The Socioeconomic Determinants of Crime in Ireland from 2003-2012

Brosnan, Stephen

University College Cork, Ireland

7 May 2016

The Socioeconomic Determinants of Crime in Ireland from 2003-2012

Abstract

This paper analyses the socioeconomic determinants of property crime and violent crime in Ireland between 2003 and 2012. The aim of the study is to determine whether individuals respond to incentives when deciding to engage in crime and whether this decision is dependent on the type of crime an individual engages in. The results of the paper support the economic theory of crime which indicates that criminals respond to incentives, particularly for property crimes. Higher rates of crime detection are associated with a fall in crime rates across all property crimes. Higher detection rates have been found to reduce crime rates for property crimes while the impact on violent crimes is found to be insignificant. The socioeconomic determinants of crime tend to be more ambiguous.

I. Introduction

This paper analyses the socioeconomic determinants of property crime and violent crime in Ireland between 2003 and 2012. The aim of the study is to determine whether individuals respond to incentives when deciding to engage in crime and whether this decision is dependent on the type of crime an individual engages in. The analysis uses data from the Central Statistics Office in Ireland (2015) which provides data for a detailed set of crime categories based on administrative data provided by the An Garda Síochana from their PULSE system. The CSO Annual Crime Statistics provides data for six Garda regions, which comprise of 28 Garda Divisions. However, socioeconomic data sourced from CSO is only available at a county level and as such Garda divisional data has been aggregated to the county level. This provides this paper with a unique dataset to estimate the impact the determinants of crime in Ireland.

The seminal work of Becker (1968) and Ehrlich (1973) led to a wave of empirical work examining the socioeconomic determinants of crime. Becker stressed that "crime is an economically important activity or 'industry' . . . almost total neglected by economists" (1968, p. 170). Since then, many studies have investigated whether individuals respond to incentives to engage in criminal activities. Incentives can be classified as both 'carrot' and 'stick'. For example, more opportunities in the illegal labour market may induce individuals to leave the labour market in favour of criminal activities whereas higher apprehension rates and longer incarceration rates may dissuade individuals from engaging in criminal activities.

Much of the research on the economics of crime has been conducted in the United States (Becker, 1968; Ehrlich, 1972; Freeman, 1983; Chiricos, 1987; Grogger, 1998; Levitt 1998,

1999, 2001) with further studies emerging in UK (Wolpin, 1978; Witt et al., 1998, 1999; Carmichael and Ward, 2000, 2001; Machin and Meghir, 2004, Han et al, 2013) but as yet studies in Ireland have been scarce. Denny et al (2004) estimate the determinants of burglaries in Ireland between 1952 and 1998. They find that while imprisonment and detection act as powerful forces for reducing crimes, were unable to find any robust effect from direct measures of labour market activity such as unemployment rates or wage levels. More recently, Hagenden (2015) estimates the impact of an increase in the number of people on the Live Register on crime rates. The findings indicate increases in unemployment lead to an increase in crime, although the impact is more evident in property crimes, as opposed to violent crimes.

This paper offers significant contributions compared to previous studies carried out in Ireland. Firstly, to the best of my knowledge this paper is the first which attempts to test the theoretical model of crime outlined by Becker (1968) across different categories of crime using economic, social and law enforcement variables in Ireland. Secondly, previous studies in Ireland fail to incorporate the dynamics of crime into their analysis. This paper includes lagged crime rate as an explanatory variable to capture crime dynamics. Thirdly, the inclusion of lagged endogenous variable as an explanatory variable requires the adoption of an instrumental variable estimation by using a Generalized Method of Moments (GMM) estimation. Most work in the area has used times series analysis and OLS methods so this paper offers advantages in methodology. Much of this work is hampered by endogeneity issues as a result of the reverse causation between crime rates and deterrence variables. This paper controls for endogeneity employing an instrumental variable approach for panel. Finally, the time period included in this study is significant for Ireland as a result of the emergence of the financial crisis which deeply impacted the Irish economy. In this vein Kelly (2009) warned that "Ireland is at the start of an enormous, unplanned social experiment on how rising unemployment affects crime, domestic violence, drug abuse, suicide, and a litany of other social pathologies".

