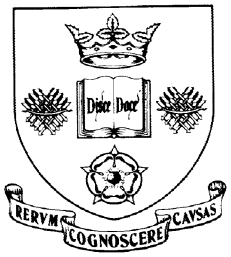
Sheffield Economic Research Paper Series

SERP Number: 2013001

ISSN 1749-8368



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January 2013

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Abstract

We use national and regional Canadian data to analyze the relationship between the unemployment rate and crime rates. Given potential aggregation bias, we disaggregate the aggregate crime data and look at the relationship between six different types of crimes and unemployment rate. At the national level, neither the aggregate total crime, nor the aggregate property crime are significantly related with the unemployment rate; however a rise in unemployment rate does significantly increase certain kinds of property crime, like breaking and entering, and robbery. At the regional level, the results of our panel data analysis also show that breaking and entering, and fraud rise as contemporaneous unemployment increases. When we extend our panel analysis to control for police-civilian ratio and other controls (this reduces our sample period) we find a significant relationship between unemployment and all crime rates except violent crime. Our results thus indicate that for Canada the unemployment rate is a significant factor in predicting property crimes but not violent crimes.

Key words: crime, unemployment, Canada, time series analysis

JEL Classification: C22, K1

Acknowledgments: We are grateful to Mustafa Caglayan and Juan Carlos Cuestas for providing helpful comments. The normal disclaimer applies.

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1. Introduction

In this paper, we use Canadian data to analyze the relationship between the macro economy, specifically the unemployment rate, and crime rates. We start our analysis by looking at the national level time series data to gather some insight into the relationship between aggregate crime and unemployment; this is followed by a disaggregated analysis, where we look at the relationship between six different types of crimes rates and unemployment. Finally, we conduct a panel data analysis to allow for disaggregation over different types of crimes and over different regions; where our panel consists of ten Canadian provinces. This paper makes two contributions to the literature. First, as far as we are aware, ours is the first analysis for Canada. Second, in our analysis we take into account the variations that occur in the relationship between unemployment and crime as a result of regional variations and the variations in the types of crime.

Since Becker's (1968) seminal paper, wherein he develops a theoretical model of crime behaviour to specifically address the role of deteriorating labour markets, a large literature has developed examining the relationship between crime and the economy. Becker argued that an individual will engage in criminal activities as long as the expected utility of committing crime is greater than the expected utility of engaging in other activities; hence, deteriorations in labor market opportunities make crime relatively more attractive. While Becker's analysis was at the micro level, we build on existing research to explore the link between crime and the state of the macro economy.

To capture the relationship between crime and the macro economy, researchers have made use of a number of different macroeconomic business cycle aggregates, such as real GDP and unemployment. Early analysis of the link between crime and the business cycle includes that of Cook and Zarkin (1985) who examine the role of real GDP; they find that expansions of economic activity (via a rise in real GDP) have a negative impact on property crimes. Wang and Minor (2002) look at the impact of job accessibility; they conclude that improvements in job accessibility occurring at times of economic expansions lower crime rates, however the relationship is stronger for property crimes than

for crimes of violence.[1] Alternatively, the unemployment rate is used in this literature, as it rises during contractions and falls during expansions and is more directly linked with the economic incentives of crime (see Hale and Sabbagh, 1991; Hale, 1991; Land, Cantor, and Russell, 1995). In this paper, we take the latter approach and utilize the unemployment rate to capture the link between the macro economy and the crime rate.

While there exist a literature examining the link between unemployment and crime from various countries[2], there is no consensus on the relationship between the two variables (Fougere *et al*, 2009). A review by Chiricos (1987) indicates that the effect of unemployment on crime is ambiguous with some studies finding a significant positive effect of unemployment on crime, and others finding either no relationship or a negative relationship. Using UK data, Cantor and Land (1985) find a weak significant effect of unemployment on crime, especially when considering crimes with a property component (such as robbery, burglary and larceny). Similarly, Gould, Weinberg and Mustard (1997), Machin and Meghir (2004) and Donohue and Levitt (2001) report a statistically significant relationship between unemployment rate and property crimes, but not one between unemployment and crimes of violence.

As part of our analysis, we specifically deal with the problem of aggregation bias. The issue of aggregation bias has been addressed in this literature. An early example is the work by Cornwell and Trumbull (1994), who in their paper use county level data from North Carolina (US) to control for unobserved heterogeneity (which they call "jurisdictional heterogeneity") and find that results based on national level data overstate the role of a number of explanatory variables. Cherry and List (2002), using the same data, extend the work by Cornwell and Trumbull (1994) by allowing for different types of crimes, and find evidence of "parameter heterogeneity" across crime types. More recently, Levitt (2001) explores the link between unemployment and crime rates in the US, accounting for aggregation bias. He argues that national level data while useful for certain types of analysis are a "crude tool" in

[1] Other macroeconomic variables that have been considered in the crime literature include poverty and inflation in Allen and Stone (1996).

