CENTRE FOR ECONOMIC RESEARCH

WORKING PAPER SERIES

2004

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WP04/16

May 2004

DEPARTMENT OF ECONOMICS
UNIVERSITY COLLEGE DUBLIN
BELFIELD DUBLIN 4

An Econometric Analysis of Burglary in Ireland *

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May 24th 2004

This paper outlines an econometric model of the level of burglary in Ireland between 1952 and 1998. We explain the evolution of the trend in Burglary 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. Imprisonment and detection act as powerful forces for reducing crimes, the effects of aggregate consumption are more difficult to pin down but we show that higher spending is associated with more lucrative but probably fewer crimes. One somewhat surprising result is that we were unable to find any robust effect from direct measures of labour market activity such as unemployment rates or wage levels.

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1 Introduction

Crime matters to people. The direct victims of crime, in addition to the immediate impact of the violence, loss of property and so on, report levels of anxiety and stress for some time after the event. The effects of the crime are not limited to these victims (and their families) alone. Society as a whole feels threatened by the level of crime. This can affect people's lives in many ways. Individuals may be reluctant to venture out for fear of assault or fear that their property will be stolen. They may go to extra expense to minimize the chances of being victimized. There may also be a lower level of trust in the community: to use current terminology "social capital" is damaged. Those responsible for crime are not drawn randomly from the population. The international evidence is that being young, male, with low education and low income is associated with being involved in crime. So wider considerations of social justice also suggest that crime is an important policy concern.

However rising crime is not inexorable. Although it is currently high in Ireland by historic standards it has fallen significantly in recent years. The actions of the courts, the probation services, the Garda Síochána (the police in Ireland) and the legal system are likely to matter. There are of course other factors, amenable to public policy, which may also influence crime such as the level of unemployment, education or inequality.

It follows then that understanding the determinants of the level of crime is important in thinking about reforms to public policy to further reduce crime levels. We emphasize that policy towards criminal justice is a complicated matter involving a host of legal, social and other issues. The causes of the level of one particular type of crime constitutes one piece of the jigsaw puzzle. Perhaps surprisingly, research on the determinants of crime is in its infancy in Ireland. In this paper we carry out one of the first econometric analyses of crime in Ireland and the first for nearly twenty years.

The major breakthrough in this field is the work of Becker(1968). In Becker's model, criminals are rational individuals acting in their own self interest. In deciding

to commit a crime, criminals weigh the expected costs against the expected benefits. So some individuals will choose to commit crimes because they value the benefits – say property taken - more than the expected cost to them. The cost of crime will be an *opportunity cost*, it is what they give up to pursue the crime. This can include working in the legitimate economy. If jobs are easier to come by and/or such jobs are well paid then the opportunity cost of crime is higher.

However crime is essentially a risky activity for the criminal and he/she needs to take into account the chance of being caught and the outcome for him/her in the event of being caught such as imprisonment. Of course there are other factors which will influence individuals decisions to commit crime, the attitudes of society to crime, the attitudes of one's family and so on. However we do not explicitly consider them here either because there is simply no way of measuring them or because they are intrinsically "micro" level variables which will influence individuals but are unlikely to explain trends in the aggregate level of crime. Here we are concerned with burglary and crimes against property more generally and it seems plausible that the "cost/benefit" approach is a sensible way of thinking about it. It is clear that there are types of crime, sexual or political crimes for example, for which this would not be the most useful framework.

A different perspective on understanding crime tends to emerge from sociological analyses which sees crime as a form of social dysfunction. This idea is associated with the French sociologist Durkheim's notion of *anomie* - feelings of alienation and rootlessness amongst individuals. There is no necessary contradiction between such a view and the approach taken here since it is difficult if not impossible to test such a model. For example it is difficult to know how one could consistently measure the trend in *anomie* over a period of 30 or 40 years. Possible indicators would be the level of suicide or the level of inequality, the former a consequence and the latter a cause of the phenomenon. In the first case however we know that measured trends in suicide are probably a poor guide to the underlying phenomenon since they will reflect changing attitudes, changes in reporting practice and so on. In the second case, although both economic and sociological

analyses would see a rôle for economic inequality affecting crime there is simply not enough data to use.

As discussed, the "cost" of crime to criminals consists of two parts. One is the income foregone by devoting time to criminal activity (the opportunity cost). The second cost is the time criminals expect to be incarcerated because of their activity. "Expected punishment" is not the same as the length of time a convicted criminal actually spends in prison. Most crimes never result in an arrest and many of those arrested are not prosecuted. Many convicts receive non-custodial sentences.

Expected punishment, from the criminal's viewpoint, is a probability, not a certainty. For example, in figures cited by Rubinstein and Woodson (1995) only 7% of U.S. burglaries result in an arrest according to the National Center for Policy Analysis (NCPA). Of those arrested, 87% are prosecuted and of those prosecuted, 79% are convicted. Of those convicted, a mere 25% are sent to prison (most are paroled). After multiplying these probabilities, we see that a potential burglar faces only a 1.2% chance of going to prison for each act of burglary committed and that once in prison, she/he will stay there for about 13 months. But since she/he will escape imprisonment more than 98% of the time, the expected "cost" of each burglary to the burglar is only 4.8 days.

The rational criminal will ask him/herself whether an act of burglary is likely to net him/her goods worth more than 4.8 days behind bars. If the answer is yes, then the crime pays. The goal of the criminal justice system is to raise expected costs of crime to criminals above the expected benefits. People will commit crimes only so long as they are willing to pay the prices society "charges."

Since Becker's seminal work economic research into the topic of crime has focused on a simple model with three elements – the supply of criminal activity, the size of the punishment and the probability of arrest and conviction with the latter two elements forming the main weapons available for deterrence of crime. Supply of crime should, in this simple economic model, decline if the offence is more likely to be detected or more likely to carry a heavy sentence hence the motivation

toward policies such as increased police coverage, closed circuit television and reviews of sentencing strategies.

However the market will have its imperfections. Criminals for example may be poorly informed about the chance of being caught and the implications of this for their liberty. Moreover for criminals to react in the manner of the simple model suggest that they are risk averse but this may not be the case. Individuals who enjoy risk may be attracted to crime as a lifestyle.

If criminals are rational they will also respond to the relative 'prices' of different crimes and move from crimes that are heavily punished to lighter crimes in punishment terms.

Criminology is a very under-developed field of research in Ireland and the rigorous statistical or economic analysis of data is the exception rather than the rule. The nature of the activity, being illegal, necessarily makes data collection difficult and hampers micro-level research in particular. There are nonetheless several important contributions worth noting.

Virtually the only economic analysis of crime in Ireland that we are aware of is Bacon and O' Donoghue (1977). This applies the model of Becker to Ireland to analyse what the optimal levels of expenditure on crime control should be. While most of this paper is not directly relevant to the proposal, they do include an econometric analysis of the determinants of crime, distinguishing between violent and non-violent crime. They find that unemployment has positive and negative effects respectively on these two categories. This is somewhat at odds with results for other countries though the crime categories do not correspond exactly.

The ESRI report by David Rottman (1980) analyses the aggregate trends in the data with a largely sociological focus. It pays particular attention to the quality of the data and notes the relatively good data on crime that can be derived from the annual reports of the Garda Síochána. It also carries out a basic statistical inquiry into the trends in the data. In particular it regresses the level of crime in nine different categories on the level of unemployment.

For most types of property crimes in particular there is a well determined and positive effect. Interestingly for assault, he finds a negative impact, a finding which is mirrored in subsequent research on US data using much more advanced estimation methods (see for example Raphael and Winter-Ebmer 1999). The techniques used by Rottman are, certainly to a contemporary reader, relatively unsophisticated. Nonetheless it provides a good introduction both to the data and the possibilities for statistical analysis.

McCullagh (1992) discusses the relationship between imprisonment and unemployment between 1951 and 1988 and concludes that there is a positive relationship but only in the latter part of the period. Disappointingly, his method is based on a visual inspection of the data and completely eschews any statistical testing. The calculation of simple correlation statistics would have been very useful and is easily done. His conclusion that "analyses based on forms of multi-regression may disguise more than they reveal about the data under examination" is not well founded. Since one does not expect crime to be determined solely by any one variable, the simple correlation between crime and unemployment, say, is of no particular significance.

An interesting micro level study is the paper by Bacik *et al* (1998). They modelled the probability of a custodial sentence as a function of characteristics of the individuals and the communities from which they are drawn. The authors collected a large sample of cases from the Dublin District Court. Their results show that those who come before the courts are not typical of the population, being predominantly male, young and from more deprived areas. While this by itself is unsurprising, as the authors note, the degree to which this holds is striking. Using multivariate methods, they show, *inter alia*, that among those appearing in court, being from a deprived area is associated with a higher probability of receiving a custodial sentence. This probability is *decreasing* in age but is higher if the crime in question was a property offence.

