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AN ECONOMETRIC INVESTIGATION INTO THE DETERMINANTS OF CRIME

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Studies into the determinants of crime are necessary to improve the effectiveness of investment in its prevention. David O'Cinneide uses Ordinary Least Squares regression analysis to investigate how unemployment, inequality, the number of police officers and the legality of abortion affect the crime rate in America.

Introduction

"Crimes increase as education, opportunity, and property decrease. Whatever spreads ignorance, poverty and, discontent causes crime.... Criminals have their own responsibility, their own share of guilt, but they are merely the hand...."

Rutherford Birchard Hayes. (Hayes, 1922:629).

Crime is a facet of human culture that has existed since the earliest of civilisations. Contemporary societies dedicate huge resources to the prevention of crime and law enforcement, and rightly so, as without civil order and a functioning criminal justice system a modern economy would grind to a halt. To increase the efficiency of the investment in crime prevention, an understanding of the determinants of crime is necessary. By knowing what causes crime, societies can better fight it. In this report, I will analyse the effects of several economic and non-economic variables on a country's crime rate. More specifically, I shall use a country's unemployment rate, income inequality, as measured by the Gini coefficient, number of police officers and whether or not a country has legalised abortion as the independent variables and regress them on the rate of property crime. I shall use cross sectional data from 20 European countries for the year 2000.

The Theory and Variables

The dependent variable, Y, was chosen to be property crime[1] per 100,000 of the country population for two reasons: firstly, to scale the variable to a relative value and secondly, to fit in with the Becker-style rational criminal framework. By scaling the amount of crimes down to relative basis, cross-country comparison is more meaningful. Comparing the absolute values of property crimes would be of no use in this analysis; therefore this value was divided by the population of the relevant country and then multiplied by 100,000 to give the final number. The data is selected from 20 European countries, because it is believed that these countries would have similar values and cultures and indeed criminal justice systems, therefore the possible variation in crime rates due to differences in these factors would be minimised. This measure of crime rate is also compatible with the Becker rational criminal framework which I believe would be more sensitive to the model's independent variables, in particular the Gini coefficient and the unemployment rate.[2] Becker argues that a potential criminal, before committing a crime, weighs up the costs (including punishment and the opportunity cost of legal work) and the benefits (monetary and psychological). Property crimes are therefore to the economic benefit of the perpetrator, representing a transfer payment between himself and the victim, as opposed to violent crimes, such as murder. Although violent crime may have psychic benefits for the criminal, they do not necessarily provide any economic benefit.

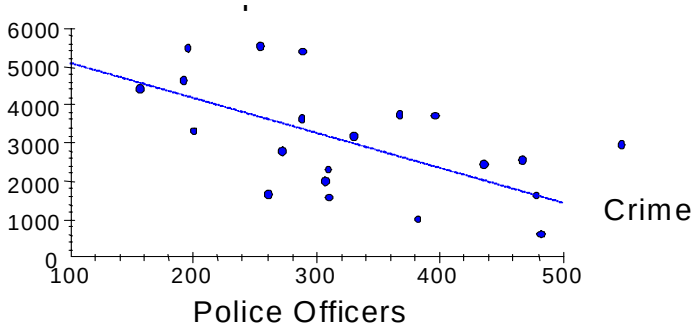
The numbers of police officers is used as a proxy for the overall effectiveness of the police force. Other studies have used perhaps more consequential measures of this, such as expenditure on crime detection and prevention per capita; however, I feel this is beyond the scope of my essay. As the number of police officers in a country increases, one would expect, ceteris paribus, the crime rate to decrease. I expect there to be a negative relationship between crime rates and police numbers. The scatter plot appears to confirm this. In reality, this may not be so. The complex relationship between police numbers and the crime rate could be considered one of joint dependency. In response to high crime rates, citizens may demand more police officers from their government. New police are hired and although the numbers of officers has risen, the crime rate remains high. The newly hired police in that period are inexperienced and perhaps their

[1] Although the variable used in the model is property crime per 100,000, hereafter, I shall simply refer to it as the less cumbersome 'crime rate'.