[2] For studies on US see Levitt (1996, 1997, 1998, 2001, 2002, and 2004), Sridharan *et al* (2012), and Saridakis (2004), among others. For Studies on the UK see Wong (1995), Machin and Meghir (2004), and Ward and Carmichael (2001), among others. Fougere *et al* (2009) use French data, and Entorf and Spengler (2000) use German data.

exploring the link between unemployment and crime rates. Moreover, according to Levitt (2001) panel data that disaggregate crime data allow for more useful results as national crime statistics potentially remove useful variations. A similar argument holds for disaggregating unemployment rates, as those can differ substantially by regions (provinces in the case of Canada). In this paper, we start with an aggregated national level analysis, followed by disaggregation alone the crime margin, followed by a regional panel analysis thus addressing aggregation bias.

The structure of the paper is as follows. Section 2 describes the econometric model that we estimate; in this section we also discuss the hypothesised link between unemployment and crime which is the motivation for our econometric model. Section 3 discusses the data and the empirical findings. Section 4 concludes the paper.

2. Econometric model

In their seminal work Cantor and Land (1985) developed a theoretical framework to explain the link between unemployment and crime. They suggested two important and opposing links: *opportunity* and *motivation*.[3] The motivation hypothesis, similar to the Becker (1968) analysis, suggested that a decrease in viable economic prospects will increase the incentive to engage in crime; so the unemployed are more likely to engage in criminal activities. The opportunity hypothesis on the other hand suggested that a decrease in economic activity will decrease the availability of criminal targets (the unemployed are also more likely to stay at home thus decreasing their vulnerability to crime, especially property crime), and hence reduce the incentive to engage in crime. They also suggested that the timing of these two links would be different, with the changes in opportunity having an immediate impact and the motivation effect working only with periods of sustained unemployment. The suggested relationship, that can be econometrically estimated thus becomes:

$$\Delta crime_t = \alpha - \beta_1 unemp_t + \beta_2 \Delta unemp_t + \varepsilon_t$$

[3] For full discussion and details of the model see Cantor and Land (1985), and Phillips and Land (2012).

where t indicates time; Δ is the difference operator, such that $\Delta Y_t \equiv Y_t - Y_{t-1}$; *unemp* is the unemployment rate; α is the intercept; β_1 captures the effect of the opportunity hypothesis, and is expected to be negative; β_2 captures the effect of the motivation hypothesis, and is expected to be positive; and ε_t is the stochastic error term.

While the economic model as given by Cantor and Land (1985) was accepted, their econometric model came under criticism by Hale (1991) and Hale and Sabbagh (1991). To summarize the criticism: we cannot explain a stationary variable ($\Delta crime_t$) by a non-stationary variable ($unemp_t$); the model is statistically misspecified, and results in spurious regressions. They instead suggested an alternative specification using the error correction model, which is the starting point of our analysis.

We begin our analysis by looking at the national level time series data. We build on the work of Hale and Sabbagh (1991) and Greenberg (2001) and start by estimating an error correction model for crime incorporating both the long-run and the short-run dynamics, where short term dynamics are viewed as departures from long-run equilibrium.[4] The relationship we aim to estimate is given by equation (1):

$$\Delta crime_t = \alpha + \lambda Z_{t-1} + \beta_1 \Delta crime_{t-1} + \alpha_0 \Delta unemp_t + \alpha_1 \Delta unemp_{t-1} + e_t \qquad (1)$$

where α is the intercept. α_i are the coefficients which capture the short run relationship between change in crime rates and change in unemployment rates, and β_1 captures the dynamics in crime. e_t is the stochastic error term. $Z_{t-1} = crime_{t-1} - \gamma\, unemp_{t-1}$ is the error correction term, it captures the long term relationship between the variables of interest; λ is the speed of adjustment, which tells us how the variable of interest, here crime, adjust to deviations from the long run relationship. For a long term relationship to exist between crime and unemployment we require $\gamma < 0$; if on the other hand we find that statistically $\gamma = 0$ then we conclude that there is no long run relationship between the variables of interest, in which case equation (1) will have no error correction term, and all we have is the short-run dynamics.

[4] This work is in contrast to that of Cantor and Land (1985, 2001) and Land, Cantor, and Russell (1995), wherein a first-difference model is used to understand short-term dynamics (year to year changes). See Britt (2001) on the discussion of the first-difference vs. the error correction methods.