While the results are very interesting, interpretation is less straightforward. For example the age result could reflect a judges' reluctance to incarcerate older individuals perhaps because of family responsibilities. It could equally reflect the

nature of the crime, maybe younger people are associated with more serious offences. The analysis includes controls for class of offence (property, drugs, public order etc) but *within* these classes there will be variation in the degree of seriousness. Another problem is that in this data not receiving a custodial sentence includes those convicted but not imprisoned and those who were acquitted.

Nonetheless this study provides an excellent example of the ability of modern statistical methods to measure the influence of different factors on a variable of interest. It would be highly desirable if micro-level data were collected to allow further research along these lines.

Also worth noting is a recent study by O'Mahoney (1997) which studies the characteristics of a sample of prisoners in Mountjoy Prison. This emphasises the fact that at the micro level, crime is strongly associated with individuals who are young, poorly educated and generally economically disadvantaged.

The significance of these last two micro-studies for the proposed research is that they largely confirm the finding of much international research. As the Whittaker (1985) report puts it "most crime at present originates amongst unemployed youth in disadvantaged areas".

The relationship between crime and the labour market has been a major issue in the US and UK research. Freeman (2000) suggests that there is little *direct* evidence linking education to reductions in crime and the perceived linkage relates to the effect that education has on factors such as unemployment and inequality. There has been a dramatic rise in crime over the period 1950 to 1997 – reported crime rose by a factor of 3 in the US and by a factor of 2 in the UK. Moreover the significant rise in wage inequality that has been observed in the US and Great Britain over the past 25 years suggests that the return to legitimate work has fallen for low or unskilled individuals. This is especially true for men.

Estimates of the return to crime are harder to gauge – again US figures suggests that criminal earnings for inner city youths rose by an average of 5% over the period of the 1980's. This, when coupled with downward changes in the probability of incarceration for youths in the US during the same periods suggests that crime

rates do react to labour market condition and that this behavior may indeed be rational for some individuals. Upward trends in inequality are associated with higher levels of both property and violent crime (see Kelly(2000) or Witt *et al*(1999)). Winter-Ebmer and Raphael (1999) find positive effects of unemployment on crime that are not just statistically significant but large in size. Leigh (1998), in a review of work published in this area, concludes that increased education is positively and strongly correlated with absence of violent crime, measures of health, family stability and environmental benefits.

Lochner (1999) develops and estimates a model of the decisions to work, to become educated and to commit crime and allows for the possibility of interactions between all of these choices. The model suggests that education is correlated with crimes *that require less skill*. Part of the model allows for simulation of the effects of education subsidies on external outcomes and predicts that education subsidies reduce crime. Insofar as possible, empirical implications were explored using various large scale US micro datasets. Ability and high school graduation significantly reduce the participation of young men in crime and the probability of incarceration. Evidence from the census data supports a general finding that states with higher rates of high school participation and tougher penalties have the lowest index for property crime.

The influence of the criminal justice system of the level of crime is one of the topics that has attracted most interest and indeed most controversy. The variables that one might expect to have an influence include the level of policing, imprisonment, sentencing policy. For example the influential study by Ehrlich(1975) argues that capital punishment deterred murder though these conclusions have attracted significant criticisms, for example Hoenack and Weiler(1980).

A potentially important issue is that there may be simultaneity as higher crime rates generate responses by policy makers such as increasing police resources. From early on in the literature the approach has been to estimate simultaneous equation systems , see Thaler(1977) for an early contribution or Van Tulder and Van Der Torre(1999) for a recent effort. The identifying assumptions made are often rather weak and difficult to justify.

An alternative approach is to use "natural experiments" where available. Levitt (1996) suggests using exogenous factors that limit the use of incarceration in the United States such as caps on prison populations as providing an independent influence on incarceration. His study uses the number of state litigation suits for violation of prison directives as a means of isolating the effect of punishment levels on crime rates. In this work a 10% increase in imprisonment rates would lead to a 0.7% decrease in property crime and a 1% decrease in violent crime using conventional methods. However using the more sophisticated methodology suggests that these figures are underestimated with the 'corrected' effects of a 10% increase in imprisonment rates being 4% for violent crime and a reduction of 3% for property crime. This shows the importance of paying careful attention to the use of appropriate statistical methods since they lead to estimates of the effects which are a multiple of the naïve estimates.

In his 1997 paper, Levitt suggests that during election years police forces tend to swell. He therefore uses US local elections to model the problem and again finds large differences between the conventional models and the 'corrected' one. For property crime he estimates that a 10% increase in the number of police officers reduces property crime by about 1.5%-3.8% depending on the precise methodology used. This implies a decline in reported property crimes per police officer of between 4 and 12.4 per officer annually. Taken in conjunction with similar effects on violent and other crime that Levitt estimates in this study, this all translates into an additional social benefit of over $200,000 from the hiring of one additional police officer[1]. The extent of the problem (and the applicability of this solution) may be less in Ireland where it takes some time to increase the size of the Garda Síochána.

A number of other experiments have been carried out largely in the United States. For example California's 'Proposition 8' imposed enhancements to sentences for a select group of crimes particularly for re-offenders. In the year following the passage of the legislation the Proposition 8 offences recorded reductions of 10%

[1] Levitt also makes the point that his study is based on reported crimes only. As criminals do not know if a crime will be reported or not it seems logical to translate the effects on reported crime into unreported crime. In any event reporting bias, if present, will understate the true effectiveness of police in reducing crime.

relative to unchanged crimes. Three years after the law came into effect eligible crimes had fallen by 20-40% compared to other crimes. This brings out a significant advantage that researchers have with de-centralised judicial systems, changes in state laws act as "natural experiments" allowing one to observe the effects of changes in variables in one state compared to another. This is much more difficult to do where reforms are only at a national level as in Ireland.

In interpreting the effect of imprisonment on reducing crime a distinction exists between whether it works though *deterrenc*e, lowering the expected return to crime, and *incapacitation*, the direct effect of criminals being unable to commit crime while in prison. It is not hard to see that it will be difficult to distinguish between the two . Levitt (1995) found for the US that deterrence is more important than incapacitation for minor crimes and the deterrence effects are generally negative. Deterrence effects were large for burglary (each arrest is estimated to eliminate two burglary crimes).

2 Data

In this section we describe the availability and quality of data that is either necessary for an exercise such as this or that might be conceivably useful given the issues arising in the first half of the report.

We first discuss data specifically related to crime including alternative measures of our dependent variable and then go on to discuss the situation vis-à-vis the demographic and economic variables that are likely to be used as covariates or explanatory factors. As with most such studies the amount of data declines as one goes back in time so there is an inevitable trade off: if one wishes to focus on more subtle measures, say of economic activity, then one may be constrained to use a much shorter time-span. A further issue concerned the quality of the data since even if the data exists one may have reason to doubt the reliability of the information in which case there may be an argument for foregoing its use.

Although the Central Statistics Office was founded in 1949 economic data in Ireland is relatively scarce before 1960.[2] In our search for data we have taken 1950 as our starting point since there is very little before this. Econometric analysis of the Irish economy typically starts with data from around 1960 or later it is unlikely that trying generate a dataset that starts before 1950 would be practical. Perhaps ironically, consistent series on crime variables precedes many of the key macroeconomic time series.

The source of the crime data is the annual Reports of the Garda Síochána. Crime data is also published in the Statistical Abstract of the CSO but this source offers no particular advantage. These reports are in general a very useful consistent source of the basic data which we wish to analyse. Note that there is considerable debate in the international research literature as well as amongst Irish researchers about the reliability of official statistics. Under-reporting is well known to be a potential problem but to an extent to which, almost by definition, is hard to ascertain. Here we have taken the data at face value since there seems little alternative and evaluation of the data is beyond the remit of the study. Further research on this issue is clearly desirable, possibly though regular surveys such as the recent ESRI survey, Watson (2000). It may also be useful to analyse data on insurance claims as an additional source of information. The only study that we are aware that explicitly addresses the question of statistical inference associated with under-reporting of crime is Pudney *et al* (2000). Their investigation, using British data, leads them to the conclusion that it is "of little practical significance".

The Garda reports classify crimes into four groups of which the second, Group 2, Crimes against property with violence, is relevant for us. We have extracted the data for burglary from these reports from 1950 until 1999. However we propose to use only data up to and including 1998 for two reasons. Firstly the data for 1999 refers only to the period January-September due to the introduction of the PULSE system of collecting crime data. Clearly it is not directly comparable with data based on a full year given especially that crime displays a strong seasonal

[2] Prior to this much of the collection and publication of data fell to the Statistics Division of the Department of Industry and Commerce.

component, being greater in the winter. We hope that this data will subsequently be revised at some point to refer to the whole year.