[2] Freeman (1994:1) asserts 'the unemployment-crime link was statistically … more closely aligned to property crimes than to violent crimes'.

introduction doesn't affect the crime rate immediately. More extensive studies may consider lagging this variable in order to take account of the time required for the crime prevention activities to bear fruit. That is, the number of police officers and their activities last period would have an effect on the crime rate this period. This is not the case in my model, however.[3]

Figure 1: Scatter Plot of Crime on Number of Police Officers



Widely debated in the literature, the link between unemployment and crime is still unclear. The general consensus is that the devil makes work for idle hands but the reality doesn't seem to be so straightforward. As Freeman (1994:1) says although "many people believe joblessness is the key determinant of crime … even the largest estimated effects of unemployment on crime suggest it contributed little to the rising trend in crime". More sophisticated studies decompose the unemployment variable into better indicators of labour market conditions, such as wage levels and employment opportunities. This links the falling 'legal' wage to a decreasing opportunity cost of crime and sits well with Becker's model. Such decomposition is beyond the scope of this project and I use the unemployment as a proxy for the labour market conditions.[4]

[3] The data on police numbers could prove problematic. The different countries in the sample have a variety of different police forces, some of which are included in the final figure. Some countries have municipal police, traffic police, etc. In some cases even the secret police are counted. My model ignores this inconsistency.

[4] Some studies (Fleisher 1963, Fougère et. al. 2003) have focused on the relationship between youth unemployment and crime. There appears to be a stronger correlation between these two, because young men have a higher propensity for criminal activity. Young, unskilled, uneducated men tend to have low returns from legal work,

Unlike unemployment, it is almost universally agreed that income inequality is a major determinant of crime. Three major ecological theories conform to the idea of inequality increasing crime rates: Becker's economic theory of crime, Merton's strain theory and Shaw & MacKay's social disorganization theory. Under Becker's framework, areas of high inequality, i.e. those areas where very poor and very rich coexist; the rational criminal's motivation is stimulated by the inequality. Merton's "strain theory argues that when faced with the relative success of others around them, unsuccessful individuals feel frustration at their situation." (Kelly, 2000:530) The greater the inequality is, the greater the inducement for low status individuals to commit crime. The motivation to commit crime is not solely drawn from the expected economic benefits, but from social disgruntlement and dissatisfaction. Social disorganization theory focuses on factors that "weaken a community's ability to regulate its members" (Kelly, 2000:530) as determinants of crime. These factors include poverty, familial instability and ethnic heterogeneity. In the parlance of the econometrician, one would expect a high degree of multicollinearity between income inequality and these factors. Therefore, I expect a negative relationship between crime rates and income equality. However data problems again occur here. The data source for the Gini coefficients, the UN Human Development Report, are not all given in the same year (2000) as the crime, police and unemployment statistics. The figures taken from the Report were assumed to be the most up-to-date and the best proxy measurement for income inequality.[5]

The final variable in the model is a dummy variable indicating whether abortion was legal in the relevant country since 1980[6,7]. The reasoning behind its introduction comes from research conducted by Levitt and Donohue (2001). The logic behind it is simple. The legalization of abortion disproportionately affects the births of those with the highest propensity to become criminals. This is because the mothers of these potential criminals are more likely to have abortions. This woman is typically young, single, uneducated and unable and/or unwilling to give her

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so the opportunity cost of committing crime is also low. Also, young men tend to be more risk loving then other cohorts therefore will not weigh as heavily the probability of being caught and punished.

[5] The actual year the Gini coefficient corresponds to is given in the data appendix.

[6] The year in which abortion must be legal is 1980, because the cohort that would have been born in that year would be entering their criminal prime when they become young adults about 20 years later, in the year 2000, the year corresponding to the crime statistics.

[7] A '0' corresponds to 'abortion is illegal in 1980' and '1' to 'abortion is legal in 1980'

child what would be considered an adequate upbringing, in terms of love and respect for the child, as well as food on the table, decent schooling, etc. Many studies have shown that a child who goes without such an upbringing has a higher propensity towards criminality (Sampson & Laub, 1993). Therefore, if a child isn't born to experience an inadequate upbringing, an upbringing that increases their tendency to commit crimes, then those crimes will never be committed. As Levitt (2005:141) puts it, 'a private sadness becomes a public good'.

