Factors Affecting Crime Rate

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Abstract

In my research, I worked to find whether certain factors behind law enforcement effect the percentage of crime rate in particular areas. The data I used pulled from a study (Durlauf & Nagin, 2011) measuring the crime rate using certain variables. After running my regression, I found that crime rate was affected significantly by variables: Prbarr (probability of arrest), prbconv (probability of conviction), prbpris (probability of imprisonment) and polpc (percentage of police). While the less significant variables were avgsen (average prison sentence), density (population density) and taxpc (tax per capita). Overall, I failed to reject the null hypothesis that police per capita increases the crime rate, and I rejected the null hypothesis that the probabilities of arrest and conviction increase the crime rate.

Introduction

Crime is prevalent across the world, and it is an evident part of human society. The purpose of my research is to find whether crime rate rises or falls in reaction to different variables. While similar studies have been done in the past, they have regressed crime rate with variables such as murder rates, larceny, car theft and other violent crimes; testing through variables such as the incremental change in the crime variables previously mentioned. On the other hand, my research uses the same dependent variable of crime rate, but regressed through significantly different variables such as police percentage, likelihood of arrest, rate of imprisonment, tax rate per county etc. Typically, people expect a strong police force to have a diminishing effect on crime rate, however, sometimes this isn't the case as my research has shown crime rates have risen in times when the sheer number of police in said territory has increased. Overall, the question my research aims to answer is: does the size and strength of the police force and harshness of sentencing (along with other factors) increase or decrease the rate

of crime in a given area? I will use a regression model to measure the impact several methods of law enforcement (size of police force, court process, and sentencing) to determine the impact of each variable on crime rate.

Literature Review

Many other studies done on this topic use the results of the 1990's implementation of The American Recovery and Reinvestment Act (a federal policy increasing fiscal funding to county police departments) on crime rate. They use these results and compare crime rates before the implementation of ARRA to crime rates after. Mello (2018) found that ARRA is one of the most effective options available for fighting crime ever implemented. Stating that "Our calculations suggest restoring the $1.4 billion COPS budget that prevailed in fiscal 2000 is likely to generate a benefit to society valued from $6 billion to $12 billion." While Ludwig & Donahue (2007) argue that though a 3% increase in police leads to a 3% decrease in crime, large scale percentage of violent crime is not significantly affected in the long run. Both comparisons test crime rate through variables such as grand-theft auto, larceny, robbery and in some cases murder. However, the data is imperfect for they fail to account for environmental changes such as private police sector spending, a massive increase in the nation's incarceration rate, and the waning of the crack cocaine epidemic and increased gun control laws throughout the 1990's.

Researchers opinions are mixed regarding the relation between the probabilities of being arrested, convicted, and imprisonment, the length of sentencing, and the crime rate. Durlauf & Nagin (2011) find that there is little evidence that criminals respond to longer sentencing, but there's stronger evidence that increasing the certainty of punishment deterred crime (by increasing officer numbers or allocating officers more efficiently). Blomberg (2016) furthers this claim by finding that increasing the probability of arrest is not related to criminal's

perception of being arrested. This counters the argument that by having more police presence, there will be a higher probability of arrest which will then deter crime because as Blomberg says, "Offenders do not think very much about the police and the threat of apprehension". Kovandzik & Vieraitis (2016) also back up this claim through their findings that police strength is unrelated to violent crime rates. However, Kessler & Levitt (1998) find that longer sentencing does lower crime. Kessler & Levitt say, "Within three years, crimes covered by the law fell an estimated 8 percent. Seven years after the law changed, these crimes were down 20 percent." This study shows that longer sentencing both deters and incapacitates crime by jailing active criminals and stopping potential criminals.

The article that is the most similar to my study is Cornwell & Trumbull (1994). The general findings of the article say, "The ability of the American justice system to deter crime is much *weaker* than previous results indicate." Cornwell and Trumbull come to this conclusion by comparing crime rate percentage with variables such as population density, young male population percentage and general economic development. Stating that with a large increase in resources to the police force, crime rate is not significantly affected. While this study is testing crime rate through different variables such as police percentage per county, likelihood of arrest, likelihood of arrest, and the amount of tax generated per county. Both this study and the study done by Cornwell and Trumbull state similar findings: that an increase in the resources and size of individual police forces does not show a greatly significant decrease in crime rate of individual counties. These sources were applied throughout this project to gives me a better idea of the research behind my study, to give me an idea of what the data might find, and to help me better understand my results.