The rest of the paper is structured as follows: Section 2 outlines a review of the previous literature in the area, section 3 highlights the data used for this study while section 4 outlines the methodology and model specification. Section 5 shows the results of the estimations and section 6 concludes the article.

1. Socioeconomic Determinants of Crime –Theory to Empirics

The analysis of crime as an economic activity goes back to the work of Becker (1968). Becker (1968) provided a model in which individuals optimally choose whether or not they will commit crimes. Under Becker's model of crime, individuals rationally analyse the costs and benefits of engaging in crimes. Benefits (denoted "B") include the financial reward for engaging in crime as well as potential psychological benefits of crime. Furthermore, decisions are influenced by the probability of being caught (denoted "C"), severity of punishment (denoted "p") and the opportunity cost in terms of other activity forgone e.g. employment in legal labour market (denoted "W").

Thus, the net benefits an individual receives from engaging in crime is equal to B-pC. Therefore, individuals will engage in crime when:

(i) $B-pC>W$

Attitudes towards risk are central to economic models of criminal choice. For example, risk adverse individuals will respond more to changes in the chances of being apprehended than to changes in the extent of punishment, other things being equal. An empirical test of Becker's model involves testing whether people do actually respond to changes in such costs and benefits (Han et al, 2013). However, opportunity costs seem to be absent from the model (Oliver, 2002). Ehrlich (1973) addressed this issue by developing a model which allows individuals allocate his time freely between legal and illegal labour markets. Furthermore, Ehrlich analysed additional socioeconomic determinants of crime such as an individual's level of income and unemployment rates. His aim, however, is still maximising the expected utility. The rest of the section highlights the empirical tests of various economic, social and law enforcement variables on crime.

Deterrence and Crime

Deterrence is an important subject not least because it lowers crime rates but furthermore in comparison to incapacitation it is relatively cheap. Researchers have used a variety of deterrence variables to examine the determinants of crime including detection rates (Denny et al, 2004; Han et al, 2010; Bandyopadhyay et al, 2011), clear up rates (Wolpin, 1978; Edmark, 2005) and number of police (Levitt, 1997; Lin, 2009; Chalfin and McCrary, 2014; Bun, 2015).

These studies have generally found crime deterrence variables to reduce crime rates, particularly for property crimes.

Unemployment and Crime

Many studies have focused on the relationship between crime and employment. Early reviews, like Freeman (1983) and Chiricos (1987) generally find small, positive effects of unemployment on crime, but the results are inconsistent across studies and are certainly not major determinants of crime. Chiricos (1987) finds that unemployment has a statistically significant positive effect on property crime in 40 percent of the studies, while the effect on violence is only statistically significant positive in 22 percent of the study. The notion that unemployment encourages criminal behaviour as a result of increasing incentives is appealing and grounded in the notion that people respond to incentives. However, results of studies estimating the impact of unemployment on crime tend to be ambiguous in nature and robustness. One explanation for the lack of consensus in estimation results is that many people who engage in crime are also part of the legitimate labour force. Reuter et al. (1990) and Freeman (1999) document how the majority of those who participate in the illegal sector simultaneously derive income from legitimate jobs. Moreover, Imrohoroglu et al. (2001) predict that about 79% of the people engaging in criminal activities are employed and only the remaining 21% are unemployed.

Results indicate that unemployment has a greater impact on crimes against property rather than crimes against the person. Edmark (2005) studies the relationship between unemployment and crime in Sweden between 1988 and 1999, a particularly volatile period in the labour market. The results show that unemployment had a positive and significant effect on some property crimes. Bandyopadhyay et al. (2011) examine the impact of unemployment on six different crime types across 43 police force areas in the United Kingdom using quantile analysis. The results indicate that not only does unemployment increase crime but it does so more in high crime areas. Moreover, they find that the crime-reducing effect of higher detection rates is stronger in low-crime areas. Also, Entorf and Sieger (2014) estimate the impact of unemployment on crime in Germany find while both conventional OLS and quantile regressions confirm the positive link between unemployment and crime for property crimes, results for assault differ with respect to the method of estimation. Studies examining the impacts of unemployment on crime in Ireland tend to be scarce. Recently, Hargaden (2015) examines the relationship between crime and the labour market in Ireland between 2003 and

2014. Using OLS, FD and IV estimation techniques Hargaden (2015) estimates property crime elasticity of about 0.5. This implies that a 10% rise in numbers on the Live Register increases thefts and burglaries by 5%. As expected, there is a much weaker connection between the labour market and violent crime.

