Unemployment and Property Crime in the United States: A Panel Study during the Great Recession

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Abstract

This paper examines the effect of unemployment rates on property crime rates during the United States' Great Recession. Using a panel data set consisting of 50 states, from the years 2005-2012, I seek to find the effect the Great Recession's higher unemployment rates had on the total occurrences of property crime. Using two separate fixed effect models, I tested for the unemployment rate's effect on total property crimes before the Great Recession in 2005 to 2007, and then for a time period of 2005 to 2012, which includes years prior to the Great Recession, years during the Great Recession, and the Great Recession's aftermath. The initial fixed effects model for the years 2005 to 2007 found that a one percent increase in unemployment rates will increase the total occurrences of property crime by approximately 0.025 percent. In an attempt to account for the Great Recession and its higher levels of unemployment, the second fixed effects model for 2005 to 2012 suggests that, at a 99 percent statistically significant level, a one percent increase in the unemployment rate will decrease total occurrences of property crime by approximately 0.012 percent. These findings disprove my hypothesis and run contrary to the theoretical and empirical framework. Overall, the study could be further enhanced with a strengthened Fixed Effects model, and additional variables that may account for omitted variable bias. Further, future studies could examine the unemployment rate's effect on specific property crimes to illuminate the relationship between the unemployment rate and certain types of property crime.

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I. Introduction

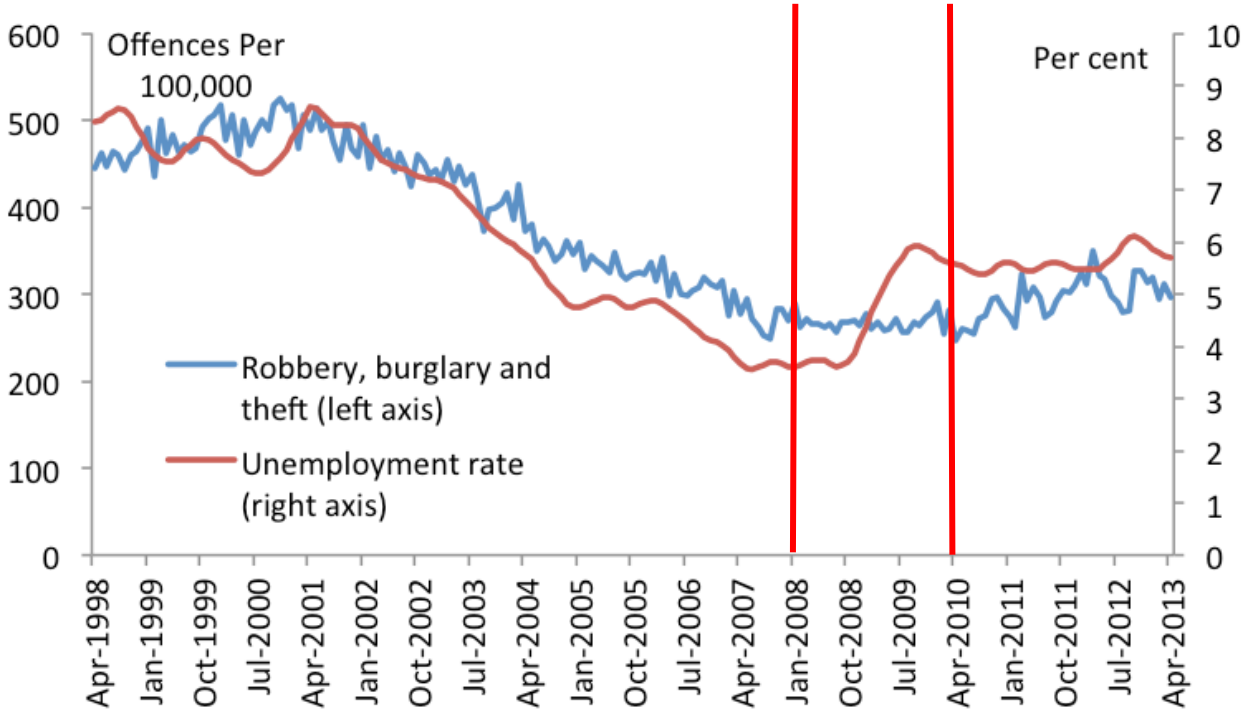
During the 1990's, crime rates in America fell year after year with violent and property crimes falling by nearly 30 percent. Concurrently, unemployment rates in America also decreased each year from 1992-1998. Trends throughout the history of crime statistics and unemployment rates have suggested that a correlation exists between unemployment rates and property crime rates. Additionally, empirical findings suggest that there are significant reasons to believe that an increase in unemployment will lead to an increase in the property crime rate. (Raphael and Winter-Ebner, 2000; Edmark, 2005.) The notion that the unemployment rates and property crime rates are linked makes intuitive sense as one can make the argument that those who are unemployed and are having difficulty obtaining a job could turn to profitable illegal activities in order to make up for lost wages and optimize wages earned, on the other hand, increased job opportunities as unemployment rates decrease, could deter potential criminals from committing crime since other profitable and legal employment opportunities exist. Either way, studies on the effect of unemployment rates on property crime rates have found statistically significant evidence, which would lead one to believe that an increase in unemployment rates will have a positive effect on property crime rates (Raphael and Winter- Ebner, 2001; Edmark 2005).

According to basic macroeconomic theory, a rising unemployment rate is often the symptom of a recession within an economy. From December 2007 to June 2009, the United States endured one of the harshest economic recessions in recent history. In 2008 and 2009 alone, the U.S labor market lost 8.4 million jobs, or 6.1% of total pay roll employment. This job loss has been the most significant employment contraction since the Great Depression. If the correlation between rising unemployment rates and crime holds, then as unemployment rates in America rose between 2007 and 2009, a simultaneous rise in property crime rates should be expected as well. However, this did not happen. Property crime rates fell

during the Great Recession, which leaves additional questions on what the effects of labor market conditions, such as the unemployment rate, are on property crime rates.

This rising unemployment rate and declining property crime rate during the Great Recession can also be found in other countries. The 2008 Financial Crisis spread around the world impacting countries in Europe, Asia and Australia. The profound impact of this global recession creates a degree of similarity when making a comparison of the unemployment rates and property crime rates of Australia, to those of the United States.

Figure 1



Source: Queensland Economy Watch, 2013

Figure 1 displays a monthly data set containing the total number of property crime offenses, as well as the unemployment rate in Queensland, Australia. From April, 1998 to April, 2007, a clear correlation between unemployment rates and property crime offenses can be seen. However, during the years of the Great Recession (2008 to 2010) something very bizarre happened. The unemployment rate increased dramatically; however, the property crime rate remained stagnant. The historic relationship of correlation between the two rates shifted in a way never before seen. Yet, once the Great Recession ended in 2010, the relationship between unemployment rates and property crime rates picked back up again with the normal positively correlated rates following one another. This odd anomaly in the relationship between unemployment rates and property crime rates that occurred during the recession between 2008 and 2010 leaves many questions. One of those questions being: what happened in the Recession that made the historically positive correlated relationship between unemployment rates and property crime rates alter so dramatically and then return to normal?