Economic Model/Econometric methodology

The crime data comes from a study done by Christopher Cornwell and William N. Trumbull called "Estimating the Economic Model of Crime with Panel Data" that was published in *The Review of Economics and Statistics*, Vol. 76, No. 2 (May 1994). The data shows the crime rates for 90 counties in North Carolina for each year from 1981 to 1987, and also shows different variables such as the probability of arrest, average sentencing, police per capita, and more. To find the effect that the different factors I were interested in had on the crime rate I chose to run a linear regression. I chose crime rate to be the dependent variable because I want to show whether policies like hiring more police and harsher sentencing actually do decrease the crime rate as promised by politicians. Throughout my project I hope to fulfill my goal of showing the factors that affect the crime rate.

The independent variables are prbarr, prbconv, prbpris, avgsen, polpc, density, and taxpc. Prbarr, prbconv, and prbpris are all probabilities so their numbers are a percentage, for example, .37 meaning a 37% probability, and 1.25 meaning a 125% percent probability, while avgsen, polpc, density, and taxpc are regular numbers.

Prbarr is the probability of arrest in the North Carolina county for people committing crimes. Through my research from the literature review I expect the sign of this regression coefficient to be negative.

Prbconv is the probability of conviction in the North Carolina county for people that have been arrested. Again, through my research for the literature review I expect the regression coefficient to be negative.

Prbpris is the probability of imprisonment in the North Carolina county for people that have been convicted of committing a crime. Like the previous two variables, through my research for the literature review I expect the sign of this regression to be negative.

Avgsen is the average sentence length in days in the North Carolina county for people that have been sentenced to serve time in prison. Through my research for the literature review I expect the regression coefficient to be negative.

Polpc is the police per capita in the North Carolina county. This variable depicts how many police there are in a county for every person in the county. Throughout my researchI expect the regression coefficient to be negative.

Density is the population density in the North Carolina county which is measured by people per square mile. For this variable I expect the regression coefficient to be positive because with more people in a single space there should more likely be more crime.

Tax per capita is the tax revenue in the North Carolina county which is measured by tax revenue in dollars per person. For this variable I expect the regression coefficient to be negative because the higher tax revenue per person means they are making more money to be taxed on which leads me to believe less crime will be committed.

My regression equation for the relationship will be:

$$Crime\ Rate = \beta_0 + \beta_1 prbarr + \beta_2 prbconv + \beta_2 prbpris + \beta_3 avgsen + \beta_4 polpc + \beta_5 density + \beta_6 density + \beta_7 taxpc$$

Data Description

The data I am using comes from a dataset containing many different variables relating to the crime rate in 90 counties in North Carolina from 1981 to 1987; for this dataset there were no details of how the data was collected. I only chose to use in this regression the variables

primarily relevant to my research question, and left out the variables that were far less significant. This left the data showing N=630 for this regression analysis.

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Crime Rate	630	.0315876	.0181209	.0018116	.163835
Probability of Arrest	630	.3073682	.1712047	.0588235	2.75
Probability of Conviction	630	.6886176	1.690345	.0683761	37
Probability of Imprisonment	630	.4255184	.0872452	.148936	.678571
Average Sentencing (Days)	630	8.95454	2.658082	4.22	25.83
Police Per Capita	630	.0019168	.0027349	.0004585	.0355781
Population Density	630	1.386062	1.439703	.1977186	8.827652
Tax Revenue Per Capita	630	30.23919	11.45469	14.30256	119.7615

Regression and analysis

The crime rate data that I used in this linear regression supported a strong conclusion. The independent variables: probability of arrest, probability of conviction, police per capita, population density, and tax revenue per capita, were all significant at the 1% level, while probability of imprisonment, and average sentencing were not significant at the 1, 5, or 10% significance levels. The entire regression as a whole was significant at the 5% level as seen by the root mean squared error. Also, as seen by the R squared, the independent variables I used to account for 62.7% of the variance in the crime rate. The adjusted R squared was 62.3% which means that there may be some independent variables that did not affect the crime rate significantly, but this percentage gives a more realistic look at the variance the independent