Income and Crime

Ehrlich (1973) proposes the mean family income should be taken as proxy for illegal income opportunities. He argues that a higher income level means higher transferable assets and thus more lucrative targets for potential criminals. Contrastingly, other studies have used mean income as a proxy for legal income opportunities with higher income associated with more rewarding legal jobs. As such, ambiguity exists when interpreting the results of the impact of income on different types of crime. Gould et al. (2002) notes that both wages and unemployment are significantly related to crime, but that wages played a larger role in the crime trends over the last few decades.

Baharom and Habibullah (2008) study the relationship between income, unemployment and crime in 11 European countries using panel data analysis between 1993 and 2001 for both aggregated (total crime) and disaggregated (subcategories) crime. Their results show that both income and unemployment have an important relationship with both aggregated and disaggregated crime. Crime displays positive significant relationship with income for all the categories except for domestic burglary. Entorf and Spengler (2000, p.85) suggest a relative income measure may be more straightforward to interpret. The authors highlight a measure of relative income which measures the percentage distance between the income of individual states and the mean income of all states and note that "a higher income inequality, for instance, may lead to worse legal income opportunities and, at the same time, to better illegal income opportunities for the lower quantiles of the income distribution".

Young Population and Crime

Young persons as a percentage of the population are included in many studies estimating the effects of deterrence on crime as they are considered the most likely socio-demographic age group to engage in criminal activities. Grogger (1998, p. 756) notes: "Thirty five percent of all Philadelphia males born in 1945 were arrested before the age of 18, and one-third of all Californian men born in 1956 were arrested between the ages of 18 and 30". Narayan and Smyth (2004), in their study on Australia, examine the relationship between seven different categories of property crime and violent crime against the person, male youth unemployment

and real male average weekly earnings between 1964 and 2001. The findings indicate that fraud, homicide and motor vehicle theft are cointegrated with male youth unemployment and real male average weekly earnings. However, there is no evidence of a long-run relationship between either breaking and entering, robbery, serious assault or stealing with male youth unemployment and real male average weekly earnings. Denny et al. (2004) explain the evolution of the trend in burglary in Ireland in terms of demographic factors: in this case the share of young males in the population, the macro-economy in the form of consumer expenditure and two characteristics of the criminal justice system : the detection rate for these crimes and the size of the prison population. The share of young males is associated with higher levels of these crimes. However, the authors were unable to find any robust effect from direct measures of labour market activity such as unemployment rates or wage levels.

II. Data

Dependent Variables

This paper uses Irish crime data sourced from the Central Statistics Office (CSO). CSO provides a detailed set of crime categories based on administrative data provided by the An Garda Síochana from their PULSE system. The crime categories are based on the Irish Crime Classification System (ICCS). The CSO Annual Crime Statistics provides data for six Garda regions, which comprise of 28 Garda Divisions.

Data at Garda Division level is very detailed and relates to specific crime categories; however it is only available at abroad spatial scale. For the majority of counties the county boundaries are used as boundaries for Garda divisions however for certain counties Garda divisions differ. Larger counties are broken down into smaller divisions, for example, Dublin is broken down into five Garda Divisions - DMR Eastern, DMR North Central, Northern DMR, South Central DMR, Southern DMR and Western DMR while Cork County is broken down into three Garda divisions - Cork City, Cork North and Cork West. For the purposes of this paper, Garda divisions in Cork and Dublin are aggregated to county level as socioeconomic variables are only available at this level of aggregation and thus it makes more sense for empirical testing to carry out analysis at this level of aggregation. Alternatively, smaller counties are aggregated into a single Garda division, for example, Laois and Offaly make up a single Garda division. As such, socioeconomic variables for these divisions are given by the average of the two counties e.g. unemployment for Laois/Offaly is given by the average of the unemployment rate across both counties.

