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Crime, Deterrence and Unemployment in Greece: A Panel Data Approach

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This study empirically examines the relationship between crime, deterrence and unemployment in Greece. A regional dataset over the period 1991-1998 was collected and analyzed. Our econometric methodology follows the Generalized Method of Moments (GMM) estimator applied to dynamic models of panel data. The results show that property crimes are significantly deterred by higher clear-up rates. Also for property crime rates, the results indicate that unemployment increases crime. For violent crimes, however, the effect of the clear-up rate and unemployment are found to be insignificant.

Keywords: crime, deterrence, unemployment, panel data, GMM

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1. Introduction

Becker (1968) marked the beginning of attempts to apply economic models of rational decision making to crime. According to Becker the potential offender assesses the potential loot, the probability of being arrested and convicted and the severity of punishment which would follow the conviction. Becker's theory was extended and tested by Ehrlich (1973), who considered a time allocation model and motivated the introduction of unemployment as a measure of how potential criminals fare in the legitimate job market. Since then, a number of significant theoretical and empirical developments have been made (see, for instance, Witte, 1980; Levitt, 1996). However, the existing economic crime literature is, in most part, developed and systematically applied to (property) crime data for the US. While some studies have addressed the same topic for the UK mainly using time-series data (e.g. Hale, 1998; Wolpin, 1978), there is a shortage of empirical work in continental Europe due primarily to the lack of suitable datasets. We must mention, however, some notable exemptions like Entorf and Spengler (2000), who used a rich panel dataset from the West German states and Marselli and Vannini (1997) who used a panel dataset of Italian regions.

In order to add further evidence for Europe, this paper examines the effect of deterrence and unemployment on crime in Greece over the period 1991-1998[1]. Six major crime categories are considered: breaking and entering, theft of motor cars, robbery, murder, serious assault and rape[2]. The present study not only adds to the literature by offering evidence from Greece, but also attempts to shed some light on

[1] Over the study period, recorded (overall) crime rose by 7% in Greece whereas recorded crime in other south European countries such as Italy and Spain fell by 8% and 7%, respectively. However, murder statistics suggest that Athens the capital of Greece is a safer city than the capitals of most of the EU member states (see Entorf and Spengler, 2002).

[2] The first three crimes are property crimes while the latter three are violent crimes. Robbery is incorporated in property crimes since it might be dominated by the desire to steal someone else's property.

the recent debate that has emerged around the relevance of the economic crime theory to explain violent behavior (e.g. Saridakis, 2004). This study takes stock of the existing empirical studies and tries to overcome limitations in several ways. Specifically, in contrast to cross-country studies/panels, a regional panel data set for one country overcomes problems associated with differences in crime definitions, reporting propensities and statistical data collection. Also, it surmounts statistical weaknesses of studies relying on national time-series crime data (see Levitt, 2001). Furthermore, we apply the Generalized Method of Moments (GMM) estimator developed by Arellano and Bond (1999) to handle unobserved heterogeneity and potential endogeneity between crime and deterrence (measured by clear-up rates)[3].

The outline of the paper is as follows. Section 2 describes the data. Section 3 presents the empirical framework. Section 4 is devoted to the presentation and discussion of the results. The last section concludes.

2. Data

The data set used in this paper is a panel of annual, regional level (Nuts 2) observations[4], running from 1991-1998. Reported crime data (per *100,000* inhabitants) and clear-up rates (%) were directly collected from the producer of crime statistics in Greece and to our knowledge are not officially published in electronic or printed form[5]. Table 1 presents summary statistics for crime and deterrence. Data for the unemployment rate (%) were extracted from the Eurostat New Cronos data base.

[3] This would be the case if a higher incidence of crime led to lower clear-up rates due to the overload of the given and temporarily fixed police resources. On the other hand, a feedback effect could be caused if the state responds to increasing crime rates by allocating more resources to the police, resulting in higher clear-up rates.

[4] Greece is divided into 13 regional districts (population in *1,000* is in parenthesis): Crete (553.1), South Aegean (263.6), North Aegean (186.8), Attica (3,479.2), Peloponnese (650.7), Central Greece (637.0), West Greece (726.2), Ionian Islands (197.2), Epirus (360.2), Thessaly (740.6), West Macedonia (300.1), Central Macedonia (1,759.3) and East Macedonia and Thrace (561,3).