We estimate equation (1) first to capture the relationship between total national crime rates and national unemployment rates. Then, we disaggregate total crime into six types of crime (including property crimes and violent crimes) and look at the relationship, at the national level, between types of crimes and aggregate unemployment rate.

Lastly, we disaggregate further allowing for regional differences, specifically considering crime rates and unemployment rates across the ten Canadian provinces. At the regional level we estimate a fixed-effects panel regression of the form:

$$\Delta crime_{st} = b_1 \Delta crime_{st} + a_1 \Delta unemp_{st} + a_2 \Delta unemp_{st-1} + a_3 X_{st} + \theta_s + \varepsilon_{st} \qquad (2)$$

where *s* indicates the region and *t* indicates time, and *X* indicates the other variables of interest; θ_s is the region specific effect; and ε_{st} is the stochastic error term.

In our empirical estimation we use log of crime throughout, hence the estimated coefficients associated with both contemporaneous and lagged change in unemployment, in both equations (1) and (2), are interpreted as semi-elasticities. In our empirical specification we also test for number of lags to be included, for both crime and unemployment, in equations (1) and (2). Since we are estimating an autoregressive distributed lag model, we also test for model misspecification.

3. Empirical Analysis

3.1 Data and descriptive statistics

All data used in this paper were collected from CANSIM, a data base of Statistics Canada. We have annual data, which at the national level covers the period of 1979 to 2006. Our data includes seven crime series. At the most aggregate level is the series of total crime rate (TC) for Canada and individual provinces. TC is then further disaggregated into two types of crimes: Crimes of Violence (VIO) and Property Crimes (PC). The PC can be further disaggregated into four types of crimes: Breaking and Entering (BE), Robbery (ROB), Theft (ATH), and Fraud (FR).

Canada has 13 regions: 10 provinces and 3 territories. In our panel analysis we include all the 10 provinces (see Table 1 for the list of provinces included in the study). We do not use the data on the

three Canadian territories (Northwest Territories, Nanavut, and Yukon), due to the large demographical differences compared to the provinces and due to the lack of data (for example, Northwest Territories was separated into Nanavut and the Northwest Territories in 1999, although Nanavut was already established in 1993, leading to missing data problems in the mid 1990s).

For the panel analysis, other than unemployment, we also include some other control variables (matrix *X*): the police civilian ratio (PCR); % male, between the ages 18 to 24 years, of total population (PMALE18); and % male, between the ages 25 to 44 years, of total population (PMALE25). The police civilian ratio is included to capture the resources dedicated to fighting crime, hence it captures the effectiveness of expenditure on fighting crime. It could be argued that crime falls when the number of police as a percent of the civilian population rises; thus we control for this possibility. We also control for the young (18-24) male population as well as the middle age (25-44) male population. This is in light of the evidence by Levitt (1996, 1997) that higher % of young population yields higher crime, with the 25-44 population having a larger impact. Instead of focusing on the whole population, we consider the male population as men are more likely to commit crime (see Steffensmeier and Allan, 1996, on the discussion of the gender gap in crime). The panel analysis is done, using annual data for two time periods: 1979 to 2006, to compare it with the national level analysis; and for the period 1986 to 2006 for which we have additional control variables available.

Figure 1 shows a plot of all the time series, at the national level. A casual inspection reveals that unemployment rose during the recessions in early 1980's and 1990's, with only a modest rise in unemployment during the slowdown in the early 2000's. [5] A close look at the total crime rates suggest that we may not obtain strong findings of a link between crime and unemployment when looking at aggregate data, however when we look at the disaggregated data we do find some interesting patterns. The robbery series mimics the unemployment series most closely, it exhibits peaks during the recession of the 1980's and 1990's with a modest increase in the early 2000's. Interestingly the increase in the

[5] There is no official business cycle dating conducted by Government Canada. The recession dates mentioned are those obtained from the work done by the Economic Cycle Research Institute (ECRI), and empirical research. While ECRI does not obtain a recession in early 2000's, empirical research by Louis and Simons (2005) suggest a recession from 2001.2 to 2002.2.

unemployment rate in the mid 1990's while not a recession, is also accompanied by a rise in the robbery rate. With respect to fraud, there is a sharp rise prior to the recession in the 1980's, however it continues to stay high into the early 1990s, at which point it falls with a slight increase in early 2000's. Thus, while it does not exhibit a sharp decline prior to the 1990's recession, it does show similar patterns in the other time periods. Similarly, breaking and entering shows only a modest decline in the mid 1980's as compared to the sharp drop following the 1990's recession. Theft falls in the early 1980's, however it rises sharply in the mid 1980's reaching a peak in the 1990's recession. Overall, the observation of the data suggests a possible link between unemployment and different types of crime rates. Overall crime rates have fallen in recent years. [6]

The descriptive statistics of all variables at the national level are given in Table 2. On average, Breaking and Entering is the largest crime committed. The average unemployment rate over this time period is 8.8%.