Descriptive statistics for the various crime types, averaged over the 2003-2012 period, are reported in Table 1a and b.

Table 1A Descriptive Statistics for Dependent Variables between 2003 and 2012

	No. of Obs.	Mean	St. Dev	Max	Min
Theft	210	260.71	514.15	50.15	5520.08
Burglary	210	560.01	204.33	197.91	1105.34
Fraud	210	87.02	38.12	19.6	303.43
Assault	210	330.86	76.45	150.22	568.58
Sexual Offences	210	41.83	33.06	16.27	303.43

Independent Variables

Table 1B Descriptive Statistics for Independent Variables between 2003 and 2012

	No. of Obs.	Mean	St. Dev	Max	Min
Theft Detection Rate	209	21.51	7.39	7.66	45.65
Burglary Detection Rate	209	23.37	7.38	8.91	44.74
Fraud Detection Rate	209	57.31	15.05	22.24	94.15
Assault Detection Rate	209	68.88	9.57	27.64	94.13
Sexual Offences Detection Rate	209	59.54	14.93	20	93.75
Income	210	24,577	5,385	16,092	50,782
Relative Income	210	93.86	9.17	73.03	118.77
Unemployment Ratio	210	6.87	3.27	1.87	15.26
Male 15-24	210	7.49	6.5	0.896	78.21

Table 1a shows the descriptive statistics for crime rates in Ireland between 2003 and 2012. Property crimes are more common than violent crimes. Burglary is the highest recorded crime with 560 incidents per 100,000 people while sexual offences is the lowest with 41 recorded cases per 100,000. Table 1b shows that the likelihood of detection is much higher for violent crimes rather than property crimes. Both assault (68.88%) and sexual offences (59.54%) display detection rates much greater than those of theft (21.51%) and burglaries (23.37%). Moving on, I will now give a brief overview of the variables included in the study, the expected relationship of each variable with crime rates and data issues.

Deterrence: The detection rate of crime is used in this paper as a proxy for deterrence to engage in criminal activities. The detection (or clear up rate) is often used as a measure of the ability of police to solve crimes, or even as a general indicator of police performance. Higher detection rates are generally associated with lower levels of crime as higher probabilities of conviction leads to a reduction in the expected utility of crime. The CSO provide detection rates across a range of crimes in Ireland at Garda divisional level between 2003 and 2012. Garda divisional detection rates are aggregated up to county level.

Income: Income has been used as a measure of both legal and illegal activities in crime studies. Higher levels of income are associated with both higher rewards for criminals due to increased opportunities of lucrative targets. Contrastingly, higher levels of income have also been estimated to reduce crime due to more opportunities to earn a living through legal activities. These interpretations have led to contrasting results for the estimated impact of income on crime levels. This study uses total income per person is used as a measure of income in this study. Total income per person is provided by the CSO at a county and NUTS 3 regional level.

Relative Income: Relative income is measured as the average income per person in a region relative to the national average.

Unemployment Ratio: The unemployment ratio is measured by the percentage of working age people on the Live Register in Ireland. The CSO provides data for number of persons on the live register in Ireland between 2003 and 2012. The unemployment figure for a given year is taken as the number of people on the Live Register in the final month of the year. The unemployment ratio is calculated by dividing the unemployment figure by population at county level.

Male 15-24: The male population between 15 and 24 is included in the study as a sociodemographic estimate of crime. Studies have shown that this demographic are the most likely to engage in particular crimes. The paper uses data from the Census 2002, 2006 and 2011 to estimate population by Garda division in Ireland. The Census provides population data broken down by age group and gender and annual data is estimated using annual average growth rates between the Census years.