In principle one could attempt to seasonally adjust the data for 1999: by using within-year variation in crime for earlier periods to impute the "missing crime" for the last quarter of 1999. However this would be a significant undertaking for a relatively small return and one that would introduce an additional source of error into the data. The second reason is that not all our covariates can be observed for 1999.

There is one issue in the construction of the basic burglary series data worth noting namely that there is a change in reporting in 1977 which amalgamated a number of different series to create a new burglary series. Up to and including 1976 there is data on the following offences: (i) Sacrilege (i.e. theft from places of worship), (ii) Burglary, (iii) Housebreaking, (iv) Breaking into shops, warehouses or other premises, (v) Attempts to break into shops and houses, (vi) Entering with intent to commit a felony and (vii) Possession of House-breaking tools. From 1977 onwards there is one series which, as far we can see, is the sum of the first five of these. Of the six categories listed above (iii) and (iv) account for the bulk of the total. We give data for the relevant period below

Table 2.1 Monitoring the Definition Changes in Burglary Data

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	Sum of (i) to (vii)
1975	76	556	5840	7194	348	1116	30	15160
1976	57	10291	4871	3372	168	382	36	19177
1977		21009					22	21031
1978		18923					22	18945

There is one further complication to be aware of, due to the changing reference period used in Garda Reports. Up to and including 1957 the reporting year ended in December. From 1958 to 1974 inclusive the reporting year ended in September after which it reverted to the end of December again.

In this section we do a simple regional breakdown of the data. This could be an important issue since one might expect differences in the nature or urban and rural crime. However this is not straightforward to do. Burglary data is only disaggregated spatially from a relatively late date which would give too short a period of data to analyse econometrically. However an alternative approach is possible. As noted above Burglary comes under the class of data recorded as Offences against property with violence or "Group 2" in the statistics. These series are consistently provided at a Division level and we have collected them for Dublin, Cork, Limerick, Galway and Limerick. We have aggregated these five series under the heading “Urban”. By subtracting the “Urban” figure from the totals for Ireland we get a “Rural” series. We think this is the best feasible way in which a spatial disaggregation can be pursued. **Figure 2.1** graphs the time series of both Burglary (based on our amalgamation of the pre-1977 data discussed above) and the Group 2 data from 1950 on. The share of the former in the latter is not constant see **Figure 2.2** and drops significantly in recent decades.

Figure 2.1 - Time Series of Crime Data

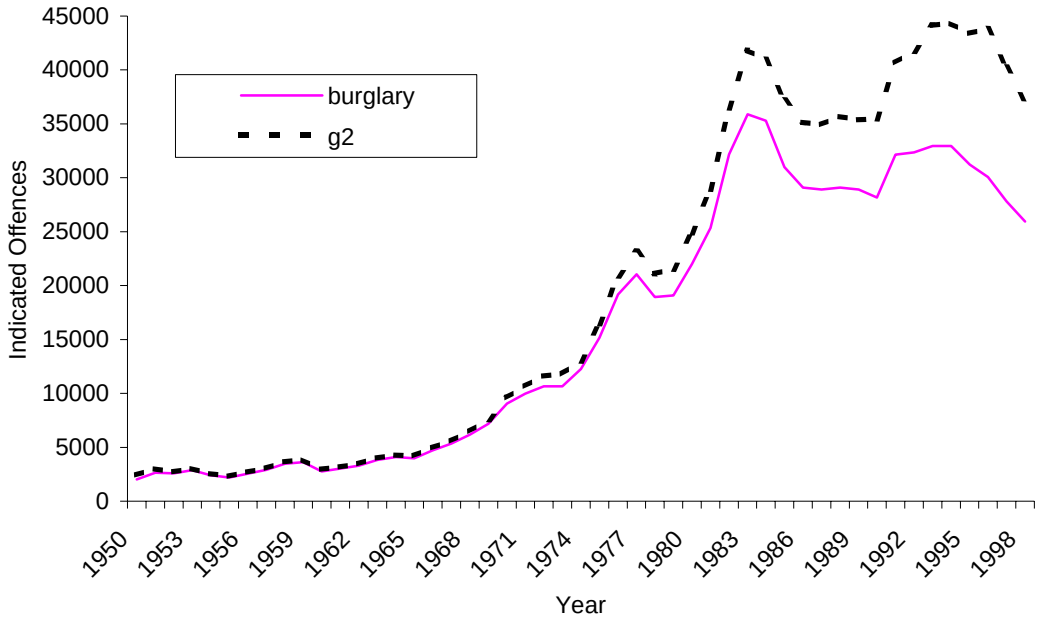
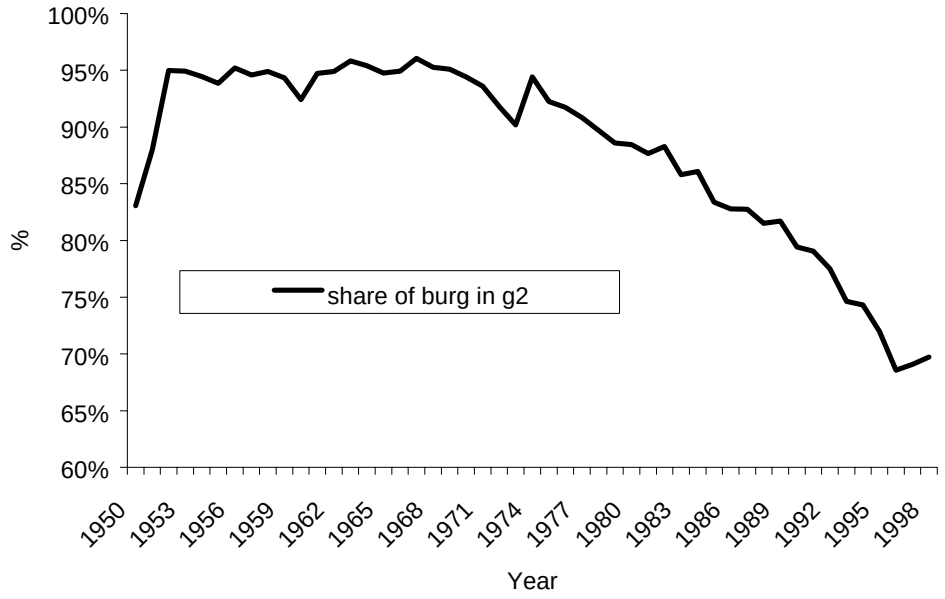


Figure 2.2 – Burglary as a percentage of Crimes against Property with violence (g2)



The fall in both series from the mid 1990s is evident. Unpublished data from the Department of Justice, Equality and Law Reform for 1999 and 2000 indicate that this trend is continuing, with the numbers of burglaries for those years being 23,042 and 20,477 respectively. So burglary for last year (2000) is now down to 79% of the 1998 figure and is lower than it has been since 1982.

To give an idea of the differences between burglary and the category of crimes against property with violence **Table 2.2** below gives a breakdown for two years. It can be seen that burglary accounts for the bulk of these crimes, over 88% in 1980 and a small number of other categories account for the remainder. As can be seen in Figure 2.2 the share of burglary in crimes against property falls over the 1980s and 1990s and this would appear to be largely accounted for by a greater incidence of malicious damage against property (including schools). It needs to be borne in mind therefore that in analysing the trend in crimes against property one is looking at a class of crime whose internal composition is to some extent changing. However the reasons as to why malicious damage to property increases in significance is one that is beyond the scope of this study.

Table 2.2 Crimes against property with violence ("Group 2")

	1980		1998	
Burglary	2,1974	88.3%	25,730	69.2%
Aggravated burglary	201	0.8%	657	1.8%
Robbery	939	3.8%	1,831	4.9%
Malicious damage to property	1,318	5.3%	8,223	22.1%
Other	446	1.8%	750	2.0%
Total	24878	100%	37191	100%

A convention in much of the literature is to normalise the burglary series by dividing by the population and this is shown in **Figure 2.3** while **Figure 2.4** shows the share of "Urban" (as defined above) in total group 2 crimes.