Table 3 gives the descriptive statistics of the variables at the regional level. Overall evidence within each province is the same, with breaking and entering being the biggest share of total crime. The highest total crime is in British Columbia followed by Saskatchewan, both in the western provinces. These two provinces also have some of the highest unemployment rates. Lastly, the police-civilian ratio is the highest is British Columbia.

3.2 National level analysis

A casual observation of the data in Figure 1 suggests that the series might be non-stationary. We conduct an ADF test to check for non-stationarity and report our results in Table 4. We find all the series, with the exception of log of ROB, to be non-stationary.

Before we can estimate equation (1) we need to check whether or not the variables are co-integrated. If we do find co-integration then we will estimate the error correction model as specified in

[6] Criminologists have observed a falling trend in crime rates in the United States during the 1990's period. Levitt (2004) analyzes the causes of decreases in crime rates in US from 1991-2001. Ward and Carmichael (2001) consider the case of England and Wales. Similar trends are observed for Canada; See Crime Statistics Canada (2007).

(1); if we find no co-integration then we estimate the specification without the error correction term. Table 5 reports the results of the co-integration test. We check for co-integration between the total crime rate and the unemployment rate, as well as each of the six disaggregated crime series and the unemployment rate. Our results indicate that for Canada there is no long run relationship between unemployment rate and crime at the aggregate level (this is similar to the findings of Hale and Sabbagh, 1991, for England and Wales); hence we focus on short-run dynamics only, the results of which are reported in Table 6.[7]

With the exception of robbery there is a degree of persistence in growth of crime rate, with the crime at period t-1 having a positive impact on the crime in period t (first row, Table 6). Column (1) of Table 6 shows the findings for aggregate total crime at the national level. The results indicate that there is no significant relationship between total crime and unemployment, contemporaneous or lagged. Once we separate TC into the two main categories, violent crime and property crime, we still find no significant relationship with contemporaneous unemployment (columns 2 and 3, Table 6).

Next, we disaggregate PC further into BE, FR, ATH, and ROB. Our findings indicate that BE and ROB have a significant link with contemporaneous unemployment (though only at 10% level of significance). The estimated coefficient on $\Delta unemp_t$ in the equation for BE of 0.02 (column 4, table 6) indicates that if the change in unemployment is one percentage point between periods t and t-1 (for example, say average unemployment increases from 8.8 to 9.8%), then the growth in BE will increase by 0.02 percentage points. The average annual growth of property crime over this period has been -0.02 (or 2% annual decline); coefficient of 0.02 on change in unemployment would then imply a 2% annual increase.

Overall, although our analysis does yield some significant results at the national level, due to the small number of observations, we extend our sample to a panel, thus allowing for another margin of disaggregation.

[7] The number of lags included, in each of the seven series was selected after doing the misspecification test. In each case reducing or dropping any of the lags results in either serial correlation in the residuals or an increase in the information criterion (we looked at both the Akaike and Bayesian information criterion). Results are available from the authors on request.

3.3 Regional level analysis

We start our analysis for the regional level data, by first checking whether or not we have a long run relationship between our variables of interest, crime and unemployment, once we disaggregate the data by regions. To this end we did a panel co-integration test for each of the seven crime series, and similar to the national level results we found no long run-relationship at the regional level.[8] Our regional level results are presented in Tables 7 and 8.

In Table 7 we use the same model and time period as used for the national level. Here, we do not find persistence in growth of crime rate for all the series (row (1) of Table). For robbery and fraud we in fact find that the crime at period t-1 has a significant negative impact on the crime in period t. We find a significant relationship between contemporaneous unemployment and both violent crime and property crime, a rise in contemporaneous unemployment has a positive impact on these two aggregate crime rates; however we still do not find any significant relationship between contemporaneous unemployment and total crime. Further disaggregation of property crime provides additional insight into the type of property crime that is linked with contemporaneous unemployment (see column (4)-(7)). BE and FR have a statistically significant positive relationship with contemporaneous unemployment; lagged unemployment is significant for FR and ATH. Robbery seems to have no significant relationship with unemployment, contemporaneous or lagged; this is in contrast to the findings at the national level where we find both contemporaneous and lagged unemployment to have a significant relationship with robbery.

Next, we estimate the model with control variables, as specified in equation (2); however, due to the inclusion of the control variables the time horizon we have is shorter (1986 to 2006). For robustness we first run the model with no control variables, for the shorted time horizon (reported in Table 8A) and then compare our findings to those with control variables (presented in Table 8B).