variables do account for. There being a small difference between the R squared and the adjusted R squared shows that there were not many independent variables that were irrelevant in the regression. The results show that high scores in the probability of arrest and conviction have a negative effect on the crime rate, and that high scores in police per capita, population density, and tax revenue per capita, have a positive effect on the crime rate; probability of imprisonment and average sentencing were not found to be significant in the regression.

```
      Source |       SS           df       MS      Number of obs   =       630
-------------+----------------------------------   F(7, 622)       =    149.59
       Model |  .129574808         7  .018510687   Prob > F        =    0.0000
    Residual |  .076967257       622  .000123742   R-squared       =    0.6274
-------------+----------------------------------   Adj R-squared   =    0.6232
       Total |  .206542066       629  .000328366   Root MSE        =    .01112

------------------------------------------------------------------------------
      crmrte |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      prbarr |  -.0314851   .0028506   -11.05   0.000    -.0370831   -.0258872
     prbconv |  -.0022023    .000299    -7.36   0.000    -.0027895    -.001615
     prbpris |   .0079762   .0052179     1.53   0.127    -.0022707    .0182231
      avgsen |  -.0000566   .0001677    -0.34   0.736     -.000386    .0002728
       polpc |   2.531726   .1933326    13.10   0.000     2.152062     2.91139
     density |   .0073754   .0003362    21.93   0.000     .0067151    .0080357
       taxpc |   .0001043   .0000403     2.59   0.010     .0000252    .0001833
       _cons |    .021666   .0031737     6.83   0.000     .0154334    .0278985
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Regression Diagnostics

As noted before, the two independent variables, probability of imprisonment and average sentencing, were not significant at the 1, 5, or 10% levels, so I took them out of the linear regression and ran it again. With the new regression, all the variables retained their previous levels of significance and their coefficients remained nearly the same. The R squared, adjusted R squared, and root marginal standard error, all remained nearly the same upon the retest, but the difference between the R squared and adjusted R squared shrunk, which means that I got rid of variables that did not contribute (as much) to explaining the variance of the crime rate.

```
      Source |       SS           df       MS      Number of obs   =       630
-------------+----------------------------------   F(5, 624)       =    208.78
       Model |  .129269735         5  .025853947   Prob > F        =    0.0000
    Residual |   .07727233       624  .000123834   R-squared       =    0.6259
-------------+----------------------------------   Adj R-squared   =    0.6229
       Total |  .206542066       629  .000328366   Root MSE        =    .01113

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      crmrte |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      prbarr |  -.0316319   .0028464   -11.11   0.000    -.0372216   -.0260423
     prbconv |  -.0022057    .000299    -7.38   0.000    -.0027929   -.0016184
       polpc |   2.525605   .1933434    13.06   0.000     2.145923    2.905287
     density |   .0074557   .0003297    22.61   0.000     .0068081    .0081032
       taxpc |   .0000951   .0000398     2.39   0.017     .0000169    .0001734
       _cons |   .0247768   .0015973    15.51   0.000     .0216401    .0279136
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Multicollinearity testing shows that the independent variables I used are not highly correlated with each other as the mean VIF is 1.23, and the max VIF is 1.42. The autocorrelation

cannot be tested because the data uses repeating years throughout the year variable for each county.

Variable	VIF	1/VIF
Police Per Capita	1.42	0.704106
Probability of Conviction	1.30	0.770495
Probability of Arrest	1.21	0.829037
Population Density	1.14	0.873547
Tax Revenue Per Capita	1.06	0.945318
Mean VIF	1.23	

To test for heteroskedasticity I used the Breusch-Pagan / Cook-Weisberg test which failed to reject the null hypothesis that the variance is constant, the p-value being 0.000. Also, by using a Shapiro-Wilk W test I found that the crime rate data does not conform to a normal curve, the p-value again being 0.000.

Conclusion

My goal is to determine whether the variables in my data: probabilities of arrest, conviction, imprisonment, average sentencing, police per capita, population density, and tax revenue per capita, lower the crime rate in populations. Although the results show that higher police per capita raises the crime rate, every other variable except for population density and tax revenue has a negative effect on the crime rate. The results that higher police per capita increases the crime rate goes against what Ludwig & Donahue (2007) found in their study that an increase in police decreases the crime rate. I came to the conclusion that, possibly, crime rate rises with police presence because regardless of police, crime still exists. However, with more police, crimes go unnoticed less often. Also, for the most part, when it came to the probabilities that a

person would be held accountable for their crimes, like arrest and conviction; I found that these probabilities had a negative effect on the crime rate and were an effective means to decrease the rate. The results regarding the probabilities of arrest and conviction that decreased crime rate coincided with the studies of Durlauf & Nagin (2011) who also found that increasing the certainty of punishment for crimes decreased the crime rate. Lastly, I found that both the more people that lived in an area and the more tax revenue per capita that was generated in an area led to a higher crime rate; the latter surprised me because I thought that tax revenue increases would be linked with a higher standard of living and in turn less crime, the opposite ended up being true in this study.

The limitations of this project are numerous as I use one dataset with information from the 1980's for one state in the United States, and this data just gives me statistics with no background information behind it for possibly why these numbers are the way they are. For further research I may be able to use data from other populations to get a more definitive look as crime is a worldwide issue, and data from a longer period of time to show trends over time possibly in relation to different government initiatives. This issue of law enforcement is an ongoing polarizing topic that still needs more research to be conclusive about what works and what does not work.

Works Cited

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