In this paper, I seek to answer the following question; "What was the effect of Great Recession's higher unemployment rates on the total occurrences of property crime in the United States?" In order to do so, I will establish and estimate the effect of unemployment rates on total occurrences of property crime during the Great Recession, using a state level panel dataset covering the years 2005-2012. The range of years covers a time period prior to the Recession, as well as after the Recession, which will isolate the Recession's immediate and short term effects on property crime. To estimate the effect of unemployment rates on property crime during the most recent recession I will utilize two, two ways fixed effects models comparing the effect of the unemployment rate on total occurrences of property crime from 2005 to 2007, and then from 2005 to 2012 to demonstrate how the Great Recession's elevated levels of unemployment effected total occurrences of property crime. The results I seek to find will provide some insight into the

question of what the effect of higher unemployment rates are on property crime rates, specifically during the Great Recession.

II. Literature Review

The topic of unemployment rates and property crime rates has been an issue of popular study amongst various scholars. Most of the existing literature is founded on the empirical framework established by Gary Becker (1968), who theorized that criminals are rational and that potential criminals base their decisions to engage in legal or illegal activities on marginal payoffs. After Becker's initial publication was met with widespread controversy, a number of authors began to examine empirically, the link between property crime and unemployment.

Among one of the earlier publications, Papps and Winkelmann (1998) conducted a panel study examining the relationship between unemployment and crime in New Zealand over the period of 1984-1996. Utilizing data that covered 16 regions of New Zealand, Papps and Winkelmann (1998) employed a model with random region effects and fixed time effects that showed that a statistically significant link did exist between unemployment rates and property crimes. The authors also noted that further research could improve with superior data and superior techniques that would create a more conclusive model which better examines the relationship between crime and unemployment.

Entorf and Spengler (2000) examined the potential link between labor market factors, such as youth unemployment and income inequality, and the crime rates in Germany, using data from 1975-1996. To do so, the authors used a panel data set of German regions with three groups of independent variables; deterrence, economic and socio-demographics. The author's deterrence variable accounted for the clear up rate, which is the proportion of the crimes that have been cleared by the police. The economic variables included in the study were the real GDP per capita, the unemployment rate, and the percentage of

unemployed people who were aged 24 years or younger. The socio-demographic variables accounted for the percentage of foreign citizens in the population, as well as the number of males aged 15-24 years in the population. Entorf and Spengler found very weak and ambiguous evidence suggesting there was a significant link between unemployment rates and overall crime rates. However, they did also pick up on a statistically significant, positive relationship, between *property* crimes and unemployment rates and that being young and unemployed increases the probability of committing crimes by anywhere from 0.39 percent to 0.66 percent. Their results may have also been affected by the reunification of East and West Germany. Entorf and Spengler suggest future research should more closely examine social and demographic influences of crime, such as poverty, gender, race, family background and social interactions.

Following the lead of Papps and Winkelman (1998) and Entorf and Spengler (2000), Carmichael and Ward (2000) conducted a panel study to investigate the relationship between crime and adult and youth male unemployment in various counties in England and Wales. The authors use eight years of data spanning from 1989-1996 which is implemented into a fixed effects model. The authors used a multitude of variables including the unemployment rate, different groups of age ranges, property crime clear-up rates and a variable accounting for the percentage of births outside of marriage. They find results indicating that male youth unemployment and male adult unemployment are both significantly and positively related specifically to burglary, theft, fraud, forgery and total property crimes. Specifically, they find that a one percent increase in the unemployment rate of males under age 25 increases the total occurrences of property crime by roughly 156 occurrences.

After studies examining the effect of unemployment on crime rates were conducted in New Zealand, Germany and England, American authors also began to look into the possible link between the two. Raphael and Winter-Ebner (2001) examine the relationship using a state level panel study that controls for various state-level demographic and economic factors between the years 1971 and 1997. The

state level demographic variables account for prison population, per capita alcohol consumption, the percentage of the state population in a metropolitan area, the percentage of the population that is under the state determined poverty line, and the percentage of the population that is African American. The authors also account for population age groups, ranging from under age 15, to age 64. The economic variables included in the study account for the unemployment rate and average income per worker. The authors used a 2 Stage Least Squares Regression, to address omitted variable bias and multicollinearity. The instrumental variables used in the 2SLS Regression account for state military contracts and oil shocks that impact state unemployment rates. These instrumental variables are exogenous and are unrelated to other possible contaminating factors in their model. Raphael and Winter-Ebner (2001) found statistically significant results that across different specifications and ranges suggests that a 1 percentage point increase in unemployment could lead to a 1 percent to 5 percent increase in total occurrences of property crime. The authors also found results indicating a significant relationship between property crime and unemployment, however, this relationship did not exist between violent crime and the unemployment rate. Raphael and Winter-Ebner (2001) conclude that based on their findings, public policies aimed at improving employment prospects would be an effective anti-property crime policy.

Gould, Weinberg and Mustard (2002) is another American study on the relationship between crime and economics, however, their study examines not only the impact of unemployment on crime, but also the impact of wages on crime. To explain the ten year change in unemployment and property crime from 1979-1989 the authors use annual county-level data of 400 US counties, from 1979-1997 with county and time fixed effects. The authors also include an additional analysis using instrumental variables accounting for the industrial composition in a state and at the national level and technological change within each industry, to explain the changes in property crime over the time range.. They also use an individual level data set to test whether local labor market conditions explain individual criminal activity. The authors include economic

variables accounting for state unemployment rates for the college educated and non-college educated population, income per capita, and average state wage. The authors also include deterrence variables regarding the number of employed police officers, arrest rates, and state expenditures on police. Gould, Weinberg and Mustard (2002) conclude that their analysis shows that wage trends and unemployment explain more than 50% of the fluctuation in property crime indexes from 1979-1997.

Drawing upon the conclusions found from different authors around the world, Edmark (2005) examined the impact of unemployment rates on crime rates in Sweden. In the early 1990's, Sweden faced a severe recession, creating a level of unemployment that had never been seen before in the country. Edmark used a panel study over 1989-1999 to study the effect of unemployment on property crime rates. Edmark used a regression with fixed effects including time and county specific effects, and economic and socio-demographic variables that accounted for the unemployment rate, average income, the rate of crimes solved by the police, education, percentage of foreign citizens, alcohol sales, and number of divorces. Edmark determined that the unemployment rate had a positive and significant effect on the total occurrences of property crime. Specifically, the author states that a 1 percent rise in the unemployment rate increases burglary by 0.15 percent and car theft by 0.16 percent. Further, Edmark determines that these results suggest that common changes in the unemployment rate can have substantial effects in terms of the number of property crimes. In regards to other aspects of crime, Edmark (2005) determined no significant relation between unemployment and violent crimes existed.