[8] The panel co-integration test was done using the xtwest command of STATA (see Persyn and Westerlund, 2008). Results are available from authors on request.

Looking at Table 8B, we now find a significant relationship between total crime and contemporaneous unemployment, this results from inclusion of the control variables and is not a result of the shorter time horizon alone. With the exception of violent crimes, all kinds of other crimes – property crimes as an aggregate and disaggregated have a positive relationship with contemporaneous unemployment. A one percentage point change in unemployment will lead to a 0.02 percentage point increase in growth of property crime and FR; the effect is much stronger, at 0.04 percentage points, for BE, ATH and FR. With respect to the crime of violence, results here are in line with those of Gould, Weinber and Mustard (1997) and Donohue and Levitt (2001), among others, who do not find any significant link between violent crime and unemployment. The impact of lagged unemployment has a negative and, with the exception of ATH, insignificant impact on crime.

For TC, PC and BE we find PCR to be negative and significant, a 1% increase in the growth of the PCR will lead to a 11% decrease in the growth of TC, a 16% decrease in growth of PC, and a 21% decrease in the growth of BE. In contrast, increase in police civilian ratio has no impact on violent crimes. Our analysis also indicates that a rise in the young male population (PMALE18) has no impact on any kind of crime; while an increase in intermediate age male population (PMALE25) increases violent crime rates.

Overall, we find property crimes to be economically motivated, while violent crime is largely unchanged by changes in economic activity; increase in police presence lowers property crime; and only a rise in the proportion of males aged 25 to 44 increases the rate of violent crimes.

4. Conclusion

We use national and regional Canadian data to analyze the relationship between economic activity – via the unemployment rate – and crime rates. Our analysis takes into account potential aggregation bias, thus we disaggregate the crime data and look at the relationship between six different types of crimes rates and unemployment rate as well as the total aggregates. Our analysis at the national level shows that a rise in unemployment rate increases breaking and entering, and robbery; we find no signification

relationship at the aggregate level – neither property crime nor total crime are significantly related with the state of the economy. Our results thus confirm the findings of Levitt (2001), Cherry and List (2002) and Cornwell and Trumbull (1994), and motivate our regional analysis, as it allows for an increase in data, while addressing possible aggregation bias.

At the regional level, our panel data analysis indicates that while total crime is not altered by changes in unemployment rate, property crime and violent crime are. However, once we disaggregate property crime, only breaking and entering, and fraud rise as contemporaneous unemployment rises; fraud and auto theft also rise with the rise in one-period lagged unemployment. When we control for the police-civilian ratio and other controls (simultaneously reducing our sample period) we find a significant relationship between unemployment and all crime rates except violent crime. Hence, in our analysis we consistently find property crimes to have an economic motive; in contrast violent crime in tends to be without economic motive – it is argued to be a "crime of passion" in the literature (see Cherry and List, 2002).

With respect to controls, our findings suggest that an increase in the police-civilian ratios act as a deterrent for property crimes, largely decreasing breaking and entering, however it has no impact on violent crimes. Further, increase in the proportion of young males has no impact on crime rate, whereas an increase in the proportion of males aged 25 to 44 increases the rate of violent crimes. Overall, we conclude that for Canada the state of economic activity is a significant factor in altering property crimes but not crimes of violence.

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TABLE 1: Variable Names and Codes

SERIES TITLE	**VARIABLE CODE**
TOTAL CRIME, ALL INCIDENTS; RATE PER 100,000 POPULATION	LTC
1. CRIMES OF VIOLENCE; RATE PER 100,000 POPULATION	LVIO
2. PROPERTY CRIMES; RATE PER 100,000 POPULATION	LPC
2.1 BREAKING AND ENTERING; RATE PER 100,000 POPULATION	LBE
2.2 FRAUDS; RATE PER 100,000 POPULATION	LFR
2.3 THEFT, MOTOR VEHICLES; RATE PER 100,000 POPULATION	LATH
2.4 ROBBERY; RATE PER 100,000 POPULATION	LROB
All the crime variables are in natural logarithms	
UNEMPLOYMENT rate, for age 15 years and over	UEM
POLICE-CIVILIAN RATIO (*in natural logarithms*)	LPCR
% MALE, between ages 18 to 24 years, of total population	PMALE18
% MALE, between ages 25 to 44 years, of total population	PMALE25
PROVINCE	**CODE**
NEWFOUNDLAND AND LABRADOR	NFL
PRINCE EDWARD ISLAND	PEI
NOVA SCOTIA	NS
NEW BRUNSWICK	NB
QUEBEC	QU
ONTARIO	ON
MANITOBA	MA
SASKATCHEWAN	SK
ALBERTA	AB
BRITISH COLUMBIA	BC

