averaged Freshman Graduation Rate (AFGR) data was collected from the National Center for Education Statistics Common Core Data (CCD). This variable serves as a proxy for the education level in each state. This research assumes that higher levels of education corresponds with a greater number of opportunities for legal sources of income. This factors into one's cost benefit analysis of crime as an additional, non-economic variable that affects the opportunity cost associated with criminal activity. A negative relationship between this variable and all crime types is expected.

Urbanization data was originally collected, though with just two years of available data on the state level, this variable was dropped from the final model because it was unable to be included in the panel regressions due to insufficient observations. This data was collected from the 2000 and 2010 Census Population Data, Rural and Urban Classification. Blackmore (2003) found that, along with unemployment and inequality, degree of urbanization was among the variables most strongly related to crime in South Africa. Following the crime theory of Cantor and Land (1985), urbanized areas have stronger opportunity force effects due to the relative population density. A positive relationship between this variable and all crimes is expected in models that include this variable, and future research would benefit from having a measure of urbanization in the analysis.

Finally, data on state-level GDP is gathered from the Bureau of Economic Analysis Regional Economic Accounts annual datasets. The log of GDP is included in the models to control for business cycle variations in the unemployment rate that may bias the analysis (Blackmore, 2003).

Final Econometric Models:

$$Crime_{it} = \alpha_i + \beta_1 Unemp_{it} + \beta_2 RPI_{it} + \beta_3 Pov\_Rate_{it} + \beta_4 Inequality_{it} + \beta_5 Gender\_Ratio_{it} + \beta_6 Age\_Ratio_{it} + \beta_7 Police_{it} + \beta_8 Grad\_Rate_{it} + \beta_9 lnGDP_{it} + \varepsilon_{it} \quad \text{Model (1)}$$

$$Crime_{it} = \alpha_i + \beta_1 Unemp_{it} + \beta_2 Unemp_{it}^2 + \beta_3 RPI_{it} + \beta_4 RPI_{it}^2 + \beta_5 Pov\_Rate_{it} + \beta_6 Pov_{Rate}{}_{it}^2 + \beta_7 Inequality_{it} + \beta_8 Gender\_Ratio_{it} + \beta_9 Age_{Ratio_{it}} + \beta_{10} Police_{it} + \beta_{11} Grad\_Rate_{it} + \beta_{12} lnGDP_{it} + \varepsilon_{it} \quad \text{Model (2)}$$

V. Results

Pooled Panel OLS regressions yielded high R-squared values and significant, generally-expected results with no multicollinearity (Variance Inflation Factors all less than five), though these estimates incorrectly assume that there are no state or year fixed-effects and are excluded from the results in this study due to inherent bias. Random and fixed-effects panel regressions were performed for each of the four measures of crime. Hausman tests were conducted for each regression, concluding that the fixed-effects model is the appropriate, more-robust choice. The Hausman Test results are shown in Table (1). The results of Model (1), the initial linear fixed-effects model, are shown in Table (2). Low R-squared values, insignificant results and numerous

unexpected signs prompted a reconsideration of the assumed linear relationship between all eight independent variables and crime. A number of functional forms were tested, and ultimately, a model that assumes a quadratic relationship between the economic variables ($Unemp_{it}, RPI_{it}$ and Pov_Rate_{it}) and crime fixed the issues of significance and unexpected relationships observed in the linear model. The quadratic model, Model (2), was also able to explain more variation in the rates of most measures of crime, with the exception of the Larceny-Theft rate. These results are shown in Table (3). This study is the first of its kind to study the determinants of multiple measures of crime using state-level data from the 2000s, and because of this time frame, the effects of the financial crisis of 2008 must be considered. Crime decreased steadily throughout the 2000s while the financial crisis of 2008 provided an exogenous shock on unemployment, income and poverty levels. Without introducing a time period dummy variable, these effects are revealed when implementing squared economic variables and are discussed in greater detail below. Compared to the analysis conducted by Blackmore (2003), this dataset is relatively unsuccessful in capturing variation in crime, suggesting that omitted variable bias is likely present. The results indicate that Rational Choice Crime Theory is a suitable framework for understanding changes in the rates of both violent and non-violent crime, though data availability at the state level prevents a more robust interdisciplinary model of crime form being tested.