The evolution of the literature regarding unemployment and property crime suggests that unemployment does have a positive effect on crime rates, specifically property crime. However, up to this point, most studies regarding the United States have only examined unemployment rates and property crime rates pertaining to the 1980's and 1990's. The United States labor market experienced a dramatic exogenous shock with the advent of the Great Recession beginning in December of 2007, which led to

major increases in the unemployment rate and the loss of 8.4 million jobs. Thus, with the findings of previous studies suggesting that a rise in unemployment rates will lead to a rise in property crime in mind, I seek to establish the validity of this relationship as it applies to the time period before and after America's Great Recession.

III. Economic Theory and Testable Hypothesis

The essential foundation that links crime and economics is derived from Becker's economic theory of crime (1968). Becker's theoretical framework applies the basic principles of consumer behavior within a market to the way people choose criminal or noncriminal alternatives. Becker establishes that non-violent crime is committed on the basis of rationality, utility maximization, and cost-benefit analysis on the part of the potential offender. Further development of Becker's theory, led to the creation of Grogger's (1998) Unemployment Effect model, which examines the relationship between unemployment and property crime, as seen in Figure 2:

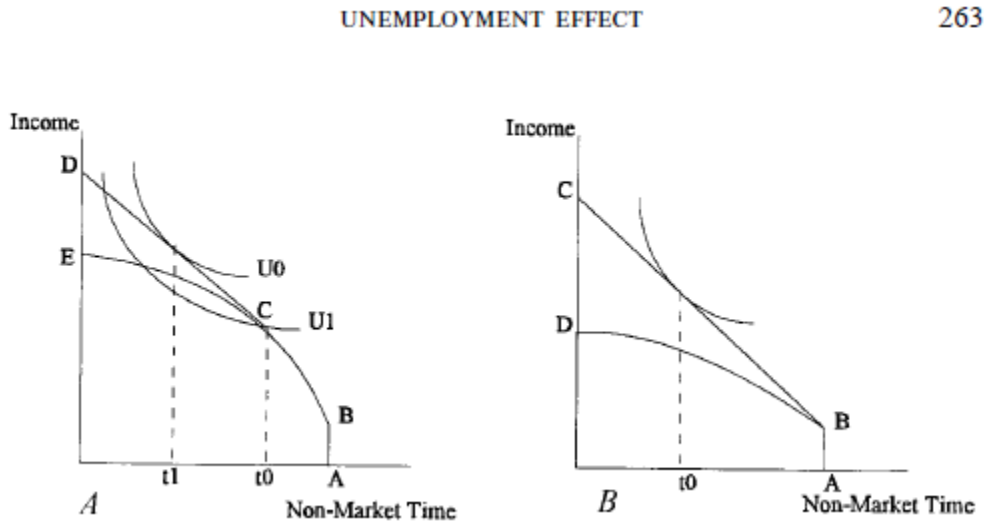


Figure 2

Grogger (1998) explains that in Figure 2A an individual has discretion over *A* hours of time and non-labor income equal to the distance of *AB.* The person converts nonmarket time into income by engaging in either legitimate employment or income-generating criminal activity. The returns to crime, represented by the curve BCE, are assumed to be diminishing because individuals first commit crimes with the highest expected payoffs, before exploring less lucrative opportunities. Figure 2A's model implies a budget constraint that differs from standard labor-leisure models, where t_0 represents a point that equates the marginal returns of time allocation spent engaging in both legitimate and illegitimate activities. Any time allocation to the right of this point involves more criminal activity, such as *A*, and any point to the left of t_0, such as t_1, denotes more work in the legitimate market. For those whom the marginal returns of crime never exceed potential wages in the legal labor market, the budget constraint is a normal labor-leisure model as seen in Figure 2B. This is shown where the marginal income generated by criminal activity (curve *BD*) is always less than the income generated by an additional hour of legitimate work (line *BC*). Assuming that the returns to allocating a small amount of time to criminal activity exceed potential wages, the individual would supply time to the legitimate labor market only after a few higher-paying criminal opportunities have been fully exploited. This occurs at point *C* where the person has allocated $A - t_0$ time to crime and where the marginal return to crime equals potential wages. Beyond point *C*, wages exceed the returns to criminal activity.

Grogger (1998) theorizes that his model can also be used to illustrate how unemployment affects crime rates by analyzing the possible behavioral responses to an unemployment spell. In Figure 2A, for individuals with relatively low potential wages, unemployment can shift the budget constraint from *ABCD* to *ABCE.* Whether this increases time allocated to criminal activity depends on the individual's preferences. For the individual in Figure 2A, the shift unambiguously increases the time devoted to criminal activity. Furthermore, the model predicts that for people who engage in criminal activity while working, an increase

in the unemployment rate will increase the time allocated to crime. As for the individual in Figure 2A who already engages in only criminal activity, unemployment will not affect the time allocated to crime. In Figure 2B, for workers with wages that always exceed the marginal return to crime, unemployment increases will shift the budget constraints from *ABC to ABD.* These new constraints determine whether or not the individual commits a crime as a result of an increase in unemployment. The individual's likelihood to commit a crime depends on whether the return to the initial hour of criminal activity exceeds his or her reservation wage. Individuals with relatively higher reservation wages will be unlikely to commit crimes as a result of an unemployment spell, whereas individuals with a relatively low reservation wage are more likely to attempt to offset income lost to unemployment through criminal activity (Grogger, 1998). This model does not account for variables that may effectively deter crime, but only examines the effect of wages and unemployment on an individual's propensity to commit crime.

The combination of Becker's economic theory of crime and Grogger's (1998) unemployment effect model allows for an understanding that it is possible for unemployment rates to effect the rate of property crime on the basis of rational choice, expected utility, and payoffs in the legal and illegal market. Through utilizing both theories I seek to answer: what was the effect of the Great Recession's high unemployment rates on the total occurrences of property crime? The testable hypothesis of this study is: *The Great Recession's higher unemployment rates will increase the number of total property crimes.*

IV. Data

The empirical model used in this study is designed to examine the unemployment rate's effect on property crime rates during the United States' Great Recession. To properly examine this research question, the state level panel data set will cover the periods of 2005-2012 for the 50 states, excluding Washington D.C. Property crime values consist of all total occurrences of burglary, larceny, and motor

vehicle theft. The dependent variable in the empirical model accounts for the total occurrences of reported property crime. All crime data and statistics were collected from the FBI's Unified Crime Report (Uniform Crime Reporting Statistics.) It is important to note that these property crime statistics do not include crimes that occur, but are not reported. This aggregate data is comprised of the compilation of data collected by local law enforcement agencies.