Figure 2.3 – Burglary per 1000 Population

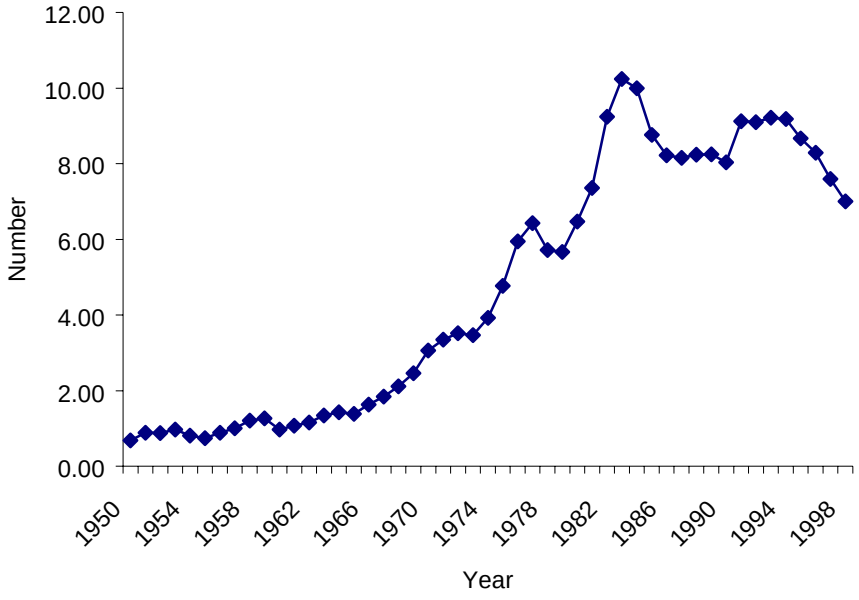
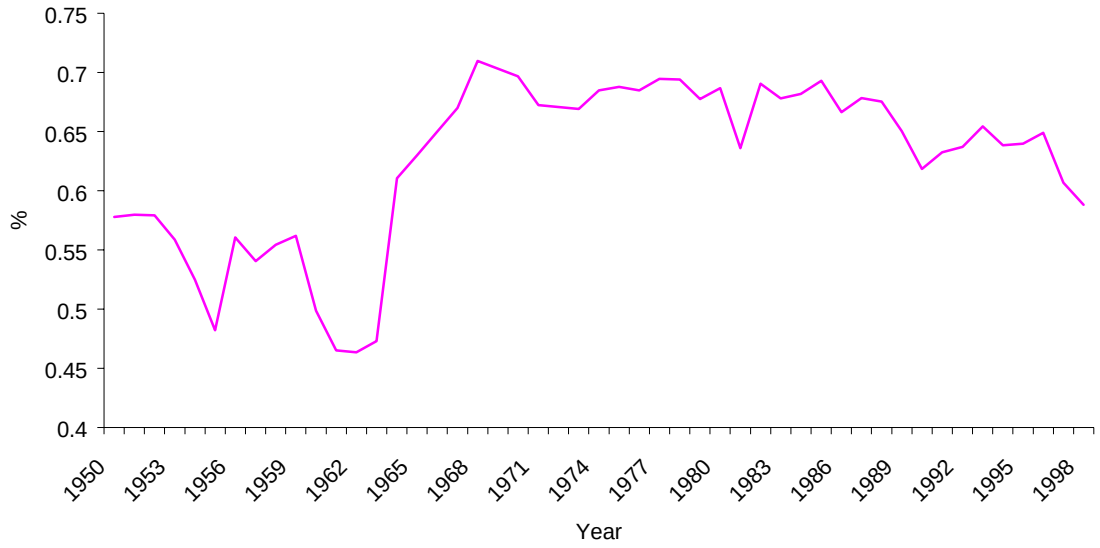


Figure 2.4 – Share of "Urban" in Total crimes against property with violence

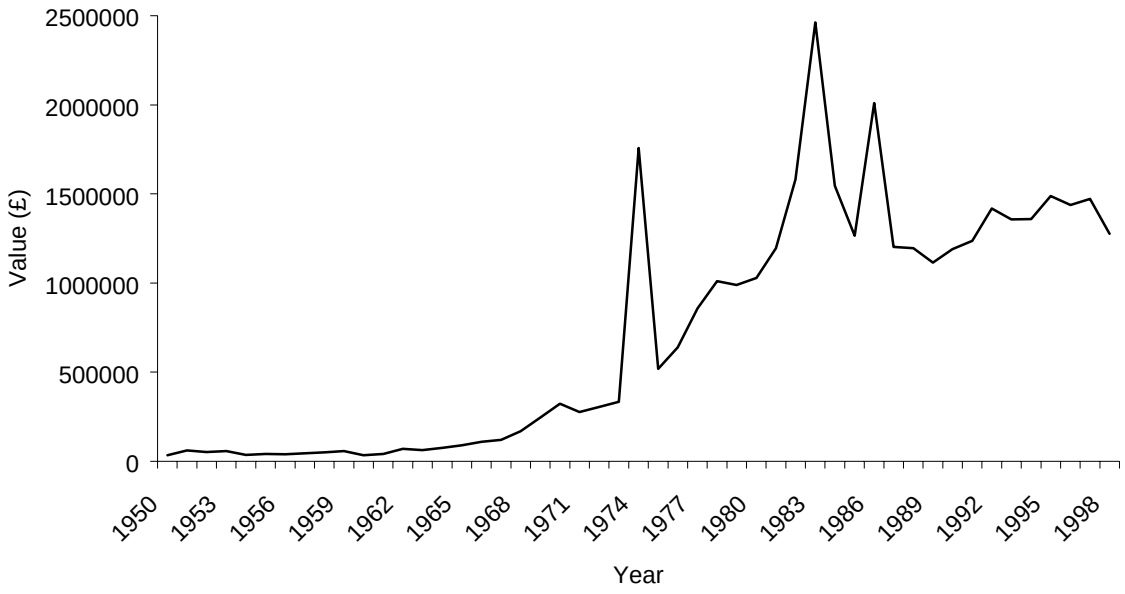


The simple frequency of crimes, that is the number of offences recorded, can be misleading or at least may be only partially informative, since it says nothing about the severity of the crime. An alternative approach is therefore to have a measure of crime that weights individual offences in some way with “bigger” robberies contributing more to the overall trend than lesser crimes. For crime against property a natural weighting would be based on the value of property stolen so that a crime in which £100 is taken is equivalent to two crimes in which £50 each is taken. This is not to say that this is the only, or even the ideal, measure of the trend in the crime in question. If it is the experience of being burgled (or otherwise victimized) rather than the property stolen that is of concern to individuals and society then the simple frequency of crimes may be the appropriate measure. Alternatively one might wish to weight the crimes by the numbers of victims so that the burglary of a household with two people counts for more than that of a single person household. This however raises the question of how one should weight non-residential properties.

So underlying the decision of whether to use a weighted or unweighted measure is to some extent a value judgement and also a question of data availability - it is not possible for example to weight burglary crimes by the numbers of residents in the household. Our view is that both approaches have merit and hence we also

estimate the same model specification but with a weighted measure - the average value of property stolen- as dependent variable.

Figure 2.5 – Value of Stolen Goods (Deflated by the Consumer Price Index, 1950=1)



The Garda reports contain a series on the value of property stolen for Group 2 crimes though not for burglary. Data is also presented on the number of crimes on which the value series is based – these are a subset of all Group 2 offences. Data is also available on the value of property recovered. This may be useful as an index of deterrence since there may be less incentive to steal if there is a high probability of it being recovered.