[5] The data were collected for a comparative project of *Crime in Europe: Causes and Consequences* (Entorf and Spengler, 2002).

During the 1990s the unemployment rate increased about 56% and therefore, it may partly explain the increase in crime.

[Table 1 about here]

3. Empirical framework

Based on the empirical deterrence literature, we can derive the following simple model:

$$c_{it} = \beta_0 + \beta_1 p_{it} + \beta_2 u + \varepsilon_{it} \quad (1)$$

$$\varepsilon_{it} = \eta_i + v_{it} \quad (2)$$

where c_{it} is the crime rate (per *100,000* inhabitants) by sub-category for administrative division *i* in year *t*. The measure p_{it} is the clear-up rate, which is treated as endogenous. The variable *u* is the unemployment rate and is considered to be exogenous[6]. All variables are measured in natural logarithms. Finally, η_i are the unobserved time constant regional-level effects which may be correlated with some of the regressors. For this reason, we estimate the following linear dynamic model:

$$\Delta c_{it} = \delta_1 \Delta c_{it-1} + \delta_2 \Delta p_{it} + \delta_3 \Delta u + \Delta v_{it} \quad (3)$$

where the variables are first-differenced to eliminate time invariant panel-level effects. In the estimation we have used recent advances in the Generalized Methods of Moments (GMM) developed by Arellano and Bond (1991) to deal with the lagged crime variable[7] Δc_{it-1} and the endogenous variables Δp_{it} (i.e. these variables are instrumented with suitable lags of their own levels).

[6] We have also allowed unemployment to be endogenous in the model (i.e. crime participation may reduce the employability of formerly convicted offenders and it may in turn contribute to observed unemployment – see Raphael & Winter-Ebmer, 2001). However, the results are generally stable and hence, are not reported here.

[7] The lagged dependent variable reflects the tendency of individuals who are involved in criminal activity to continue in it even after the circumstances that led them to turn to crime have changed (Witt *et al.*, 1999).

4. Empirical results

Table 2 presents the one-step GMM-results of the crime models for Greece. We first comment on property crime results presented in Columns 2-4. Clearly these columns show a strong negative effect of the clear-up rate on property offences with a sole exception of theft of motor cars. The coefficient estimates for breaking and entering and robbery suggest long-run clear-up elasticities of -0.46 and -0.43, respectively. These estimates are similar to those reported by Witt *et al.* (1999) for England and Wales. For the three individual property crimes, the estimated effects of unemployment are strongly positive. The GMM estimates of the unemployment rate range from 0.236 to 0.866. In fact, recent panel data studies by Marselli and Vannini (1997) for Italy and Raphael and Winter-Ebmer for the US also found significantly positive effects of unemployment on property crime rates. This result is reasonable and in line with the mainstream economic view of criminality suggesting that unemployed individuals who are excluded from legal income opportunities, are, ceteris paribus more likely to commit crime than people who have a job.

[Table 2 about here]

The results for the specific violent crimes presented in Columns 5-8 are strikingly different from the results for property crime. The estimated deterrent effects of the clear-up rate are negative but statistically insignificant for all models. A possible explanation for the failure of the clear-up rates in deterring these type of offences may be that violent crime is more often driven by impulsive actions (caused by hate, jealousy or anger) than by rational reckoning. Furthermore, unemployment is insignificant for murder and serious assault models suggesting that unemployment does not affect one's propensity towards violence. For rape, however, the estimated effect of unemployment is strongly negative and hence, opposite to what is expected

of motivational effects. To resolve this counterintuitive result, we follow Raphael and Winter-Ebmer (2001) by separately identifying the effects of the unemployment rate of the offending and victimized populations[8]. Hence, in the rape specification the general unemployment rate is substituted by gender specific unemployment rates. The results presented in the last column show that the coefficient on female unemployment is negative. Therefore, it could be argued that unemployed females are less exposed to the potential dangers that can arise during the time travelling to work and returning from work (and even while at work). Finally, the coefficient for male unemployment is positive with a significant effect, consistent with Raphael and Winter-Ebmer (2001).

The Wald test suggests a rejection of the null hypothesis that all the coefficients are zero for property crime and rape models. We find no significant evidence of serial correlation in the first-difference errors at order 2[9]. The Sargan test which comes from the one-step homoscedastic estimator[10] provides strong evidence in favour of the null hypothesis that the overidentifying restrictions are valid in all cases with a sole exception of serious assault[11].