I.) Murder Rate:

Consistent with the findings of Kelly (2000), Blackmore (2003), and numerous studies discussed in the surveys conducted by Freeman (1994), Box (1987) and Chiricos (1987), the relationship between unemployment and the murder rate is insignificant. Unexpected negative signs were observed in both the linear and quadratic models. These results are perhaps best

explained by Kelly (2000). In his study of inequality's effect on crime, Kelly makes the distinction between crimes that are motivated primarily by pecuniary concerns and those that aren't, suggesting that many violent crimes (including murder) are not committed for economic gain and are therefore not explained by conventional rational choice theory.

The relationship between income and the murder rate is significant and positive, though the magnitude of this relationship is so small that it is essentially zero. Income squared, however, exhibits a significant, negative relationship of a higher magnitude, suggesting that up to a certain point, changes in income don't drastically affect the murder rate. Eventually, once incomes rise past a certain level, the expected negative impacts of income on crime are exhibited. These results are supported by Gould et. al. (2002), who found that wages are a more important explanatory variable for crime than unemployment. Blackmore (2003) only tested a linear relationship between crime and unemployment but also found a significant positive effect of income on the murder rate. Blackmore (2003) used income per capita as an income variable instead of Real Personal Income and did not include any control for levels of inequality. Because of this, Blackmore's positive income-crime relationship may be the result of income increases for the wealthy minority. This study attempts to separate the two effects, though the use of share of income held by the top 5% of earners as an inequality variable does not change the results for income.

Poverty rate was insignificantly related to crime in the linear fixed-effects model but significant in the quadratic model. The expected positive relationship was observed for poverty rate and a negative relationship for poverty rate squared, suggesting that the combination of crime reduction during this period and an exogenous increase in poverty levels caused by the 2008 financial crisis influenced this relationship. These findings are inconsistent with Samavati (2006), who found that poverty rate was an insignificant explanatory variable in his study of bank robberies

in the United States. Kelly (2000) also uses poverty rate and achieves a significant, positive linear relationship across all crime types studied, including murder rate. The poverty rate statistic used in this research and the research conducted by Samavati (2006) does not distinguish beween men, women and children who fall under the poverty line. Kellly (2000) may have achieved significant linear results by only using the poverty rate of men aged 18 to 65.

II.) Violent Crime

The quadratic model explained more variation in the rate of violent crime than the linear model and achieved significance for every variable except the proportion of males aged 15-24. According to both models, high rates of unemployment correspond with lower rates of aggregate violent crime. As mentioned in the discussion of the results for the murder rate, these findings are not uncommon. A primary justification for these results comes from Cantor and Land (1985). These researchers proposed the idea of conflicting forces that affect the unemployment rate's role in potential criminals' cost-benefit analysis of crime. The motivational force, much in-line with the theory proposed by Becker (1968), is the positive effect that unemployment may have on crime– fewer legal opportunities for income motivates potential criminals to support themselves through illegitimate activities. In contrast, the opportunity force effect of unemployment may lower crime rates– because of higher levels of unemployment, more people are spending time at home and are making less money, therefore reducing the number of available opportunities for criminal behavior. The negative relationship found between unemployment and crime in both models suggest that the opportunity force effect of unemployment is more powerful than the motivational force, which means that conventional rational choice crime theory may not be the most suitable framework for studying the unemployment rate's relationship with violent crime at the state level.

Income is insignificant in the linear model, but significant in the quadratic model. A very slight positive relationship up to a certain point is exhibited between income and crime, until the relationship reverses at higher income levels. Once a certain threshold of income is met, the relationship is the same as that found in Gould et. al. (2002), which is negative across all crime types included in that study. Gould et. al. (2002) collected county-level and individual data in the United States, using log retail wage of uneducated males as the income variable. The results found here in the quadratic model indicate that real personal income levels for the entire population may provide a suitable substitute for retail wages in state-level analyses of crime.

The poverty rate exhibited an unexpected, significant negative relationship with violent crime in the linear mode. Assuming a quadratic relationship between this variable and crime solves this issue. As discussed above, this may be explained by the exogenous impact of the 2008 financial crisis. Poverty rate also has the highest impact on violent crime than any other crime type. The poverty rate is not exactly a wage variable, but these findings are consistent with the findings of Gould et. al. (2002), who found that wages explained more variation in violent crime than property crime. This is especially apparent when considering the results of both models on the larceny-theft rate, which found no significant impact of the poverty-rate.