TABLE 2: Descriptive Statistics: National Level
(Time Period: 1979-2006)

	Mean	**Standard Deviation**
LTC	9.14	0.10
LVIO	6.78	0.18
LPC	8.51	0.16
LBE	7.10	0.21
LFR	5.94	0.21
LATH	6.10	0.23
LROB	4.56	0.09
UEM	8.79	1.66

TABLE 3: Descriptive Statistics: Regional Level
(Time Period: 1979-2006)

Province		LTC	LVIO	LPC	LBE	LFR	LATH	LROB	LPCR*	UEM	PMALE18	PMALE25
AB	MEAN	9.29	6.90	8.64	7.08	6.20	6.24	4.45	1.10	6.90	6.11	17.12
	SD	*0.12*	*0.14*	*0.16*	*0.22*	*0.15*	*0.23*	*0.14*	*0.04*	*2.39*	*1.16*	*0.83*
BC	MEAN	9.54	7.12	8.93	7.44	6.05	6.42	4.79	1.51	9.28	5.34	16.01
	SD	*0.10*	*0.13*	*0.12*	*0.21*	*0.22*	*0.32*	*0.17*	*0.09*	*2.54*	*0.75*	*0.91*
MA	MEAN	9.38	7.10	8.70	7.29	6.00	6.45	4.86	1.25	6.87	5.62	14.99
	SD	*0.10*	*0.36*	*0.14*	*0.18*	*0.43*	*0.51*	*0.28*	*0.09*	*1.62*	*0.74*	*0.88*
NB	MEAN	8.93	6.63	8.10	6.73	5.75	5.38	3.14	1.30	11.93	5.71	15.43
	SD	*0.08*	*0.27*	*0.11*	*0.16*	*0.19*	*0.14*	*0.19*	*0.09*	*1.71*	*0.84*	*0.99*
NFL	MEAN	8.77	6.70	7.93	6.61	5.59	4.74	2.49	1.28	17.13	5.97	15.09
	SD	*0.07*	*0.29*	*0.12*	*0.12*	*0.14*	*0.18*	*0.36*	*0.10*	*1.99*	*0.78*	*0.97*
NS	MEAN	9.07	6.76	8.31	6.82	5.95	5.42	3.82	1.12	11.10	5.60	15.24
	SD	*0.10*	*0.30*	*0.11*	*0.14*	*0.25*	*0.24*	*0.31*	*0.12*	*1.85*	*0.96*	*1.02*
ON**	MEAN	10.22	8.77	8.68	7.94	5.53	6.59	3.69	1.97	7.31	4.80	15.84
	SD	*0.24*	*0.14*	*0.20*	*0.25*	*0.20*	*0.13*	*0.69*	*0.37*	*1.22*	*0.10*	*0.59*
PEI**	MEAN	10.21	8.46	8.94	7.88	6.16	6.65	3.89	1.22	13.23	5.53	14.30
	SD	*0.27*	*0.22*	*0.16*	*0.18*	*0.31*	*0.22*	*0.16*	*0.15*	*2.00*	*0.74*	*0.81*
QU	MEAN	9.03	6.71	8.39	6.86	5.93	5.85	4.28	0.99	7.60	5.52	16.21
	SD	*0.16*	*0.16*	*0.23*	*0.26*	*0.27*	*0.25*	*0.16*	*0.04*	*1.71*	*1.00*	*0.97*
SK	MEAN	8.93	6.44	8.09	6.57	5.79	5.14	2.59	1.18	13.23	5.62	14.19
	SD	*0.16*	*0.30*	*0.12*	*0.20*	*0.25*	*0.19*	*0.34*	*0.18*	*2.00*	*0.72*	*0.92*

* Time Period: 1986-2006, ** Time period: 1999-2006

TABLE 4: Results of the ADF test: National Level

Crime Variable	No trend		With trend	
	ADF statistic	**p-value**	**ADF statistic**	**p-value**
LTC	-2.188	0.2108	-2.220	0.4789
LVIO	-2.482	0.119	-1.600	0.7924
LPC	-0.744	0.8349	-2.837	0.1838
LBE	-0.337	0.9201	-2.329	0.4178
LFR	-0.699	0.8469	-2.841	0.1825
LATH	-1.446	0.5598	-1.694	0.7534
LROB	-3.227	0.0185	-3.224	0.0797
UEM	-2.558	0.1020	-3.030	0.1239

Reported statistics, for all variables, are from the Dickey-Fuller regression with a constant and one lag. Choice of one lag was made based on the diagnostics done on the residuals from the Dickey-Fuller regression, for all variables. All the residuals were found to be white noise (Q-test) and the null hypothesis of 'no serial correlation' could not be rejected (Breusch-Godfrey LM test for autocorrelation).