To account for state specific and socio-demographic variables, the number of citizens in poverty in a state, the percentage of the population over 25 with a Bachelor's degree and a proxy for race is added that accounts for the percentage of a given state's population of black citizens. All of these variables were collected from the U.S. Census Bureau (American Fact Finder) and are included in the panel data set. The state specific economic variable of interest included in the study is the unemployment rate, which was collected from the Bureau of Labor Statistics (Local Area Unemployment Statistics.) To account for criminogenic commodities that are typically complements to criminal behavior, variables that account for alcohol consumption and incarceration rates were added to the panel data set. The per capita alcohol consumption, measured in gallons of ethanol, was collected from the National Institute of Alcohol Abuse and Alcoholism, whereas the incarceration rates per 100,000 people in a given state were collected from the Bureau of Justice Statistics. The incarceration variable is added as a deterrence related variable, representing the potential risk and possible cost that prison time would be to a potential offender. In this study I included the incarceration rate as a deterrence related variable rather than a variable regarding the police force because the incarceration rate represents the likelihood of an offender being caught, convicted, and then sentenced, whereas a police force variable would only indicate the probability of an offender getting caught. Thus, increased incarceration rates would theoretically serve as an increased deterrent to committing a crime because they represent the total marginal costs associated with committing a crime, rather than just the potential cost of getting caught by the police.

It is to be noted that this panel data set does not include all of the variables that may account for the variation in the relationship between unemployment rates and crime rates due in part to the fact that one cannot fully observe all the possible variables that affect crime. To exploit all aspects of the panel data set and control for state and year variation, fixed effects were added to the state level data. This fixed effect addition is implemented in an attempt to eliminate all variation in crime rate caused by factors that vary across states, yet are constant over time. In accordance with the fixed effects of the individual, which is in this case is the state, a fixed effect is also added to the time variable, which in this study is represented by the year. Variable definitions and statistics can be found in Table 1, in the Appendix.

V. Empirical Methodology

To examine the relationship between unemployment rates and property crime occurrences, before and after the Great Recession, this study uses two fixed effects models pertaining to data from the 50 United States, between 2005 and 2012. One of the fixed effects models examines the time period of 2005-2007 to analyze the unemployment rate's effect on property crime occurrences before the Great Recession. Whereas the other fixed effects model examines the time period of 2005-2012 to analyze the Great Recessions higher unemployment rate's effect on property crime occurrences.

The Econometric Model used for the Two Way Fixed Effects Models is as follows:

$$lnPC\_TOTAL_{it} = \beta_0 + \beta_1 UE\_RATE_{it} + \beta_2 lnINCARCE_{it} + \beta_3 lnPOV_{it} + \beta_4 BACHELOR_{it} + \beta_5 lnALCOHOL_{it} + \beta_6 B\_RATE_{it} + \varepsilon_{it}$$

Where:

lnPC_TOTAL is the dependent variable in the empirical model which measures the total occurrences of property crime. This variable is the sum of all property together. This includes burglary, larceny and motor theft.

UE_RATE measures the unemployment rate percentage that comes from the number of unemployed individuals divided by all individuals currently in the labor force. According to Grogger's (1998) Model of Unemployment and Crime, as the unemployment rate rises, the crime rate is also expected to rise. Thus, the expected coefficient should have a positive effect on total occurrences of crime.

lnINCARCE measures the log of the incarceration rate of a given state. Incarceration is seen as a marginal cost associated with the risk of committing a crime. If incarceration is truly a deterrent in the rational offender's decision to commit a crime, than a higher incarceration rate may lead an offender to deduce that there exists a higher likelihood of being incarcerated if the crime is committed, resulting in the offender not committing the crime due to the marginal cost of prison time. However, higher incarceration rates may exist in areas that already have higher crime rates. If the former belief regarding incarceration is true, then *INCARCE* is expected to have a negative effect on crime rates as it pertains to this study.

lnPOV measures the log of the number of people in a given state that are below the poverty level as defined by the U.S. Census Bureau. The more impoverished people who may already be struggling from a spell of unemployment may face a higher likelihood and higher propensity to commit a crime due to the expected marginal benefit associated with crime that cannot be found in the legal market due to unemployment or whatever the issue is that is creating the state of poverty. Thus, *POV* is expected to have a positive effect on crime rates.

BACHELOR measures the proportion of the population over 25 in a given state that has obtained a bachelor's degree. Including a variable reflecting the level of educational attainment in a state is a measure of socio-demographics. Generally, those with a bachelor's degree are able to obtain higher earning jobs which would result in an increased ability to obtain a higher wage. This higher wage would present more of an incentive to find and seek the marginal benefits of legal work, rather than engaging in criminal activity and its associated costs. The variable is expected to have a negative sign, since a higher proportion of

bachelor's degrees could potentially result in higher paying legal jobs, the likelihood of engaging in criminal activity intuitively should decrease, overall, decreasing the total occurrences of crime.

lnALCOHOL measures the per capita consumption of alcohol as measured in gallons of ethanol. Alcohol is seen as a complement to criminal behavior, as it is often a factor involved in the decision making process related to engaging in illegal activity and irrational behavior. Since crime tends to have a positive relation with alcohol consumption, *lnALCOHOL* is expected to have a positive effect on crime rates.

B_RATE is a measure of the total number of African American citizens in a given state. This variable is associated with racial demographics for a given state. Past studies have found that black males and females are affected by unemployment at a higher rate than white males and females. If this racially based unemployment pattern holds, and the theory that a rise in unemployment leads to a rise in crime, then it can be deduced that blacks may have a higher propensity to seek the marginal benefits of engaging in criminal activity if a spell of high unemployment rates exist. This in turn, means the variable for *B_RATE* is expected to have a positive effect on crime rates.

This study includes two fixed effects models examining the effect of the unemployment rate before and after the Great Recession. As established in prior literature, the two way fixed effects models are necessary for this study in order to exploit the various aspects of the panel data set that account for year and state specific variations that are unspecified in a standard ordinary least squares regression. In both models, some of the variables are logged to determine crime related elasticities. Table 2, in the Appendix, presents a summary of statistics and the expected signs for the variables included in this study.

It should be noted that the variables included in the study could create a certain degree of multicollinearity. However, I believe that these variables are appropriate to include in the model considering that many of the previous studies have also included the similar variables. To further gauge variable

correlation, Table 3, in the Appendix, displays statistics regarding the correlation between the individual variables included in the model. Table 3, suggests that the variables regarding the incarceration rate, poverty and the percentage of African American citizens in a given state are all highly correlated. This could be due to a shared commonality between each group where, highly impoverished people also are highly likely to become incarcerated, or where there is a higher amount of the African American population that is incarcerated or impoverished. Further it is important to understand that the results may be impacted by multicollinearity.

VI. Empirical Results

In an attempt to answer whether an increase in unemployment rates had a positive effect on property crime rates, before and after the Great Recession, two fixed effects models were created to analyze the data. The results of models 6.1, 6.2, can be seen in Table 4, located in the Appendix.