Inequality's significant negative impact on violent crime is contrary to the hypothesized results, though this may be a result of not controlling for the effects of the 2008 financial crisis. Kelly (2000) calculated a Gini coefficient at the county level for a much more realistic measure of inequality, while an income-based variable is used in this study. Crimes continued their downward trend throughout the late 2000s though incomes rose for the wealthy minority in the post-recession United States, causing this negative relationship to be exhibited.

III.) Larceny-Theft

Of each of the crime types studied, the Larceny-Theft rate was least explained by both models by a significant margin. Other than log GDP, the only significant explanatory variables were the percentage female population and percentage of the population that is male aged 15-24, as well as income. Demographic variables across most crime types consistently yielded significant results, supporting the results of Blackmore (2003) that these are important inclusions to any interdisciplinary model of crime. Income exhibited positive effects in the linear model and positive effects after a certain point in the quadratic model, suggesting that as the general income level increases, people have more goods worth stealing, making the expected returns from larceny-theft higher.

IV.) Burglary Rate

The insignificant impact of unemployment on both the Larceny-Theft rate and the Burglary rate is highly unexpected. With this insignificance, in combination with the low R-squared values relative to panel data analysis conducted by Blackmore (2003) or most time series studies, the most likely explanation for this outcome is omitted variable bias. According to Box (1987) and Chiricos (1987), as well as recent findings by Blackmore (2003), the relationship between Unemployment and property crime is well-established as significant and positive, which we do not see in these results.

Income exhibited slight positive effects on burglary rate up to a point, followed by higher-magnitude negative effects very similar to the trend seen in the murder rate results.

VI. Conclusion

The results of this study are not able to reject the null hypothesis of a negative crime-unemployment relationship across all crime types. The issues of unexpected signs and insignificant results in the linear model of crime were largely fixed by making the assumption of a quadratic relationship between select macroeconomic variables and crime. This assumption makes sense in the context of the time period studied, which witnessed the effects of the 2008 financial crisis on the United States economy.

Data limitations at the state level presented difficulties in gathering variables that explained large amounts of variation in the crime types studied. The weakest variables were those that attempted to capture levels of inequality, probability of apprehension and level of education. Future iterations of this analysis would benefit from a more complex calculation of inequality than a simple share of income held by the top 5 percent of earners, instead taking the lead of Kelly (2000) and attempting to calculate inequality using both an income variable and an education variable to separate income inequality's impact on crime from other income variables. As Samavati (2006) discusses, police officers per 100,000 residents is not an ideal measure of the probability of apprehension but is the best available measure at the state level currently. Clearance rate data would be more appropriate, because endogeneity exists in police presence data due to higher numbers of officers in historically high-crime areas. Finally, Averaged

Freshman Graduation Rate and Averaged Cohort Graduation Rate are crude measures of the overall population's level of education, and if data were available at the state level, overall educational attainment levels of the population would have been more appropriate to use.

Since the time period studied includes the effects of the financial crisis, future studies during this time period may benefit from the addition of a time period dummy variable to separate the effects of pre-2008 and post-2008 independent variables on crime, eliminating the need to break from convention and assume a non-linear relationship between economic variables and crime. It was worthwhile to attempt to replicate Blackmore's results using state-level data in the way that Blackmore (2003) used provincial data in South Africa, though more accurate results may be achieved at the county level. Using county-level data would allow a more appropriate inequality variable to be tested in a manner similar to Kelly (2000) or Demombynes and Ozler (2005). County-level data would also open the possibility of incorporating an urbanization variable that has more observations than the very limited years available at the state level.

Despite the limitations of this study, some important insights may be drawn from the results. High levels of significance for the income variable across all crime types supports the finding of Blackmore (2003) that income is a highly important explanatory variable and should be included in crime determinant models. This is also true for the demographic variables, particularly the gender ratio. The effects of the financial crisis provide an unexpected hurdle to achieving expected results, but the introduction of non-linear estimates to the crime literature is an important finding. Finally, from the results of this study, the inclusion of a poverty rate variable may be an important addition to the interdisciplinary model of crime explored by Blackmore (2003).