5. Conclusions

This paper empirically examines the effect of clear-up rates and unemployment rate on crime in Greece. Using regional data from 1991-1998 we estimated a linear dynamic panel data model based on the GMM estimator developed by Arellano and

[8] For rape, the most part of the offending population is male and the victimized population is female (see Raphael and Winter-Ebmer (2001, pp.277).
[9] We find evidence against the null hypothesis of zero autocorrelation in the first-differenced errors at order 1. However, this does not imply model misspecification because the first-differenced errors are serially correlated when the idiosyncratic errors are independent and identically distributed.
[10] The Sargan test cannot be computed when the robust option is specified, since its asymptotic distribution is not known under the assumption of the robust model.
[11] The Sargan test after a two-step estimator was used as an alternative. We found no evidence against the null hypothesis that the overidentifying restrictions are valid.

Bond (1991). We found that property crimes were significantly deterred by higher clear-up rates whereas unemployment increased crime. However, these associations could not be detected for violent crime. Only after employing gender-specific unemployment rates in the rape model we found strong evidence that the effect of male unemployment is positive and significant. As a consequence of the low explanatory power of the traditional explanatory variables motivated by the economic crime theory and because of the very high social cost of violence, economists should start seeking (empirical) models more suitable to explain violent behaviour.

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Table 1:
Crime and Deterrence in Greece, 1991-1998

	% change in		Average	
Property crime:	recorded crime	clear-up rate	recorded crime	clear-up rate
Breaking and entering	37	-33	365.1	13.4
Theft of motor cars	95	-40	116.5	12.8
Robbery	83	-29	15.6	31.1
Violent crime:				
Murder	50	-16	2.7	74.9
Serious assault	0	-4	67.3	95.5
Rape	0	12	2.4	69.5

Notes: Recorded crime is per *100,000* inhabitants. Clear-up rate is in %.

Table 2:
Crime equations-GMM Estimates

Type of crime:	**Property crime**			**Violent crime**			
	Δ(Breaking and entering)	Δ(Theft of motor cars)	Δ(Robbery)	Δ(Murder)	Δ(Serious assault)	Δ(Rape)^	Δ(Rape)^
Variable	GMM	GMM	GMM	GMM	GMM	GMM	GMM
$\Delta\log(c_{t-1})^{\S}$	0.406**	0.677**	0.401*	0.083	0.057	-0.050	0.018
	(0.098)	(0.123)	(0.235)	(0.129)	(0.095)	(0.120)	(0.133)
$\Delta\log(p)^{\S}$	-0.274**	-0.188	-0.257**	-0.128	-0.273	-0.108	-0.149
	(0.114)	(0.146)	(0.136)	(0.156)	(1.358)	(0.227)	(0.187)
$\Delta\log(u)$	0.453**	0.263**	0.866**	0.189	0.025	-0.319**	-
	(0.167)	(0.118)	(0.118)	(0.199)	(0.118)	(0.149-	
$\Delta\log(u_{female})$	-	-	-	-	-	-	-0.735**
							(0.227)
$\Delta\log(u_{male})$	-	-	-	-	-	-	0.528**
							(0.194)
Constant	2.835**	1.153	0.224	1.067	4.965	-12.759**	-12.124**
	(0.652)	(0.782)	(0.866)	(0.661)	(6.222)	(5.549)	(5.788)
Wald test	0	0	0	0.746	0.888	0.002	0.001
Sargan test	0.249	0.1774	0.218	0.642	0.006**	0.143	0.169
m1	0.032	0.013	0.023	0.017	0.057	0.042	0.035
m2	0.162	0.148	0.083*	0.521	0.365	0.670	0.673
n	78	78	78	76	78	49	49

Notes: Standard errors are robust to both heteroskedasticity and serial correlation and presented in parentheses. The p-value of the Wald test of a joint significance of all explanatory variables is reported. Sargan is a test of the overidentifying restrictions for the GMM estimators, p-value is reported. *m1* and *m2* are the tests of first-order and second-order serial correlation, asymptotically N(0,1), p-value is reported. GMM results are one-step estimates.

[§]These variables are instrumented by lagged own values.

^The equation of rape also included a variable "nights spent by non-residents in hotels and similar establishments", the coefficient of which was found to be positive and statistically significant (full results are available upon request).

**Significant at the 5% level ; *Significant at the 10% level.