6.1 Fixed Effects Model for 2005-2007

To observe the effect of unemployment on property crime prior to the Great Recession, this two way fixed effects model observes a time period of 2005-2007. This model accounted for 150 observations, displayed an F-Value of 102.47 and returned with an R squared of 0.9994, suggesting that the variables included in the model accounted for 99.94 percent of the variation in total property crimes. However, such a high R-Squared in a fixed effects model suggests that the model may be contaminated by multicollinearity. The model for this time period before the Great Recession returned two variables of statistical significance; the unemployment rate, and the variable for the percentage of the African American population in a given state. The variable of interest, unemployment rate, returns with a positive coefficient suggesting that a 1 percent increase in the unemployment rate will increase the total occurrences by 0.024261 percent. This coefficient is very low, however, it in accordance with the theoretical framework, which suggests that an

increase in unemployment will result in an increase in the amount of property crime (Becker, 1968; Grogger, 1998). The other statistically significant variable, at the 99 percent level, in this model is for the percentage of the African American population in a state. The results suggest that a one percent increase in the African American population, relative to all other racial groups, will decrease the total occurrences of property crimes by 0.08764 percent. This runs counter to the expected sign for the racial variable, as the African American population tends to be more dramatically effected by unemployment, which if Grogger's Model (1998) holds true would suggest that this racial group would have an increased propensity to engage in illegal market activity to make up for any wages lost from a spell of unemployment. Furthermore, this model suggests that an increase in unemployment has a positive effect on the total occurrences of property crime, however, it is important to note that this model covers a three year time period prior to the labor market shock of the Great Recession.

To address the possibility of the model's multicollinearity contamination, a similar model was used removing the highly correlated variables: incarceration rates, the number of people in poverty and the percentage of African Americans in a given state. The results were designed to examine if the unemployment rate still had a positive effect on property crime before the Great Recession once the multicollinearity between certain variables was removed. Further, the results suggest that the unemployment rate still had a positive impact on property crime even once potential multicollinearity was accounted for.

6.2 Fixed Effects Model for 2005-2012

To account for the economic shock of the Great Recession the model is now adjusted to account for the time period from 2005 to 2012, which covers the years before, during and after the Great Recession. The two way fixed effects model contained 50 cross sections over a time series of 8 years. 397 observations were used, displaying an F-Value of 90.89 and an R-Squared of 0.9980; suggesting that the

independent variables of the model account for 99.80 percent of the variation in the dependent variable, property crime. Again, as stated in section 6.1, it is important to realize concerns regarding multicollinearity in the model. A multicollinearity test similar to that used in 6.1, which removes the highly correlated variables from the estimation, returned results that remained stable to those found in 6.2. The only two variables to retain significance were *lnALCOHOL and UE_RATE.* The log per capita alcohol consumption variable had a flipped coefficient relative to the 2005 to 2007 fixed effects model, resulting in the 2005 to 2012 model's per capita alcohol consumption variable having a positive effect on property crimes. Specifically, the fixed effects model suggests that a one percent increase in per capita alcohol consumption will increase property crimes by 0.141923 percent. The per capita alcohol variable was found significant at the 90 percent level.

The most surprising aspect of the fixed effects model regards the variable of interest in the study; unemployment rates. Once cyclical changes were accounted for by state and year, the fixed effects model found unemployment rates to have a negative effect on the total occurrences of property crimes. At the 99 percent statistical significance level, the unemployment rate variable estimates that a one percent increase in the unemployment rate will lead to a decrease in property crimes by 0.01139 percent. Again, it is worth noting that the unemployment rate variable returns with a 99 percent level of significance, however, it is still very low. These results run contrary to previous literature which has established either a positive relationship between unemployment rates and crime, or no relationship between the two. These results also exist in disagreement with the theoretical and empirical framework established by Becker (1968) and Grogger (1998). Further, it can be hypothesized that the results return a negative coefficient for the unemployment rate due to either omitted variable bias in the model or some type of odd phenomenon regarding property crimes that occurred in the United States' Great Recession, or, a combination of both.

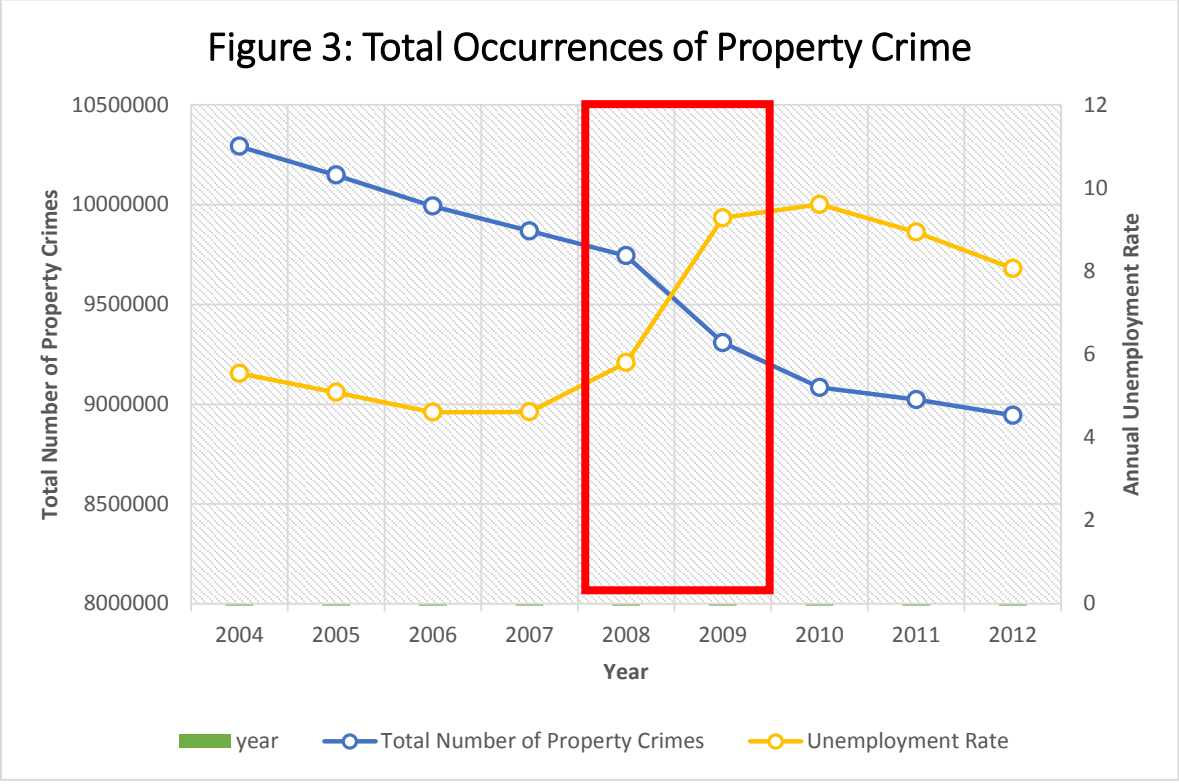
In summation, the two-way fixed effect models reveal that individual states, years and cyclical effects have an impact on the overall effect of the variables included in the model. The 2005 to 2012 model accounts for the effects of the Great Recession on the variable of interest, the unemployment rate. These effects resulted in the unemployment variable's negative coefficient that remained statistically significant. This suggests that the Great Recession may have had a dramatic impact on the relationship between unemployment and property crime. The results of the 2005 to 2012 fixed effects model do not follow the established theory, prior literature or historic trends regarding unemployment and its effect on property crime. This may be the result of omitted variable bias or a national phenomenon that has decreased the amount of property crime