III. Methodology

Framework of this research is based on the Becker–Ehrlich deterrence hypothesis. Notably, there are other factors which affect committing crimes, and we will include them as explanatory

variables in the specification of model. Crimes are classified as crimes against property (property crimes) and crimes against the person (violent crimes), both are assessed empirically by econometrics techniques. The empirical analyses on the effect of labour market opportunities on crime relies typically on four types of data (Freeman, 1995): aggregate time series data, cross-section data, regional panel data and individual level data. Analyses of the first two types confirm the existence of a positive relationship between unemployment and crime. These studies, even presenting some advantages, are very likely to be affected by biases due to the omission of relevant variables. This paper uses a GMM estimation which presents significant advantages over alternative methods used in previous studies. Much of this work is hampered by endogeneity issues as a result of the reverse causation between crime rates and deterrence variables. This paper controls for endogeneity employing an instrumental variable approach for panel.

A. Model Specification

$$\boldsymbol{Crime_{i,t} = \alpha_{i,t} + Crime_{i,t-1} + Detection_{i,t} + Income_{i,t} + Rel.Income_{i,t} + Unemp_{i,t} + male16-24_{i,t} + \varepsilon_{i,t}}$$

with i =1... N denoting regions, and t =1...T, denoting time periods.

$\text{Crime}_{i,t}$ = Crime rate per 100,000

$\text{Crime}_{i,t-1}$ = Lag of Crime rate per 100,000

$\text{Detection}_{i,t}$ = Detection rate

$\text{Income}_{i,t}$ = Average Income per person in region

$\text{Rel. Income}_{i,t}$ = Average Income per person in region/ Average Income per person nationally

$\text{Unemp}_{i,t}$ = Unemployment ratio

$\text{male16} - 24_{i,t}$ = Percentage of Males in population between ages 16-24

In the above specification, αi and β and δ are parameters to be estimated. α_i is time invariant and control for country specific effects not explicitly included in the regression equation. Lagged crime rate measures the persistence of crime over time. Han et al (2013) note there could be several reasons why crime rate can be thought to be correlated over time: (1)

recidivism caused by, among other things, negative expected payoffs from the labour market for being a criminal; (2) business cycle features such as recessions affecting the crime rate over successive periods and (3) peer effects with lagged crime acting as a proxy for fluctuating peer effects.

IV. Estimation and Results

This section presents the results of the estimation of the models outlined in section four. The section analyses whether crime detection rates act as a deterrence for individuals engaging in criminal activities in Ireland as well as interpreting the impact of socioeconomic factors on crime in Ireland between 2003 and 2012. The paper is concerned with estimating the socioeconomic determinants of crime in Ireland and as such a number of hypothesises have been developed in order to estimate the impact of these factors on crime.

Table 2 presents the results of the estimation of the socioeconomic determinants of crimes against property in Ireland between 2003 and 2012. All three crimes against property display a negative coefficient on detection rates which indicates that higher detection rates of crime lead to a statistically significant reduction in individuals engaging in criminal activity. A ten percent increase in detection rates is estimated to reduce theft rates per 100,000 by 2.45%, burglary rates per 100,000 by 1.4% and fraud rates per 100,000 by 6.1%. These results are consistent with previous research in the area (Han et al, 2013).

Table 2 GMM Estimation of Crimes against Property in Ireland between 2003 and 2012

Variable	Theft	Burglary	Fraud
Crime t-1	0.387 (0.063)***	0.280 (0.096)***	0.157 (0.092)*
Detection Rate	-0.245 (0.085)***	-0.140 (0.074)***	-0.614 (0.118)***
Income	1.443 (0.264)***	-0.115 (0.204)	0.725 (0.377)**
Relative Income	-1.121 (0.085)**	-0.582 (0.464)	-1.450 (0.906)
Unemployment Ratio	-0.097 (0.028)***	0.016 (0.026)	0.022 (0.048)
Male population	-0.028 (0.068)	-0.014 (0.048)	-0.049 (0.096)
Sargan-Hansen	74.74	76.78	66.68
p-value	0.27	0.21	0.52
No. of Observations	146	146	146

*** Significant at 1% level; ** significant at 5% level; * significant at 10% level.

The J-statistic is computed for the Sargan/Hansen over-identifying restrictions. Under the null hypothesis that the over-identifying restrictions are valid, the J-statistic follows a Chi-Squared distribution with the degree of freedom being the difference between the instrument rank and the number of coefficients estimated. The reported over-identification test is the corresponding *p*-value; non-rejection of the Sargan-Hansen test indicates validity of the instrument.