TABLE 5: Results of the Co-integration test: National level

In each case below we are testing for CI between unemployment and the crime variable		
Crime Variable	**Hypothesis: rank = 0 Trace Statistics (5% critical value = 12.53)**	**Hypothesis: rank <=1 Trace Statistics (5% critical value = 3.84)**
LTC	5.781	0.001
LVIO	8.5299	0.2929
LPC	6.0436	0.5067
LBE	8.5297	0.7633
LFR	6.4065	0.4274
LATH	6.7766	0.0594
LROB	4.8784	0.2666

Reported trace statistics are for Johansen's test with two lags, in all case. Different orders of lags were tested, the results do not change.

Table 6: National Level Results: 1979-2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Y	LTC	LVIO	LPC	LBE	LFR	LATH	LROB
	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t
ΔY_{t-1}	0.47**	0.77***	0.58***	0.53***	0.52***	0.41*	0.28
	(0.20)	(0.18)	(0.20)	(0.18)	(0.19)	(0.22)	(0.30)
$\Delta unemp_t$	0.00	0.00	0.01	0.02*	0.01	-0.00	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta unemp_{t-1}$	-0.01	-0.01	-0.02*	-0.02	-0.02*	-0.01	-0.04**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Constant	0.00	0.00	-0.01	-0.01	-0.01	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
N	28	28	28	28	28	28	28

Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01

Table 7: Regional Level Results, no control variables: 1979-2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Y_t	LTC	LVIO	LPC	LBE	LFR	LATH	LROB
	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t
ΔY_{t-1}	0.26**	0.24**	0.24**	0.12	-0.26**	-0.01	-0.35***
	(0.09)	(0.10)	(0.10)	(0.09)	(0.09)	(0.08)	(0.08)
$\Delta unemp_t$	0.01	0.01**	0.01*	0.02**	0.03**	0.01	0.02
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta unemp_{t-1}$	-0.01**	-0.00	-0.01*	-0.01	-0.01*	-0.03***	0.01
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
CONSTANT	0.01***	0.02***	-0.01***	-0.01***	-0.01***	0.01***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	263	263	263	263	263	263	263
R-square within	0.10	0.09	0.10	0.07	0.10	0.05	0.12

Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01

The results presented are for the fixed effect model. Hausman's test for specification was done, which rejected the random-effect model.

Table 8A: Regional Level Results, no control variables: 1986-2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Y_t	LTC	LVIO	LPC	LBE	LFR	LATH	LROB
	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t
ΔY_{t-1}	0.18*	0.32**	0.19	0.11	-0.10	-0.01	-0.38**
	(0.09)	(0.12)	(0.12)	(0.09)	(0.07)	(0.09)	(0.12)
$\Delta unemp_t$	0.01	0.00	0.02**	0.04***	0.01	0.04**	0.04**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta unemp_{t-1}$	-0.01	0.00	-0.01	-0.01	0.00	-0.03**	0.02
	(0.01)	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
CONSTANT	0.01**	0.01***	-0.01***	-0.01***	-0.02***	0.02***	0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
N	184	184	184	184	184	184	184
R-square within	0.06	0.11	0.09	0.10	0.01	0.06	0.15