Figure 2.6 – Average Value of Crime Per Reported Case

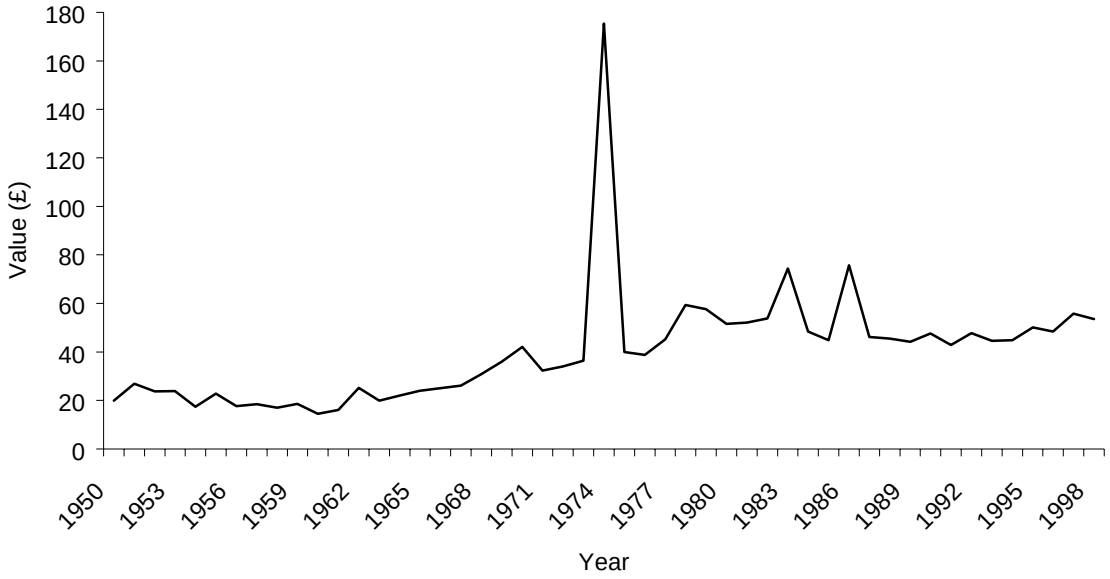
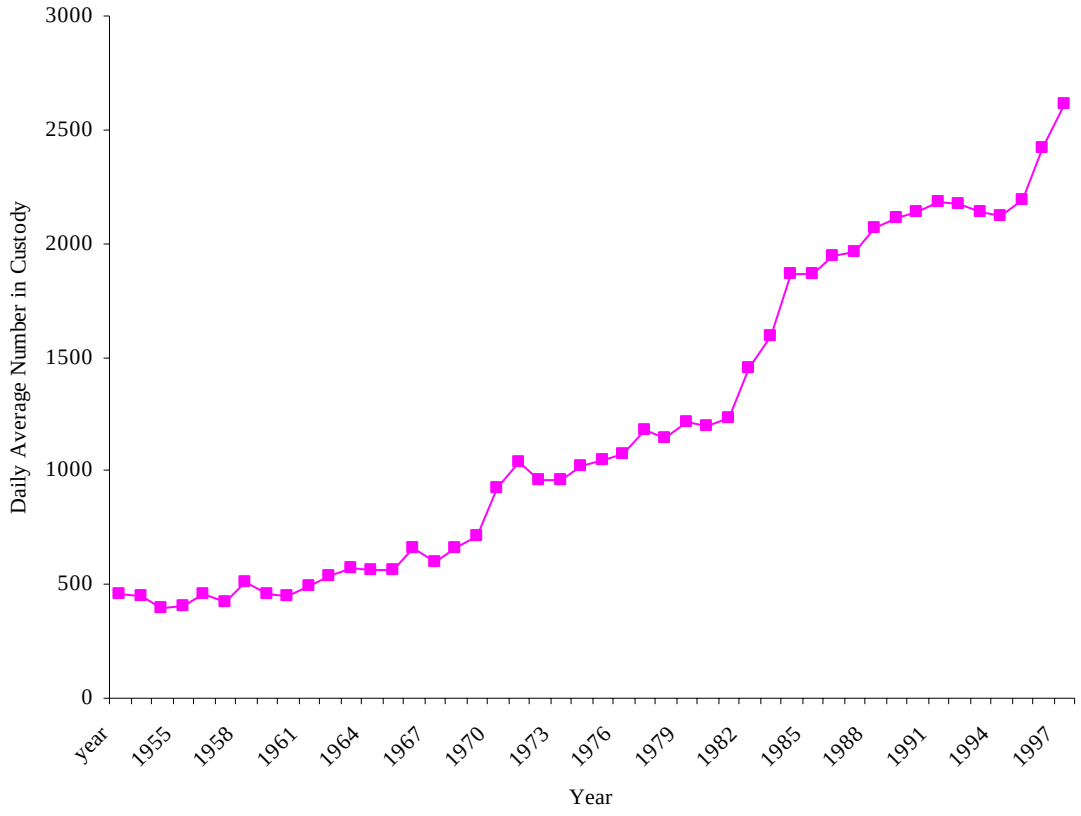


Figure 2.5 graphs the value series, deflated by the Consumer price Index (indexed 1950=1). The three "spikes" in the data at 1974, 1983 and 1986 are striking. An obvious question which can be asked is whether and to what extent these spikes can be explained by an increased frequency of crimes. So in **Figure 2.6** we graph the value series divided by the number of cases, which hence corresponds to the average value of property stolen (in real terms). This to some accounts for the spikes in 1983 and 1986 which are now much less pronounced. The Garda reports for 1974 and 1986 identify one particular crime in each of those years and give the value taken (see data appendix) so we simply adjust the series by subtracting the amount. For 1983 we were unable to explain the spike, instead we replace the observation for that year with the mean of the 1982 and 1984 data. More complicated methods of imputation are available but we believe this method is adequate.

As explanatory variables we propose to consider a small number of key demographic and economic variables which the international literature has suggested as determinants of property crime. In addition one may wish to consider

variables representing the criminal justice system which may act as deterrents to criminal activity. We use two variables under this heading one relating to detection of crime and one to imprisonment. For the latter we use the daily average number of people in prison from the CSO's Statistical Abstract augmented by the report of the Prison Service. **Figure 2.7** graphs this for the period of interest.

Figure 2.7: Daily average numbers of people in custody



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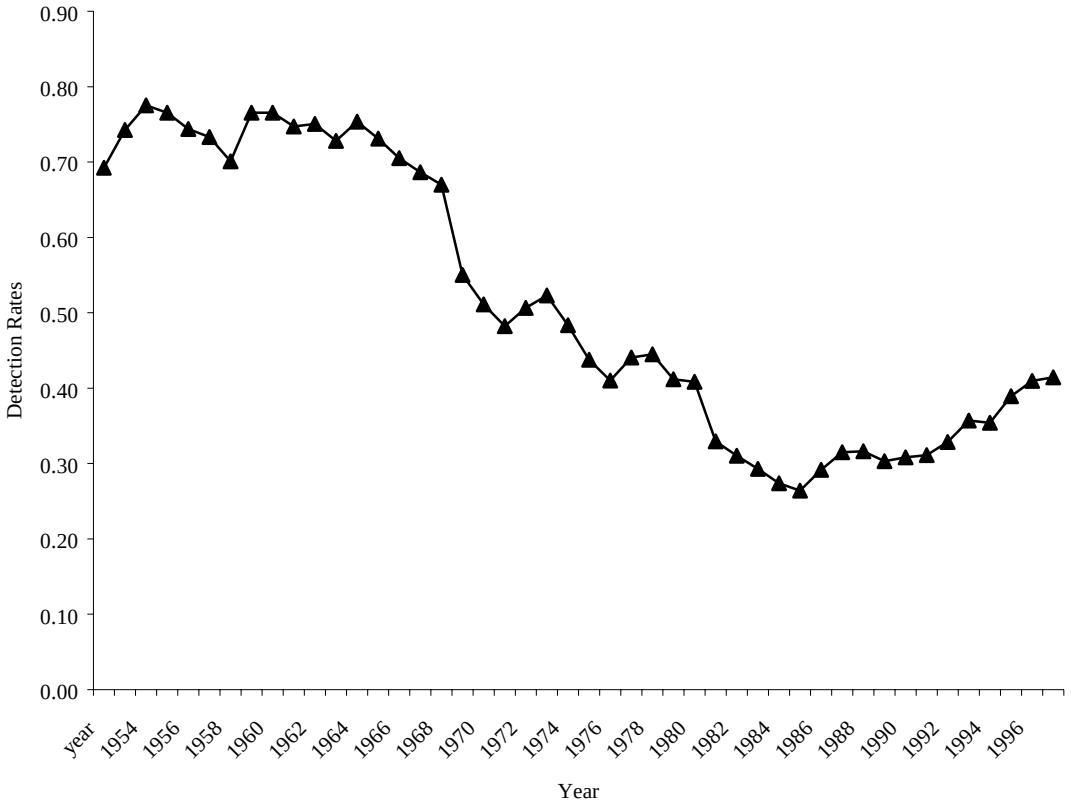
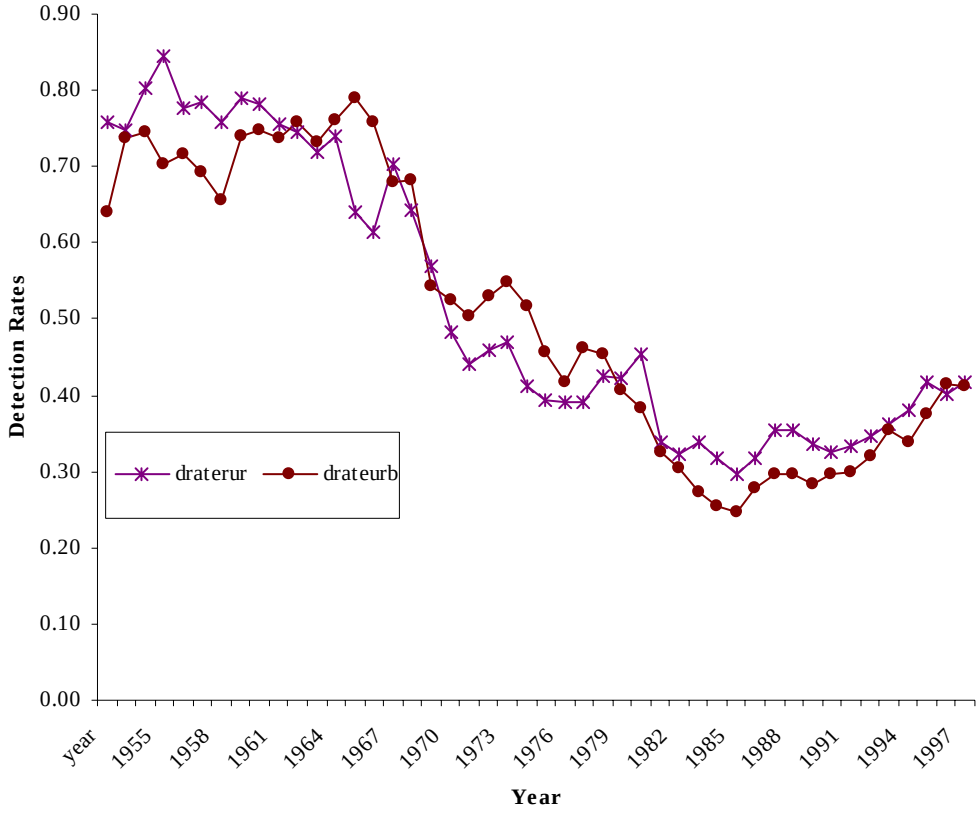
For detection rates we use the number of indictable offences in group 2 detected by the Gardaí, there is no figure available specific to burglary. The data can also be broken down regionally which is useful. The detection data as a proportion of the corresponding crime level is given in **Figure 2.8**:

Figure 2.8 Detection rate for crimes against property with violence



The detection rates broken down into an Urban series ("drateurb") and a Rural series ("draterur") earlier are in **Figure 2.9**. As can be seen they follow a very similar pattern.

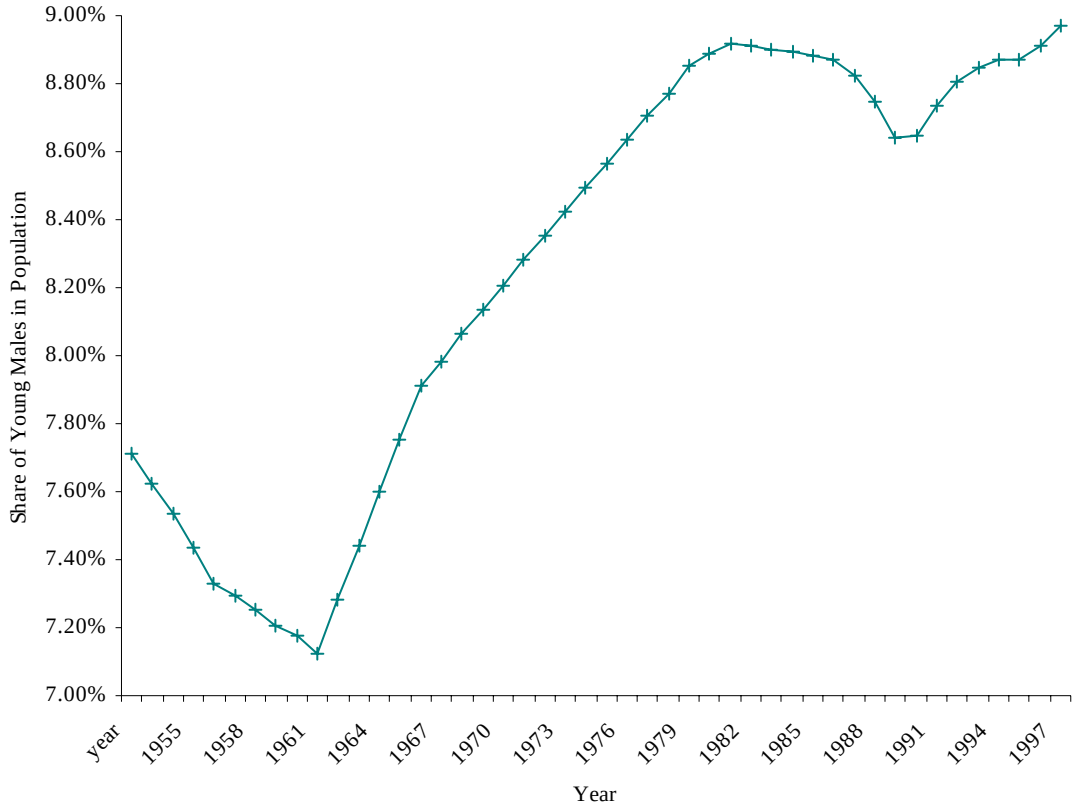
Figure 2.9 Detection rate for crimes against property with violence : rural and urban



There are a number of reasons why one might want to use demographic data. As noted above one may want data on total population to scale the number of crimes so that one analyses "burglary per head of population". Whether to model this or the simple level of burglary is to some extent a matter of taste and the literature is divided on which is the best to use. In this study we do *not* divide the crime data by population. A more important reason is that the age and gender composition of the population is likely to be important since the international evidence is that crime, at least of the sort considered here, is largely committed by young males. The evidence for Ireland is consistent with this. Fortunately all, or almost all, of the demographic data that one needs is available in one source the ESRI Time Series Databank, developed and provided by John Fitzgerald and Jonathan Hore. This gives population broken down into four age categories (0 to 14, 15-24, 25 to 64, 65+) for males and females separately from 1950 to 1999.

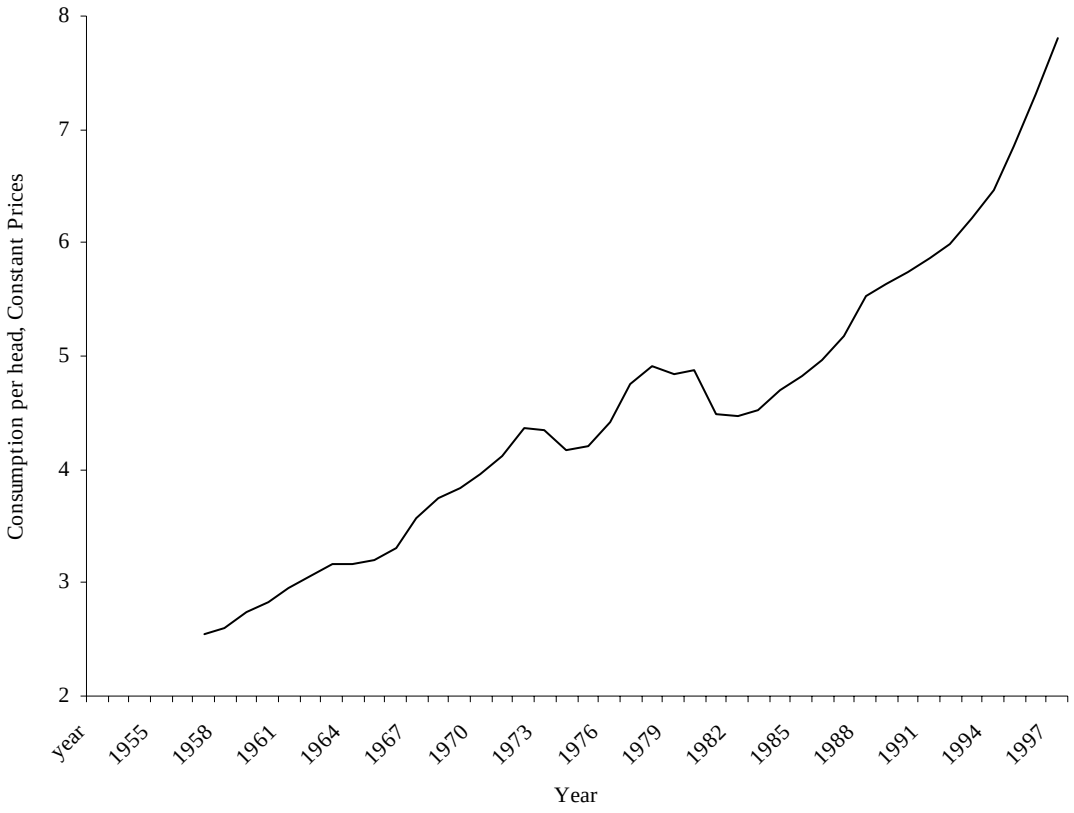
We construct a variable which is the share of young males in total population. "Young" in this context means between the ages of 15 and 24 inclusive. This series is graphed in **Figure 2.10**.

Figure 2.10 Share of young males in total population



We have experimented with a number of macroeconomic variables. Perhaps surprisingly only one was found to feature consistently so we end up with quite a parsimonious specification. Amongst the variables we considered are the level of real wages, the rate of unemployment and the level of migration. The variable that we did use is consumer expenditure, in real terms, per capita. It should be noted that the recent United Kingdom Home Office studies (Field(1999), Dhiri *et al*(1999)) also find a crucial role for consumer spending. Another variable which would be a close substitute for consumer spending would be GNP per capita. **Figure 2.11** illustrates the series that we have used.