Crime rates in the previous period is estimated to have a positive and significant impact on crime in the current period across all categories of property crime. This indicates that crime may have an evolutionary element with regions displaying high levels of crime continuing to record high levels of crime in subsequent periods. A ten unit increase in number of crimes per 100,000 in the previous year is estimated to increase theft per 100,000 by 3.8%, burglary per 100,000 by 2.8% and fraud per 100,000 by 1.57%. The results indicate that criminals engaging in activities involving crime against property respond to crime reduction incentives i.e. higher rates of detection. Also, regions with high levels of property crime in previous year tend to continue to record high rates of property crime which may indicate self-reinforcing properties of crime, evidence of career criminals and knowledge spillovers within a region.

Turning attention to the socioeconomic determinants to property crime, income per capita is estimated to have both a positive and significant impact on crime rates in Ireland for both theft and fraud. The sign on the coefficient for burglaries is negative for income however the results are insignificant. Entorf and Spengler (2000) note that the results of studies estimating the impact of income on crime rates tend to be ambiguous as higher levels of income can be considered to both promote and deter crime. Higher levels of income provide more legal opportunities while also providing more lucrative criminal activities. A one percent increase in income per capita is estimated to increase theft rates by 1.44% while fraud rates increase by 0.73%.

Entorf and Spengler (2000) note relative income is much easier to interpret than the standard income measure. Relative income is estimated to have a positive impact on the crime rate for crimes against property in Ireland between 2003 and 2012. The coefficient on all three categories of crime is negative which indicates that an increase in a regions income relative to the national average will reduce crime rates for all crimes against property. However, the results are only statistically significant for theft rates. A one percent increase in relative income leads to a reduction in thefts per 100,000 by 1.12%.

Perhaps surprisingly, the unemployment ratio is estimated to have a positive effect on crime rates for theft. An increase in the unemployment ratio of 1% is associated with a fall in the theft rate of 0.09%, with results statistically significant. A negative coefficient for unemployment is found for burglary and fraud rates however the results are not statistically significant. The relationship between unemployment and crime rates is found to ambiguous at best. Han et al (2013) in a find an increase in unemployment leads to a decrease in burglary and fraud rates while an inverse relationship is evident for theft rates. One possible explanation for this is the unemployment rate captures the net effect of two countervailing forces – while higher unemployment motivates potential offenders to commit crime by reducing the opportunity cost of crime, it also reduces the opportunities available for crime thus presenting different impacts across crimes.

The results differ to that of Hagenden (2015) in a study of Ireland finds a deterioration in the labour market is associated with higher crime rates, with a property crime elasticity of 0.5. This implies that a 10% rise in numbers on the Live Register increases thefts and burglaries by 5%. There could be several possible reasons for this difference. Firstly, differences in aggregate levels could contribute to differences results. Also, Hagenden (2015) uses total number of crimes as the dependent variable and total number of people on live register as the independent variable while this study uses crime rates per 100,000 population as dependent variable and county unemployment ratio i.e. number of unemployed per working population in county as independent variable. Third, direct comparison of this study with Hagenden (2015) is further complicated by the fact that different set of explanatory variables, different model specifications and a different estimation methodology are included compared to this study. The results indicate that the percentage of males between the ages of 15-24 in the population is insignificant on crime rates.

Continuing on to violent crimes, Table 3 presents the results of the estimation of the socioeconomic determinants of crimes against person in Ireland between 2003 and 2012. Similar to previous literature (Han et al 2013; Hagenden 2015) the results of the detection rate on crimes tends to be more ambiguous across crimes against the person compared to crimes against property.