VII. Conclusion

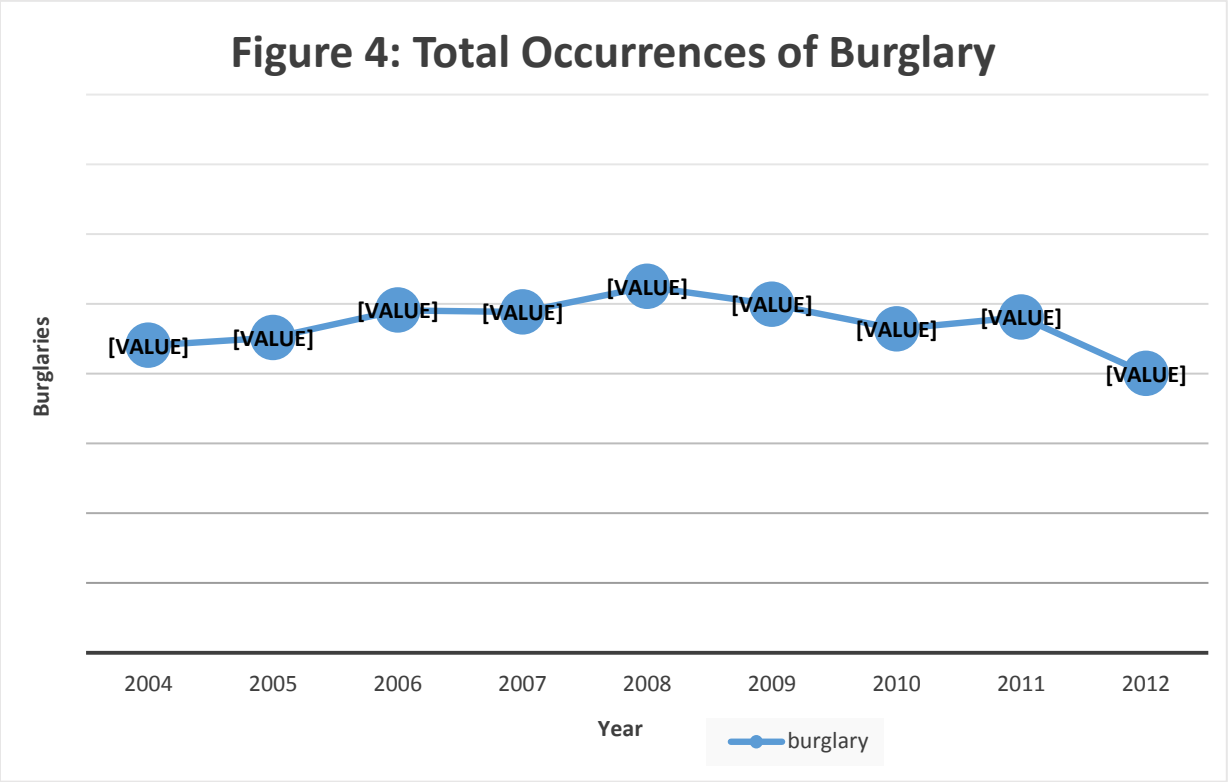
In an effort to find the unemployment rate's effect on property crime during the Great Recession, two fixed effects models were implemented, to examine a time period before the recession and a time period including the recession and its aftermath. The initial model explained in 6.1, accounted for 2005 to 2007, before the Great Recession, and found unemployment rates to have a significant and positive effect on property crime rates, where a one percent increase in the unemployment rate would increase the total occurrences of property crimes by 0.024261 percent. However, once the Great Recession is accounted for in the model described in 6.2, the unemployment rate is found to have a negative effect on the total occurrences of property crimes, where a one percent increase in the unemployment rate would decrease the total occurrences of property crimes by 0.01139 percent. These coefficients suggest unemployment has a very small effect on property crime, however, it is a statistically significant effect. The finding of a negative unemployment coefficient contests the theoretical framework, disproves my hypothesis and runs contrary with the previous literature regarding the topic. Consequently, the results from the fixed effect model suggest that during the two year period from 2008 to 2009 of the Great Recession, the historical positive

relationship between property crime and unemployment experienced an anomalous structural shift that was unexpected according to Becker's theory. In addition, Figure 1 and Figure 3 display that in the years following the 2008-2009 Recession that the unemployment rate and property crime returned to the standard predicted positive relationship described in the theoretical framework.

The time series displayed in Figure 3 shows that overall property crime rates appear to be on the decline, rather than just correlated with the unemployment rate. Figure 3 shows that even though the unemployment rate increased during the years of the Great Recession, crime rates were unaffected by this increase, and inversely continued to decrease. In sum, the unemployment rates did not have a positive effect on property crime rates during The Great Recession. Once the elements of property crime (burglary, larceny and motor vehicle theft) are more closely examined, in begins to make sense why this decline of property crime continues to happen.



Figures 4, 5, 6, illustrate a time series graph of burglary, larceny and motor vehicle theft, respectively. These graphs display the declining property crime patterns that have been seen between 2004 and 2012. Burglary and larceny occurrences do experience gradual decline, however, the dramatic decrease in property crime is due to the drastic drop in the amount of motor vehicle thefts, which can be seen in Figure 6. A total of 1,229,443 motor vehicle thefts were reported in 2004, and nine years later only 717,392 motor vehicle thefts were reported in 2012. Over this nine year time period, which includes years reported in this study, motor vehicle thefts dropped by 41.6 percent. This decline in motor theft vehicles can be seen as the major impetus behind the decline in property crime over the 2000's.