VII. List of Tables

Table (1)

Model (1) Hausman Test	Murder Rate	Violent Crime Rate	Larceny-Theft Rate	Burglary Rate
Chi^2	109.81	504.04	102.31	834.39
p-value	0.0000	0.0000	0.0000	0.0000

Table (2)

Linear Fixed Effects	Murder Rate	Violent Crime	Larceny-Theft Rate	Burglary Rate
Unemployment	-0.2292***	-10.7452***	-28.9020***	-1.4313
	(0.045)	(1.641)	(6.745)	(2.372)
Income	0.0001**	0.0000	0.0174***	0.0061***
	(0.000)	(0.001)	(0.006)	(0.002)
Poverty Rate	-0.0407	-3.3089**	-9.2908	-2.5613
	(0.043)	(1.579)	(6.490)	(2.282)
Inequality	-0.0262	-1.7943	-0.5790	1.3470
	(0.030)	(1.099)	(4.518)	(1.589)
Female Pop. (%)	0.0206	-41.7083**	-375.2077***	-65.5294**
	(0.569)	(20.751)	(85.309)	(29.995)
Males aged 15-24 (%)	0.0194	0.9718	9.4648**	4.5294***
	(0.033)	(1.217)	(5.003)	(1.759)
Police per 100,000 people	-0.0156	0.9170**	2.2975	-0.4275
	(0.010)	(0.362)	(1.491)	(0.524)

HS Graduation Rate	-0.0184 (0.015)	-2.1476*** (0.546)	1.1480 (2.2431)	-0.2762 (0.789)
lnGDP	-1.6708 (1.070)	-14.5670 (39.112)	-1769.117*** (160.791)	-349.6169*** (56.535)
Constant	25.399***	2970.381**	41814.5*** (4831.868)	7946.14
R^2	0.0239	0.0998	0.0006	0.1211
N	480	480	480	480

All Standard Errors in Parentheses

*** indicates significance at 1% level

** 5%

* 10%

Table (3)

Non-Linear Fixed Effects	Murder Rate	Violent Crime Rate	Larceny-Theft Rate	Burglary Rate
Unemployment	-0.1257 (0.174)	-23.46913*** (6.556)	-41.3131 (27.831)	-4.2216 (9.512)
Unemployment^2	-0.0044 (0.011)	0.9018** (0.423)	0.5436 (1.797)	0.3028 (0.614)
Income	0.0008*** (0.000)	0.0176*** (0.004)	-0.0431*** (0.016)	0.0376*** (0.005)
Income^2	-7.5200*** (9.5700)	-1.8500*** (3.6100)	5.9100*** (1.530)	-3.2700*** (5.240)
Poverty Rate	0.5761*** (0.143)	20.5156*** (5.406)	28.4091 (22.94)	16.5404** (7.844)
Poverty Rate^2	-0.0241*** (0.005)	-0.9016*** (0.1875)	-1.2045 (0.796)	-0.7707*** (0.272)
Inequality	-0.0198 (0.029)	-2.3756** (1.097)	-0.5051 (4.660)	1.1607 (1.592)

Female Pop. (%)	-0.1224 (0.535)	-56.2172*** (20.212)	-374.9173*** (85.802)	-75.8880*** (29.326)
Males aged 15-24 (%)	0.0348 (0.031)	1.0540 (1.172)	9.4024* (4.974)	4.8841*** (1.699)
Police per 100,000 people	-0.0149 (0.009)	0.9241*** (0.348)	1.6601 (1.475)	-0.3208 (0.504)
HS Graduation Rate	-0.0176 (0.014)	-1.7910*** (0.542)	3.2261 (2.303)	-0.3706 (0.787)
lnGDP	-5.7567*** (1.190)	-123.4004*** (44.940)	-1338.271*** (190.782)	-547.3415*** (65.207)
Constant	61.5605 (31.406)	4508.066*** (1185.883)	37684.21*** (5034.292)	10038.36*** (1720.668)
R^2	0.0587	0.1556	0.0000	0.1246
N	480	480	480	480

All Standard Errors in Parentheses

*** indicates significance at 1% level

** 5%

* 10%

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