Table 2 GMM Estimation of Crimes against Persons in Ireland between 2003 and 2012

Variable	Assault	Sexual Offences
Crime t-1	0.466 (0.102)***	0.003 (0.127)
Detection Rate	0.026 (0.082)	-0.119 (0.140)
Income	1.047 (0.165)***	-4.096 (0.497)***
Relative Income	-1.08 (0.349)***	2.519 (1.115)**
Unemployment Ratio	-0.034 (0.022)	0.106 (0.053)**
Male population	-0.000 (0.036)	-0.174 (0.120)
Sargan-Hansen	66.49	74.22
p-value	0.52	0.28
No. of Observations	146	146

*** Significant at 1% level; ** significant at 5% level; * significant at 10% level.

Detection rates are estimated to have no significant effect on crimes against the person in Ireland between 2003 and 2012. One explanation for this is that detection may not reduce all crimes as there may be some 'type' criminals who would not respond to incentives. Crime rates in the previous period are found to have a positive impact on crime rates in the current period. The coefficient is positive for both assault rates and sexual offences rates however the results are only significant for assault rates. A one unit increase in assaults per 100,000 in the previous period leads to an increase in assaults in current period of 0.46%.

The estimates for the socioeconomic determinants of crimes against the person tend to be ambiguous. The coefficient on income is positive for assault rates while it is negative for sexual offences. This indicates that an increase in income leads to an increase in assaults while it leads to a fall in sexual offences, both results are statistically significant. An inverse relationship is evident between income and relative income i.e. when income is positive, relative income is negative and vice versa. An increase in relative income is found to reduce the rate of crime for assault while it is estimated to increase the rate of crime for sexual offences.

Similarly, the results of the unemployment ratio are found to be ambiguous for crimes against the person. A one percent increase in the unemployment ratio is estimated to increase the sexual offences rate per 100,000 by 0.11%, while the results for the impact of the unemployment ratio on assault rates is not statistically significant. Similar to crimes against property, the percentage

of males aged between 15 and 64 are estimated to be insignificant on crime rates across all categories of crime in Ireland between 2003 and 2012.

V. Conclusion

This paper contributes to the literature on how property and violent crime responds to social, economic and law enforcement conditions at county level in Ireland. The results of the paper support the economic theory of crime outlined by Becker (1968) which indicates that criminals respond to incentives, particularly for property crimes. Higher rates of crime detection are associated with a fall in crime rates across all property crimes. A dynamic GMM model with fixed effects has been estimated which eliminates any time-invariant unobservable differences between counties that jointly determines the crime rate and (any of) our explanatory variables. Additionally, the potentially endogenous law enforcement variables, detection rate, has been instrumented by using past lagged values of these variables as instruments. This addresses the concern of potential reverse causality for this variable which has hampered previous studies in the area.

The use of GMM allows for the inclusion of lagged endogenous variable as an explanatory variable. This paper finds that the lagged variable is statistically and economically significant across all crime types, with the exception of sexual offences. This indicates that regions with high levels of property crime in previous year tend to continue to record high rates of property crime which may indicate self-reinforcing properties of crime, evidence of potential career criminals and knowledge spillovers within a region. In line with the literature in the area, higher detection rates have been found to reduce crime rates for property crimes while the impact on crimes against the person is insignificant. A ten percent increase in detection rates is estimated to reduce theft rates per 100,000 by 2.45%, burglary rates per 100,000 by 1.4% and fraud rates per 100,000 by 6.1%.

The socioeconomic determinants of crime tend to be more ambiguous with the significance of each variable varying across different crime types. Socioeconomic factors have the greatest impact on theft rates. While increases in income per capita is found to increase theft rates, possibly as a result of more lucrative illegal opportunities, increases in both relative income and unemployment is found to reduce the theft rate. For crimes against the person, the income variables are found to statistically significant though has opposing effects on each crime type. Increase in income are found to increase the number of assaults while lowering the number of sexual offences.

References

BANDYOPADHYAY, S; BHATTACHARYA, S and SENSARMA, R. 2011. "An Analysis of the Factors Determining Crime in England and Wales: A Quantile Regression Approach", University of Birmingham, Discussion Paper No 11-12.

BAHAROM, A. H. and HABIBULLAH, A. S. 2008. "Is Crime Cointegrated with Income and Unemployment? A Panel Data Analysis on Selected European Countries" *MPRA Paper No. 11927*, University Library of Munich, Germany

BECKER, G.S. 1968. "Crime and punishment: An economic approach". *Journal of Political Economy* 76, 1169-1217.

CARMICHAEL, F. and WARD, R. 2000. "Youth unemployment and crime in the English regions and Wales", *Applied Economics*, 32, 559–71.