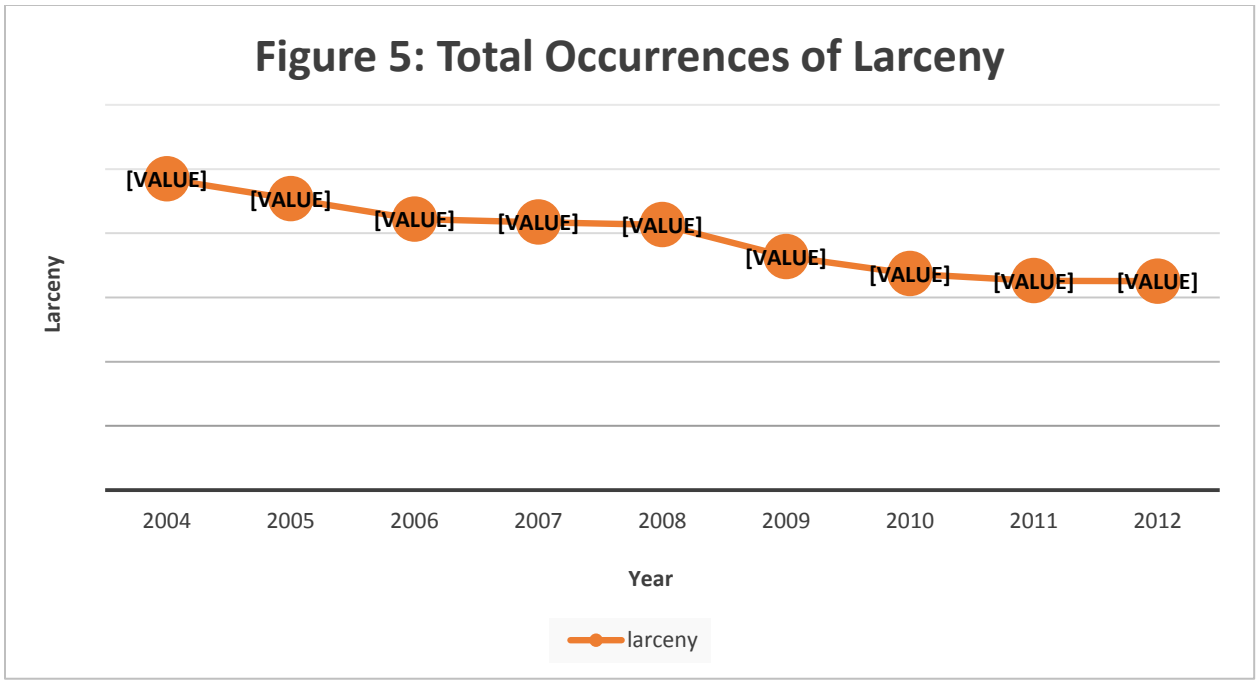


Figure 5: Total Occurrences of Larceny
Larceny
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year
larceny

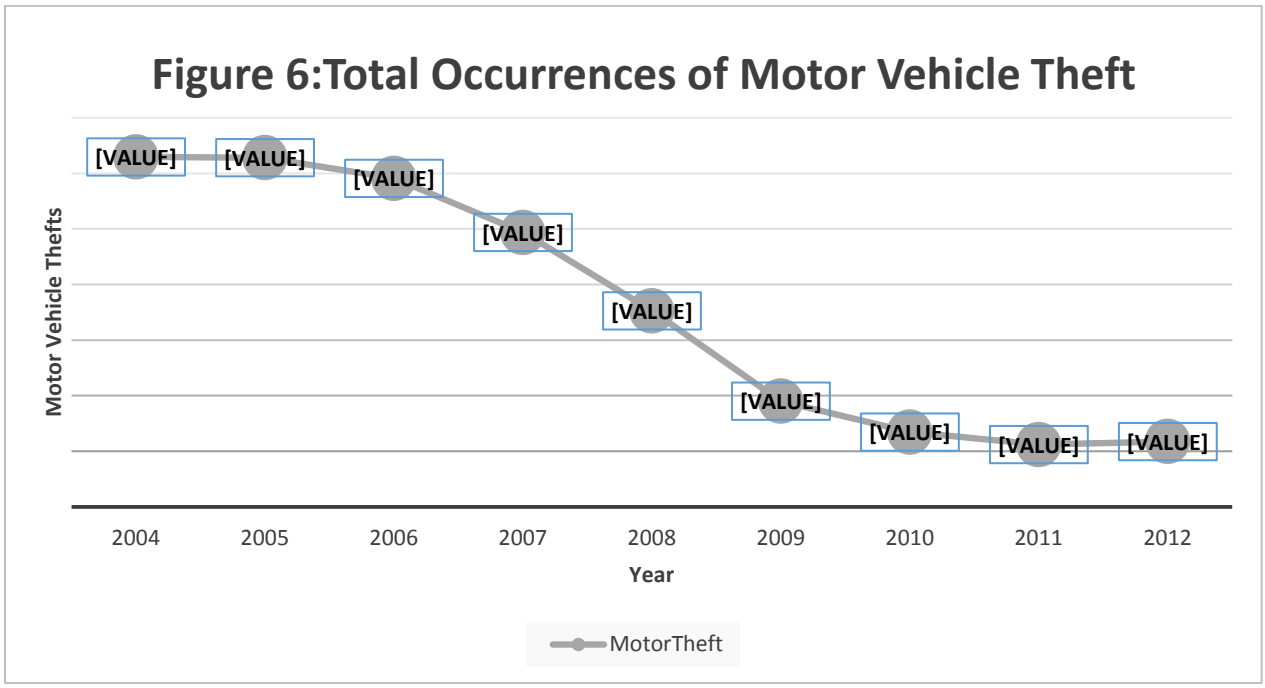


Figure 6:Total Occurrences of Motor Vehicle Theft
Motor Vehicle Thefts
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
[VALUE]
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year
MotorTheft

This sudden drop in motor vehicle thefts leaves questions as to why this phenomenon occurred. In the mid 2000's car manufactures began producing cars with upgraded security systems, resulting in cars that were harder to break into or steal (Barro, 2014.) These protocols included better locking and alarm mechanisms that protected cars from being broken into or burglarized. Additionally, manufactures also introduced new wiring mechanics making it much harder for criminals to attempt to start a car without a key, or "hot-wire" a car so that it could be driven away and stolen from the owner. These upgraded security systems decreased the ease and accessibility for stealing cars, reducing the supply of available cars to steal for criminals in the motor vehicle theft market. Thus, the total number of stolen motor vehicles depends on the percentage of the supply of cars with upgraded security systems. Further, when the Great Recession hit, prices in the used car market soared and then dropped (Tuttle, 2014.) In order for a stolen car to provide marginal payoffs it must be resold or sold for parts back on to the used car market. This price drop, in addition to older cars losing value through depreciation, created a less lucrative stolen car market, in turn reducing the marginal benefit of stealing cars, therefore, decreasing the demand for stolen cars. This downward equilibrium shift in the stolen car market probably also determined the massive decrease in the amount of motor vehicle thefts that occurred over the 2004 to 2012 time span.

As it pertains to this study, the drastic drop in motor vehicle theft can offer a potential hypothesis as to why the increased unemployment rates of the Great Recession had a negative effect on total property crime occurrences. Even though the unemployment rate skyrocketed during the years of the Great Recession, the continued rapid decrease of motor vehicle thefts overpowered any increases in property crime that might have stemmed from increased levels of unemployment. Although the results of this study run contrary to the theoretical framework, the decrease in motor vehicle thefts, in addition to other criminal justice theories explaining the overall decrease in crime, such as an aging population, increased use of birth control and increased incarceration rates, can help justify the odd phenomenon that occurred in the

relationship between property crime and unemployment rates during the Great Recession (Goldstein, 2014.) Further, the results suggest that fighting property crime through boosting employment may not have the desired anti-crime effect that public policy often desires.