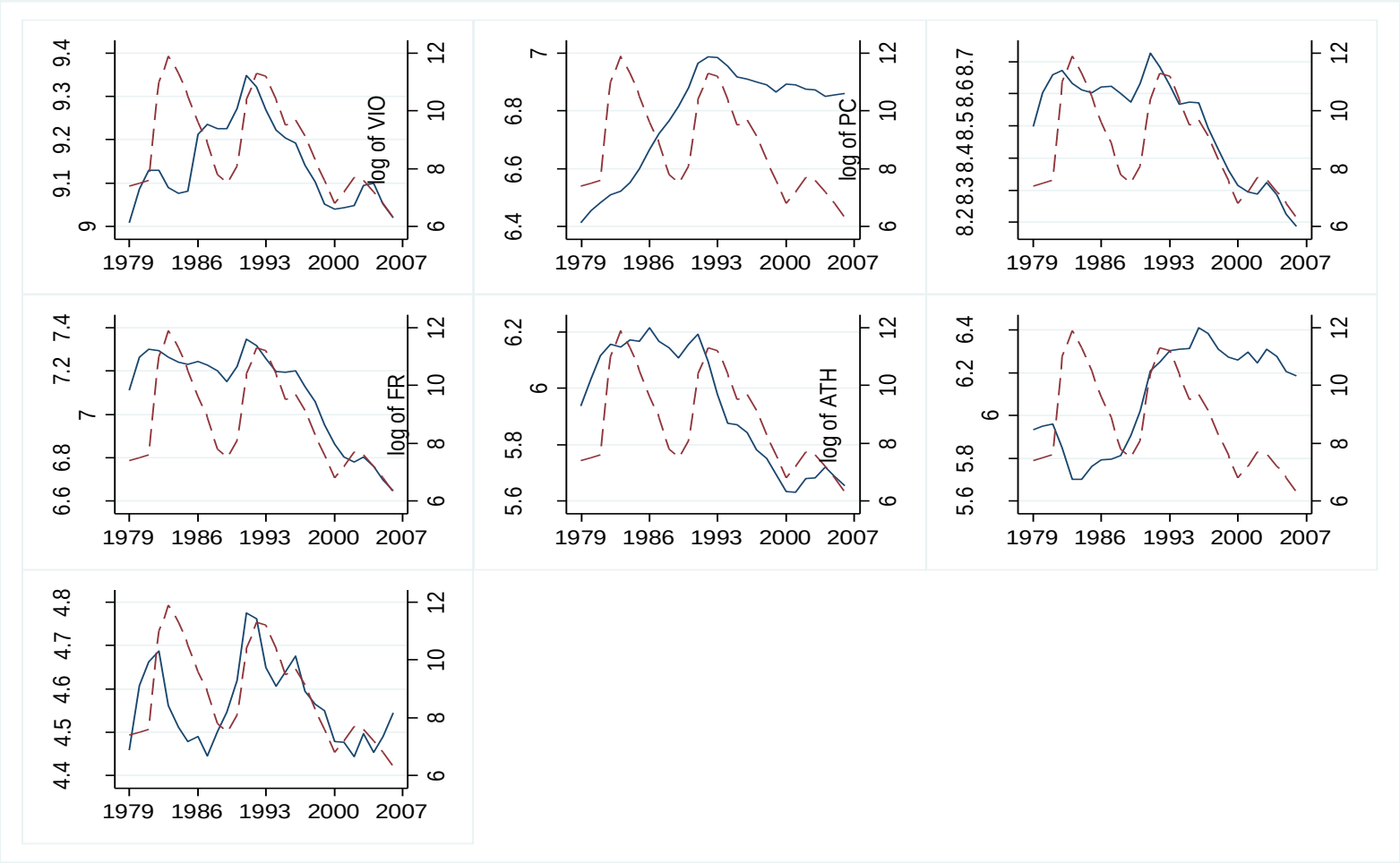
Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01
The results presented are for the fixed effect model. Hausman's test for specification was done, which rejected the random-effect model.

Table 8B: Regional Level Results, with control variables: 1986-2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Y_t	LTC	LVIO	LPC	LBE	LFR	LATH	LROB
	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t	ΔY_t
ΔY_{t-1}	0.20**	0.15*	0.18	0.11	-0.20***	-0.01	-0.42***
	(0.08)	(0.07)	(0.10)	(0.08)	(0.06)	(0.08)	(0.13)
$\Delta unemp_t$	0.02**	0.01	0.02**	0.04***	0.02**	0.04***	0.04**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta unemp_{t-1}$	-0.01	0.01	-0.01	-0.00	-0.00	-0.02*	0.01
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta LPCR_t$	-0.11*	-0.07	-0.16*	-0.21**	-0.22	-0.01	-0.17
	(0.06)	(0.06)	(0.08)	(0.08)	(0.12)	(0.13)	(0.13)
$\Delta PMALE18_t$	-0.02	0.03	-0.01	-0.00	-0.04	-0.11	-0.11
	(0.05)	(0.05)	(0.07)	(0.09)	(0.11)	(0.07)	(0.12)
$\Delta PMALE25_t$	0.02	0.16***	0.07	0.08	0.07	0.01	-0.06
	(0.04)	(0.02)	(0.05)	(0.07)	(0.06)	(0.06)	(0.10)
CONSTANT	-0.00	0.03***	-0.01	-0.01	-0.02	0.01	0.02
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
N	184	184	184	184	184	184	184
R-square within	0.15	0.23	0.16	0.15	0.07	0.05	0.18

Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001
The results presented are for the fixed effect model. Hausman's test for specification was done, which rejected the random-effect model.

Figure 1: Unemployment rate and Crime at the National Level (1979-2006)



Notes: The solid line gives the crime rate (left hand side axis); the dashed line gives the unemployment rate (right hand side axis).