Figure 2.11 Real per capita consumer spending



3 Results

In this section we present the econometric analysis that is the core of this report. We first outline some important statistical preliminaries. We then present the estimated model of burglary using data from 1957 to 1998. As will be clear from the section on methodology this proceeds in two steps, the first estimating the long run relationship between a set of variables and the second considering short run responses. Following the analysis of burglary we consider the analysis of a broader class of crime, *crime against property with violence.* As explained earlier we do this to model separately the trends in rural and urban crime. We also present a set of estimates of the determinants of the average value (in monetary terms) of property crimes.

The choice of variables used in the analysis is clearly crucial. It is also particularly problematic in an exercise such as this since existing theory, economic and otherwise, gives only fairly weak guidance as to what should and should not be included. By contrast, for example, in looking at say the demand for money, there is a large body of empirical and theoretical research which places strong restrictions on the form of the model.

After a certain amount of experimentation we isolated four variables as determinants of crime. One is demographic: the share of young males in the total population. This is consistent with a lot of international evidence and some for Ireland that young males are the group most likely to commit crime, particularly the sort considered here. There is one variable which reflects the general level of "prosperity" of the economy: real consumer spending per capita. Note that consumption was found to be the driving force in the recent UK study cited earlier. An alternative one could use which gives very similar results is GNP per capita inflation adjusted.

What is striking however is the absence of any labour market variable. Neither the level of wages nor the rate of unemployment appear in the model. This might seem unusual since the economics of crime emphasizes the importance of opportunity

cost: as legitimate labour market activity becomes less rewarding the relative return to crime becomes more attractive. Nonetheless we were unable to detect a robust effect of the labour market on the level of crime *given the other variables included*. It is worth noting that a recent study for New Zealand (Papps and Winkelmann, 1998) cite evidence that just one half of studies of the crime/unemployment relation find a positive effect with the remainder finding no such effect.

There is an important issue that needs to be remembered: one should think of the macro-economy as generating at least two conflicting effects on crime. As an economy becomes prosperous, some criminals may switch away from illegal activities because the opportunity cost of engaging in crime is now higher. On the other hand there is also more to steal, so the rewards to a given crime are higher because peoples homes have more and better goods in them. Ideally one would be able to isolate these two effects but if they cannot be distinguished empirically what one observes is the "net effect" of the two opposing forces. An additional possibility is that as consumers have more money to spend they allocate additional resources to security in the form of burglar alarms and so on and this acts to depress burglary.

Finally we have two variables reflecting features of the criminal justice system: the average level of custody i.e. numbers in prison and detection rates of Group 2 crimes. Again it is important to note that controlling for one variable has implications for how we interpret the presence of absence of another variable. Therefore the fact that a measure such as the number of serving Garda Síochána does not appear in the model does *not* mean that they have no effect. Rather their effect works through the level of custody and the detection rates. Holding the latter constant it would be surprising if Garda numbers had an independent effect.

We use the Grainger Engle(1987) 2 step Error Correction Mechanism (ECM) approach which is widely used in modelling aggregate time series data in a range of areas including crime trends. In has the advantage of easily distinguishing between short and long run determinants of the crime rate. It is possible that some of the variables we consider feature as long run determinants of the crime rate but not in the short run or vice versa.

We establish using the Augmented Dickey Fuller test that a set of variables of interest are all I(1).[3] We test for the presence of one or more cointegrating vectors using the Johansen procedure. Since we are able to identify a unique vector we estimate this vector by OLS which is "super consistent" (i.e. o(n)). We then estimate a differenced version of the model but including the lagged residuals from the static model. Since all these regressors are I(0), inference can proceed as usual. For two covariates,say, this amounts to first estimating

$$Y_t = a_0 + a_1 X_t + a_2 Z_t$$

Followed by

$$\Delta Y_t = b_0 + b_1 \Delta X_t + b_2 \Delta Z_t - b_3 (Y_{t-1} - \hat{a}_o - \hat{a}_1 X_{t-1} - \hat{a}_2 Z_{t-1})$$

Estimating the system in one step gives very similar results , in this case:

$$\Delta Y_t = b_0 + b_1 \Delta X_t + b_2 \Delta Z_t - b_3 (Y_{t-1} - a_0 - a_1 X_{t-1} - a_2 Z_{t-1})$$

ECM's are now commonly used in modelling crime rates; in addition to the UK studies cited, recent work on Italy (Scorcu and Cellini 1998) and Germany (Entorff and Spengler 2000) use this approach.

Based on our discussion above the model is developed by estimating long run 'cointegrating ' relationships between recorded property crime and other factors, and by estimating short run relationships which are corrected for the presence and effect of the underlying equilibrium level of crime

We first estimate whether or not the variables of interest can form a cointegrating regression. Table 3.1 outlines this first stage of the process, which can be thought of in its own right as estimating the effect of the independent variables on the long run equilibrium level of crime. This corresponds to equation (1) in the appendix.

[3] See the appendix for details. Using the non parametirc Phillips Perron test gives identical results.

Table 3.1: Estimating the long run relationship

Dependent Variable – Log of the National Burglary level

	Estimated Coefficient	*Standard Error*
Young Males as % Population (Log)	3.852*	0.542
Consumption (Log)	-0.297	0.260
Custody Rate (Log)	-0.886*	0.190
Detection Rate	-3.245*	0.303
Trend	0.054*	0.008
Constant	-78.865*	15.225
N	41	
Adjust R^2	0.993	

* indicates statistical significance of 90% or higher.

Interestingly the level of consumption does not have a statistically significant effect on the level of crime. What is evident however in this regression, as denoted by the asterisked terms, is that the long run or equilibrium level of crime is positively influenced by the stock of young males in the population - every 1% increase in the young male population (as a fraction of total population) raises burglary crime by 3.8%. Moreover crime appears to trend upwards, assuming all other things held constant, by about 5.4% per year. "Policy variables" such as the custody level and detection rate do tend to lower the level of crime. A 1% increase in detection rates or the numbers in custody lowers the level of burglary by 3% and 0.9% respectively.

We use the Johansen procedure to test for the existence of a long run relationship between these variables and are unable to reject the hypothesis that there is a unique cointegrating vector.

The long term relationship between crime, demography and the economy, as described above, determines what might be called the ‘equilibrium’ level of crime. There is nothing permanent or final about this equilibrium, which may change over time in response to demographic and economic changes. It may also respond to a range of other socio–economic factors or specific criminal justice variables.

Table 3.2 Dynamic Error Correction Models

		Standard Error
Growth in Young Male Population	4.720*	1.285
Growth in Consumption	-0.851*	0.323
Growth in Custody Number	-0.410*	0.127
Change in Detection Rates	-2.280*	0.471
Year	-0.000	0.0009
Error Correction Term (lag)	-0.650*	0.138
Constant	0.549	1.984
N	40	
Adjust R^2	0.7197	

Table 3.2 shows the results for the dynamic models which address these short-run influences but which also incorporate the error correction term from Table 3.1 to allow for the effect of the long run equilibrium relationship to be estimated. The Table shows a regression which relates the growth in burglaries to the growth in the independent variables.

The key findings here are:

Consumption growth tends to depress property crime growth – a 1% increase in the rate of growth in consumption lowers the growth in crime levels by 0.85%. This is consistent with a view that an improvement in the macroeconomic environment generates opportunities in the legitimate economy which raise the opportunity cost of crime. Note from Table 3.1 that this variable only has a statistically significant effect in the short run, there is no long run effect of macroeconomic prosperity on burglary.

Changes in the growth rate of the young male population has a very large positive impact on crime – about 4.7% for every 1% increase in the rate of growth. The criminal justice system variables remain important negative determinants of the growth in crime. Finally the negative coefficient on the Error Correction term means that the system display sensible dynamic properties. That is when the level of crime is below its long run level it tends to rise until it attains equilibrium and similarly it falls when it is above the long run.

The results broadly accord with what theory and the international literature would suggest. For example Entorff and Spengler (2000) find the same effect of young males and the effect of deterrence for Germany as we find here. The importance of consumer spending is also found in a recent Italian study (Scorcu and Cellini 1998).

One issue, already raised in section 1, is the potential for criminal justice measures to be endogenous with respect to crime; that is criminal activity may influence policy responses. It is difficult to deal with this issue. As discussed in section 1 in order to do so we need to identify events which, for example, influence the detection rate but which themselves have no direct effect on crime[4]. These may only be available through some policy initiative which, for example, is piloted in a specific division or region in order to provide the research with a treatment group and a control group. One possible solution in the context of time series modeling is to use lagged values of the criminal justice variables in a procedure known as instrumental variables. This, when applied to the data used in table 3.1 and 3.2, shows no notable differences in the results, see the Appendix. So this suggests, that insofar as we can control for this problem, that no major distortion is introduced by treating crime as exogenous. However our instruments are probably not very good.