My model has shortcomings of its own and could certainly be improved to more adequately determine the unemployment rate's effect on property crime rates. For one, it is impossible to accurately capture all of the economic, socio-demographic and intangible variables that could possibly be determinants of crime, and adding these variables to the model could help expand the explanatory power and reduce omitted variable bias. With this being said, further improvements to the fixed effect model that account for omitted variable bias could resolve possible discrepancies between my results and similar studies results. Also, accounting for two-way causality in the relationship between unemployment and crime would help to further isolate the true nature of the root of the research question, and determine which variable is the cause of the other; unemployment rates or property crime rates. Variables that could be included in future studies could account for different groups of ages in the population, the percentage of a state that is divorced, and the percentage of cars with upgraded security technology. Further analysis could also be done on individual types of property crime to determine if the unemployment rate has a more significant effect on specific types of property crimes, rather than others, specifically on motor vehicle thefts. Overall, more advanced econometric modeling techniques beyond the fixed effects, such as the 2 stage least squares regression, as well as additional variables could help further illuminate the link between unemployment rates and property crime rates before and after the Great Recession.

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Appendix

Table 1: Variable Definitions and Sources		
Variable	Definition	Source
lnpc_total	Total Occurrences of Property Crime (Theft, Larceny, Burglary, Motor Vehicle Theft) [9.3934; 13.99823]	FBI's UCR
ue_rate	Annual Unemployment Rate of a given state, in a given year [2.5; 13.8]	Bureau of Labor Statistics
lnpov	Log of the total number of people below the poverty line in a given state, in a given year [6.23,10.54]	U.S. Census Bureau
bachelor	Percent of population over 25 , in a given state, that has obtained a Bachelor's Degree [16.5; 39]	U.S. Census Bureau
lnincarce	Log of number of citizens incarcerated per 100,000 citizens in a given state, in a given year [37.1189; 41.9956]	Bureau of Justice Statistics
black	Percentage of population of African Americans in a given state, in a given year [0.38; 37.4]	U.S. Census Bureau
lnalcohol	Log of Per Capita Alcohol Consumption in a given state, in a given year (Measured in millions of liters.) [0.239; 1.5475]	National Institute on Alcohol Abuse and Alcoholism

Table 2: Descriptive Statistics						
Variable	N	Mean	Std Dev	Minimum	Maximum	Expected Sign
lnpc_total	397	11.62134	1.0959444	9.3934949	13.998275	Dependent Variable
ue_rate	397	6.41325	2.3680199	2.5	13.8	+
lnincarce	397	39.495398	1.1894376	37.118977	41.995655	-
lnpov	397	8.2188995	1.0153657	6.232448	10.543023	+
bachelor	397	27.013	4.723	16.5	39	-
lnalcohol	397	0.8592847	0.1895394	0.2390169	1.5475625	+
b_rate	397	10.5700	9.5179	0.3800	37.4	+

Table 3: Pearson Correlation Coeffcients, N=397							
	lnpc_total	*ue_rate*	*lnincarce*	*lnpov*	*bachelor*	*lnalcohol*	*b_rate*
lnpc_total	1	0.29499 <.0001	0.96015 <.0001	0.97895 <.0001	0.01917 0.7033	-0.40616 <.0001	0.46415 <.0001
ue_rate	0.29499 <.0001	1	0.32575 <.0001	0.31694 <.0001	-0.03243 0.5194	-0.09597 0.056	0.2371 <.0001
lnincarce	0.96015 <.0001	0.32575 <.0001	1	0.95569 <.0001	-0.07147 0.1552	-0.3809 <.0001	0.53494 <.0001
lnpov	0.97895 <.0001	0.31694 <.0001	0.95569 <.0001	1	0.09787 0.0514	-0.37956 <.0001	0.41897 <.0001
bachelor	0.01917 0.7033	-0.03243 0.5194	-0.07147 0.1552	0.09787 0.0514	1	0.25852 <.0001	-0.1615 0.0012
lnalcohol	-0.40616 <.0001	-0.09597 0.056	-0.3809 <.0001	-0.37956 <.0001	0.25852 <.0001	1	-0.23846 <.0001
b_rate	0.46415 <.0001	0.2371 <.0001	0.53494 <.0001	0.41897 <.0001	-0.1615 0.0012	-0.23846 <.0001	1

Table 4: Property Crime Models		
Dependent Variable: lnpc_total	Fixed Effects 2005-2007	Fixed Effects 2005-2012
Intercept	7.868755**	10.14336***
	(2.60)	(6.75)
ue_rate	0.024261*	-0.01139***
	(1.84)	(-3.31)
lnincarce	0.123484	0.061154
	(1.02)	(1.01)
lnpov	0.003229	-0.2819
	(0.01)	(-1.55)
bachelor	-0.01048	-0.29647
	(-1.03)	(-0.31)
lnalcohol	-0.36712	0.141923*
	(-1.78)	(1.73)
b_rate	-0.08764***	-0.76041
	(-3.46)	(-0.64)
N	150	397
Adj. R-Squared	0.9994	0.9980
F-Value	102.47	90.89
Cross Sections	50	50
Time Series	3	8
T-values in parentheses. *, **, and *** represent significance at the 90 percent, 95 percent, and 99 percent level, respectively.		
Results originate from data pertaining to the 50 United States of America from 2005-2012.		

SAS Code

```
proc import datafile=" E:\My
Vaults\senior_project_the_remix\Data\data_edu.csv"
            out=Crime1
            dbms=csv
            replace;
            getnames=yes;
            run;
Data crime1;
    set crime1;
    */convert percentages;
    w_rate=w_rate*100;
    b_rate=b_rate*100;
    i_rate=i_rate*100;
    a_rate=a_rate*100;
    isl_rate=isl_rate*100;
    bachelor=bachelor*100;
    pc_rate=pc_rate/100;
    incarce=incarce*100;

    */create logged variables;
    lnc_total=log(c_total);
    lnvc_total=log(vc_total);
    lnpc_total=log(pc_total);
    lnpov=log(pov);
    lnalcohol=log(alcohol);
    lns_pop=log(s_pop);
    lnincarce=log(incarce*s_pop/100);
    lnavgwage=log(avgwage);
    lnpci=log(pci);
    lnbachelor = log(bachelor*s_pop/100);
    lnblack =log(black);
    lnue_rate=log(ue_rate);
    lngdppc=log(gdp/s_pop);

    */remove observations with missing variables;
    if incarce="." then delete;
    if bachelor="." then delete;

run;

proc reg data=crime1;
title OLS Property Crime Model;
model lnpc_total= ue_rate lnincarce lnpov bachelor lnalcohol b_rate;
run;

proc panel data=crime1;
title Fixed Effect Model Property Crime;
id state year;
Model lnpc_total= ue_rate lnincarce lnpov
bachelor lnalcohol b_rate/FIXTWO;
run;
```