CARMICHAEL, F. and WARD, R. 2001. "Male unemployment and crime in England and Wales", *Economics Letters*, 73, 111–5.

CHIRICOS, T. 1987. "Rates of crime and unemployment: An analysis of aggregate research evidence", *Journal of Social Problems* 34, 187-211

COOK, P. and ZARKIN, G. 1985. "Crime and the Business Cycle", *Journal of Legal Studies* 14(1): 115-128

DENNY, K; LYDON, R; HARMON, C. 2004. "An econometric analysis of burglary in Ireland", *ISSC Discussion Paper series*; ISSC WP 2004/04 Publisher University College Dublin

EHRLICH, I. 1973. "Participation in illegitimate activities: A theoretical and empirical investigation". *Journal of Political Economy* 38(3), 521-565.

EDMARK, K. 2005. "Unemployment and Crime: Is There a Connection?", *Scand. J. of Economics* 107(2), 353–373, 2005

GOULD, E.D., WEINBERG, B.A. and MUSTARD, D.B. 2002. "Crime rates and local labor market opportunities in the United States; 1979-1997", *The Review of Economics and Statistics*, 84(1): 45–61

GROGGER, J. 1998. "Market Wages and Youth Crime", *Journal of Labor Economics*, 16(4): 756-791.

ENTORF, H. and SPENGLER, P. 2000. "Socioeconomic and Demographic factors of crime in Germany Evidence from Panel Data of the German States", *International Review of Law and Economics*, 20 2005, 75-106.

HORST, E & SIEGER, P, 2014. "Does the Link between Unemployment and Crime Depend on the Crime Level? A Quantile Regression Approach", *IZA Discussion Papers 8334*, Institute for the Study of Labor (IZA).

FREEMAN, R 1983. "*Crime and Unemployment. In Crime and Public Policy*", edited by James Q. Wilson. San Francisco: Institute for Contemporary Studies Press.

FREEMAN, R. (1995) "*The labor market*". In James Q. Wilson and Joan Petersilia (eds.), Crime. San Francisco: Institute for Contemporary Studies Press

FREEMAN, R. and. RODGERS, W.M 1999. "Area Economic Conditions and the Labor Market Outcomes of Young Men in the 1990s Expansion", *NBER Working Paper* 7073, April.

HAN, L; BANDYOPADHYAY, S and BHATTACHARYA, S. 2013. "Determinants of violent and property crimes in England and Wales: a panel data analysis", *Applied Economics*, Vol. 45, No. 34, 4820–4830

HARGADEN, E. 2015. "Crime and the Labour Market in Ireland, 2003-2014"

ENTORF, H and SIEGER, P. 2014. "Does the Link between Unemployment and Crime Depend on the Crime Level? A Quantile Regression Approach", *The Institute for the Study of Labor (IZA) Discussion Paper Series*.

IMROHOROGLU, A., MERLO, A. and RUPERT, P. 2006. "Understanding the determinants of crime", *Journal of Economics and Finance* 30(2), 270 – 283.

LEVITT, S. D. 1998. "Juvenile crime and punishment", *Journal of Political Economy*, 106, 1156–83.

LEVITT, S. D. 1999. "The limited role of changing age structure in explaining aggregate crime rates", *Criminology*, 37, 581–97.

LEVITT, S. D. 2001. "Alternative strategies for identifying the link between unemployment and crime", *Journal of Quantitative Criminology*, 17, 377–90.

MACHIN, S. and MEGHIR, C. 2004. "Crime and economic incentives", *Journal of Human Resources*, 39, 958–79.

NARAYAN, P.K. and SMYTH, R. 2004. "Crime rates, male youth unemployment and real income in Australia: evidence from Granger causality tests". *Applied Economics*, 36, 2079–2095

REUTER, P, MACCOUN, R and MURPHY, P. 1990. *"Money from Crime: A Study of the Economics of Drug Dealing in Washington, DC",* Santa Monica, CA: The RAND Corporation.

WOLPIN, K. 1978. "An Economic Analysis of Crime and Punishment in England and Wales", *Journal of Political Economy*, 86:5, 815-40