The Model and Ordinary Least Squares Regression

The econometric model I shall use for my analysis is as follows:

$$\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 D_4 + \mathit{u}}$$

where

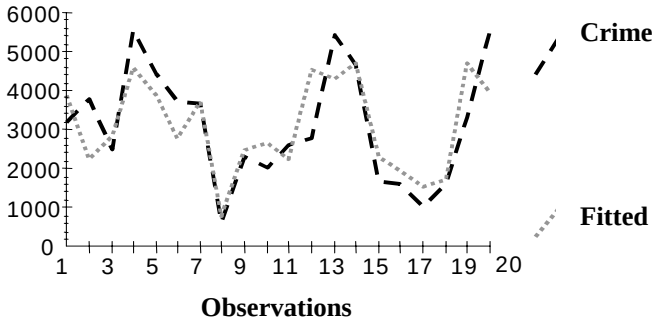
Y	= property crime per 100,000
X_1	= police officers per 100,000
X_2	= unemployment rate
X_3	= Gini coefficient
D_4	= abortion
u	= statistical residual

After running an OLS regression on the Microfit programme, the results are presented below:

Regressor	**Coefficient**	**Standard Error**	**T-Ratio[Prob]**
CONSTANT	5363.5	1801.4	2.9774[.009]
POLICE	-4.2919	2.8495	-1.5062[.153]
UNEMP	-154.0846	54.9593	-2.8036[.013]
GINI	-19.5439	54.5908	-.35801[.725]
ABORT	1212.8	544.0512	2.2291[.042]

R-Squared	.64087
R-Bar-Squared	.54510
F-statistic F(4,15)	6.6918[.003]
Functional Form CHSQ(1)	.90739[.341]
Jarque Bera Test CHSQ(2)	.27338[.872]
Heteroscedasticity CHSQ(1)	3.8480[.050]

Overall, the R-squared result tells us the model explains 64% of the variation in the crime rate. Since there are four independent variables, it behoves us, as prudent econometricians, to consider the adjusted R-squared measure of 54.5%, to take in consideration available degrees of freedom. The F-statistic returns a value of 6.6918, large enough to reject the null, that my model has no explanatory power, at the .3% level of significance. The plot of fitted and actual values for the observations confirms there appears some degree of accuracy in the relationship between the crime rate and the model's variables.

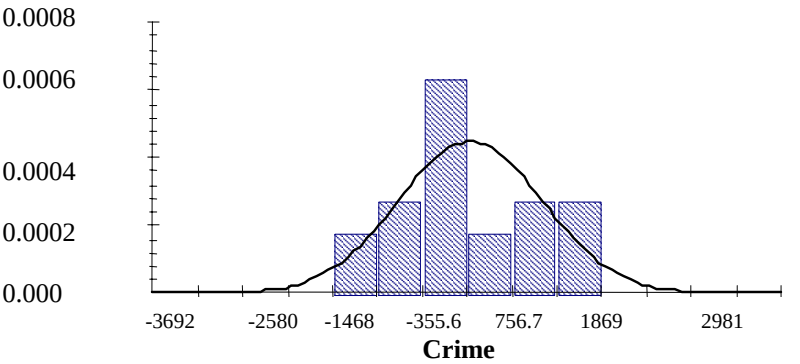


However, the other regression results are less encouraging. The t-statistics test the hypothesis that the variable coefficients are individually equal to zero. For the police numbers variable, this hypothesis can only be rejected at a level of significance greater that the 15.3% level. According to my model, adding one more police officer on the beat reduces property crime by 4.3 per 100,000. Given that the mean number of crimes in my

sample is 3089.2 crimes per 100,000, a drop in crime of 4.3 would represent a decrease of .14%, an unimpressive return. Unemployment, the ambiguous regressor, yields a t-value of -2.8036, significant at the 1.3% level. Unfortunately, the sign is not what I hypothesized. In fact, my model predicts a 1% *increase* in unemployment leads to a 5% *decrease* in crime (from the mean of my sample). The Gini coefficient appears to be highly insignificant, which runs contrary to much more extensive research. Perhaps this insignificance is owing to the inconsistencies in the data. The estimate for the abortion dummy variable is significant at the 5% level; however, my model predicts that a country with legalized abortion would have an *increase* in crime, which diverges from Levitt and Donohue's study.

The diagnostic results are important because they inform whether the classic linear regression models (CLRM) assumptions are fulfilled, otherwise all t, F, and standard error estimates will be wrong, and the model's results rendered meaningless. Since the data used in this model is cross sectional, correlation between residuals is not expected; therefore the results of the Durbin-Watson test and Lagrange multiplier test results are ignored. The Ramsey RESET test of functional form, which returns a result significant at levels greater than 34%, tells us that there is a considerable chance of error in model specification. Since this test is only valid asymptotically, it is partially invalidated because of the small sample size. Other results in the regression must be referred to, such as the individual t-statistics and the F-statistic of overall significance, to ascertain whether the model is adequately specified to describe the relationship between the variables. The Jarque-Bera test for normality considers the null hypothesis that the errors are distributed normally versus the alterative that they are not. The Jarque-Bera statistic returned has a value of .273, very close to the desired value of 0, indicating that the residuals are very close to have normal skewness and kurtosis.