Although the 2 step Grainger and Engle method are super consistent and asymptotically efficient there are small sample biases. Engle and Yoo(1991) propose a simple third step which gives estimates which are asymptotically equivalent to FIML. For a single cointegrating vector with weakly exogenous regressors this is particularly easy to implement. The table below gives the results of applying this method. The results are very similar to the two step. The main differences are a smaller (but still substantial) role for the demographic variable and a greater role for the deterrence variables, the elasticity with respect to custody being significantly bigger.

[4] See Appendix 1 or Levitt (1996).

Table 3.2:

3 Step estimate of co-integrating vector

	Estimated Coefficient	*Standard Error*
Log Young Males (as % Population)	3.116	0.783
Log Consumption	0.032	0.322
Log Custody Rate	-1.259	0.246
Detection Rate	-3.8556	0.474
Trend	0.06	0.010
Constant	-86.37	12.24
N	41	

Table 3.3 shows the results of the regression model as applied to the rural and urban data separately. The dependent variable is the natural logarithm of G2 crimes owing to the unavailability of the burglary data by region as explained earlier, so comparisons with Table 3.1 and 3.2 should bear this in mind. Where relevant all explanatory variables are specific to the region under analysis.

The interesting issues in Table 3.3 are (a) the extent to which there are differences between the rural and urban results and (b) the differences between these results and the aggregate burglary figures in Table 3.1.

Comparing rural and urban we find that overall the results are very similar with the notable exception that the detection rate exerts a much more powerful effect in reducing crime in rural areas than urban. For every 1% change in the detection rate in rural areas the fall in crime is almost 3% compared to 1.3% in urban areas. Another interesting difference emerges when we look at the dynamic Error Correction model (in the bottom panel of Table 3.3). The effect of the growth in the young male population, so noticeable in the results in burglary, is shown to be only a feature of the urban sample.

Comparing these results with those for burglary in Table 3.2 we find that the qualitative results are very similar but there are important quantitative differences in the size of the effects. The negative effect of consumption on this class of crime, for example, is almost three times greater than on burglary.

Table 3.3 Rural/Urban Breakdown of Analysis

	RURAL		***URBAN***	
	Coefficient	Standard Error	Coefficient	Standard Error
Long run relationship				
Young Males as % Adult Population (Log)	0.3041	3.0097	1.5261	1.6837
Consumption (Log)	-0.9755	0.3997	-1.0996	0.2565
Custody Rate (Log)	-0.6985	0.3460	-0.4942	0.1472
Detection Rate	-2.7758	1.0680	-1.3144	0.2421
% Population in urban areas	-0.0320	0.1333	0.2768	0.0717
Trend	0.1038	0.0257	0.0148	0.0091
Constant	-186.5408	39.9605	-25.3805	12.2139
N	38		39	
Adjust R^2	0.9755		0.9956	
Error correction model				
Growth in Young Male Population	-3.3873	2.4175	4.4604	1.4800
Growth in Consumption	-1.2208	0.5563	-1.1069	0.3208
Growth in Custody Number	-0.1019	0.2097	-0.2776	0.1216
Change in Detection Rates	-1.0529	0.5250	-1.3274	0.2907
Change in % Population in urban areas	-0.0528	0.2399	0.1808	0.1843
Year	-0.0027	0.0031	0.0001	0.0027
Error Correction Term (lag)	-0.3639	0.1750	-0.6826	0.1554
Constant	5.4295	6.1844	-0.1701	5.4055
	38		38	
	0.4113		0.7806	

An alternative way of modeling crime is to consider the value of a crime defined as the total value of goods taken divided by the corresponding number of crimes. Table 3.4 shows the results from our two-step model with the dependent variable now based on this average inflation adjusted value of crime data (as opposed to the number of crimes).

Table 3.4 Estimates based on Average Value of Crime

Long run relationship	Coefficient	Standard Error
Young Males as % Adult Population (Log)	2.0865*	1.2440
Consumption (Log)	0.9284*	0.4336
Custody Rate (Log)	-0.7717*	0.2813
Detection Rate	-1.7818*	0.5533
Trend	0.0117	0.0154
Constant	-15.1002	29.5715
N	41	
Adjust R^2	0.9399	

Error correction model	Coefficient	Standard Error
Growth in Young Male Population	0.5941	2.6880
Growth in Consumption	1.6041	0.4277
Growth in Custody Number	-0.5436	0.3231
Change in Detection Rates	-2.2862	0.5951
Year	-0.0002	0.0021
Error Correction Term (lag)	-0.6211	0.1466
Constant	0.4430	4.2493
N	40	
Adjust R^2	0.487	

In the long run relationship we see results that are broadly in line with the earlier findings based on the number of crimes. The most notable difference is that consumption is a significant and positive determinant in both the short run and long run. This contrasts with the earlier finding that consumption only has a negative and short run effect when looking at the number of crimes. This implies that pro-cyclical swings in consumer spending generate fewer but more lucrative crimes. This suggests that it is predominantly “small time” crime which is reduced when the macroeconomy improves. As the economy improves those involved in high value crime benefit from the greater prosperity in that individual crimes are more lucrative. On the other hand those involved in low value crime may be attracted away to the legitimate economy hence the finding of a positive effect on the value but not on the level. Also growth in the young male population does not have a significant effect on the value of crime.

A number of alternative models were estimated throughout the completion of the report, which, for reasons of brevity, have been omitted. However some important points are worth noting about these specifications. One variable that some will be surprised to see omitted from the list of explanatory variables is unemployment or some other direct measure of labour market activity such as the wage level. However, once we control for the explanatory variables used in the modelling, we were unable to find *any* robust effect from these labour market variables. Given the mixed evidence on this in the international literature it is perhaps not that surprising. We also experimented with migration rates and with the level of burglary in the UK however in both cases we could eliminate them from the model.

4 Conclusions

In this paper we present an econometric analysis of the trend in Irish burglary crime between 1958 and 1998. We have collected an extensive dataset based on Garda reports and other official publications and we use this data to develop an econometric model of burglary and the wider category of crimes against property with violence (known as Group 2 crimes in the published statistics). The model explains burglary in terms of demographics, the macroeconomy and two characteristics of the criminal justice system. We distinguish between the determinants of the level of crime (the long run or equilibrium level) and the short run dynamic behaviour of crime. We develop the model for national data and also for an urban/rural split. Moreover we consider data on the value of property stolen in Group 2 crimes as an additional indicator of crime level.

Our key findings are that macroeconomic conditions as measured by the level of real consumer spending per capita have little effect on the equilibrium level of national burglary crime but, in the short run, growth in consumer spending does depress crime. However consumption has a much more pronounced and positive effect on the average value of a burglary act. Hence the evidence suggest that consumption affects the nature of the crime but not the overall frequency of crime in the long run.

Demographic conditions are measured by the share of young males in the adult population. This variable has a positive effect on crime both in the long run and the short run. The criminal justice system impacts on crime through two channels – the detection rate (reflecting the probability of being caught), and the numbers in custody for Group 2 crime (reflecting the consequences of being apprehended). Both have well determined negative effects on crime reflecting the deterrence effect and the direct effect of incarceration.

Some difference can be noted when we consider the data separately for rural and urban populations. Detection has twice as big an effect on crime in the rural areas possibly reflecting the more risk averse nature of criminals in these areas. One somewhat surprising result is that we were unable to find any robust effect from direct measures of labour market activity such as unemployment rates or wage levels.

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Appendix: ADF tests for main model, constant included

	I(0) vs. I(1)		(I1) vs. I(2)	
lags	**0**	**2**	**0**	**2**
log Burglary	0.650	0.296	0.000	0.005
log Male in Population	0.986	0.800	0.250	0.123
log Consumption per cap	0.965	0.971	0.003	0.003
log Prison population	0.962	0.901	0.000	0.001
Detection rate	0.800	0.539	0.000	0.008
log Property crime ("G2")	0.992	0.995	0.001	0.003

P values

Table A1 : IV estimate of long run burglary model

	Estimated Coefficient	*Standard Error*
Log Young Males (as % Population)	3.124137	1.045058
Log Consumption	-.0742192	.3784929
Log Custody Rate *	-1.394362	.4485604
Detection Rate *	-3.972494	.7226298
Trend	.0672152	.016202
Constant	-103.8314	29.32473
N	41	
Adjust R^2	0.993	

Instrumented variables: log custody rate, detection rate
Instruments: log burglary(t-2), log burglary (t-3), detection rate(t-3), detection rate (t-4), log custody rate (t-3), log custody rate (t-4)

Sargan test of over-identifying restrictions: 8.134471 Chi-sq(4) P-value = .0868

Davidson-MacKinnon test of exogeneity: 1.051032 F(2,33) P-value = .361