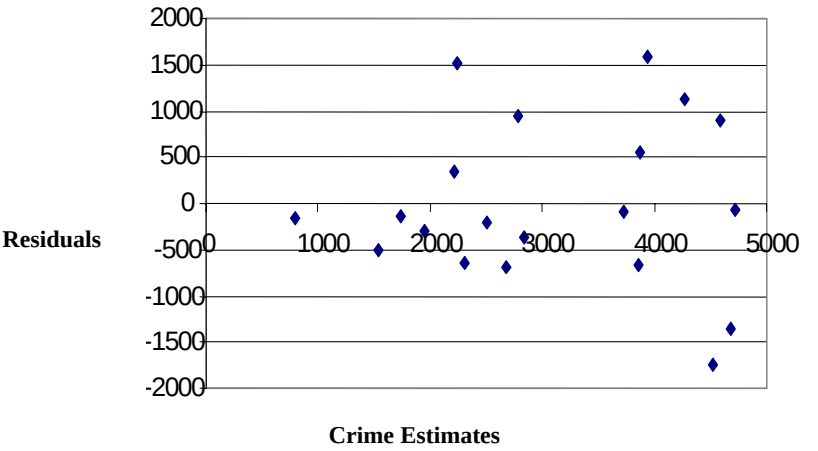
Figure 3: Histogram of Residuals and the Normal Density



An inspection of the histogram of residuals also supports this claim. Although this seems like a good result, the test is valid only in large samples, and therefore the t and F statistics must be regarded with caution.

The heteroscedasticity test result is problematic. The null hypothesis of homoscedasticity can be rejected at the 5% level; therefore this model violates one of the crucial assumptions underlying the CLRM, that of unequal spread of errors, as is usually the case for cross sectional data.

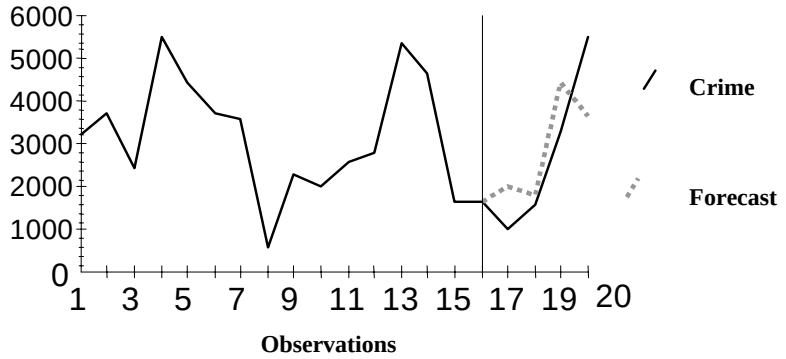
Figure 4: Crime Estimates and Residuals



A look at the graph of residuals on estimated values confirms this unequal spread. It seems that as crime rates rises, the spread of the residuals grows also. This apparent heteroscedasticity means the OLS estimates, although still linear and unbiased, are no longer best. There exist estimators with smaller variances. Therefore, my models estimates will be inefficient and will not accurately describe the relationship between the variables.

An illustrative way of testing the models accuracy is by trying to make a forecast onto the data in the sample. The regression was run again, but without the final 4 observations, the resulting graph showing the observed crime rate and the forecast.

Figure 5: Plot of Actual and Single Equation Static Forecast(s)



The forecast seems to follow the general trend, although not with a high degree of accuracy.

Conclusion

Enquiries along these lines are useful to policy makers if they mean to pro-actively tackle the scourge on society that crime is. This particular study, however, has its limitations. With more accurate and consistent data, I believe, a similar model would have a greatly increased ability to calculate crime rates. The decomposition of the variables into more relevant proxies of the concepts that are to be precisely quantified would offer a better description of the relationship between them. For example, police force effectiveness has very little to do with police numbers and more to do with police training, and a country's unemployment rate is probably not a good measure of the labour market conditions which face the potential criminal.

By refining our variables and data in this fashion, further studies will deepen our understanding of the causes of crime and methods of how to counteract it.

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