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Crime and Labour Market Opportunities in Italy (1993-2002)

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Abstract

This paper investigates the relationship between labour market conditions and crime in Italy accounting for both age and gender in unemployment measure and considering regional disparities between North-Centre and South of Italy. Using regional data over the period 1993-2002, we study the impact of wages and unemployment on different types of crime. To mitigate omitted-variables bias we control extensively for demographic and socioeconomic variables. Empirical results suggest that unemployment has a large and positive effect on crime rate in southern regions. Our results are robust to model specification, endogeneity, changes in the classification of crimes and finally, to alternative definitions of unemployment.

Key words: Crime; Unemployment; Panel Data

JEL Classification: J00; K40

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1 Introduction

"The question that traditionally motivated analyses of crime and the job market has been the effect of unemployment on crime. Many people believe that joblessness is the key determinant of crime, and have sought to establish a significant crime-unemployment trade-off" (Freeman, 1994).

From a pure theoretical perspective, criminal behaviour is the outcome of a rational calculations by which agents compare expected costs and benefits from legal and illegal activities taking into account the probability of being arrested and punished and the expected returns from crime. If legal income opportunities are less lucrative than potential gains from crime activity, individuals will be more prone to engage in crime. Since involuntary unemployment may reduce legal returns from work, it could exist a substitution effect that induces agents to commit more crime. In other words, unemployed individuals have a lower opportunity cost of engaging in criminal activities than employed ones. Hence, unemployment could represent a determinant of crime. The idea that unemployment affects crime rate also has a long tradition in sociology and criminology.

However, empirical research to date has failed to reach a consensus on the relationship between unemployment and crime. In fact, though some research suggest the existence of a positive correlation between unemployment and crime, recently Raphael and Winter-Ebmer (2001) and Gould *et al.* (2002), there are many studies indicating that the relationship is weak or inconsistent and insignificant.[1]

The aim of this paper is to study the role exerted by labour market opportunities on crime rate for Italian regions over the period 1993 to 2002.

We believe that our paper is a useful contribution to the relevant literature in many respects. First, we examine both the role of wage and unemployment on crime rate. Empirical analyses typically focus their attention on the unemployment rate ignoring the effect of wages on crime rate. Wages may represent a better measure

[1] See Chiricos (1987), Freeman (1999) and Masciandaro (1999) for a complete review of the empirical literature.

for labour market opportunities of potential criminals. Grogger (1998), using data from the National Longitudinal Survey of Youth (NLSY), finds that falling real wages play an important role in rising youth crime during the 1970s and 1980s in the US. Using US county level data, Gould *et al.* (2002) explicitly consider the impact of both wages and unemployment rate on crime and find that both wage and unemployment are significantly related to property crimes like theft and burglary.

Second, the high variability in Italian unemployment between the 1990s and 2000s represents a good opportunity to isolate the effect of unemployment on crime. As noted by Nilsson and Agell (2003) "most studies exploit data for countries and periods in which unemployment is fairly sTable, or changes steadily over time. With such data it is not easy to separate the effect of unemployment from the effect of general time trends, and to avoid that omitted variables bias the result" (p. 4). The recent changes in Italian labour legislation, and in particular the most decisive legislative step in favour of non-standard employment represented by the Law 196/1997, the so-called Treu Act (by the name of the minister of Labour and Welfare, Tiziano Treu) considerably eased the discipline of temporary work and favoured the development of this institution in Italy. Moreover Treu Act made temporary work agencies legal and introduced new instruments to ease employment for young people in southern regions.

Third, we take account of age, gender and duration in the unemployment measure. Specifically, we consider different measures of unemployment rate: total unemployment rate, unemployment rate of males aged 15-24, male unemployment rate and long term unemployment rate. Furthermore, to mitigate omitted variables bias we control extensively for demographic and socioeconomic variables. For example: the level of education of the population, the share of male aged between 15-24 that are responsible for a huge amount of crime or the percentage of population living in large cities.

Fourth, we account for the structural and relevant differences between the North-Centre and South of Italy. Italy's economic development is characterized by one of the widest geographic dualisms of all OECD countries, with marked regional disparities between a very prosperous North-Centre and a lagging South. Despite recent signs of change, the unemployment rate in the Southern regions continues to be three times

higher than in the North-Centre. The infrastructure in the South remains far inferior to the national average, and organized crime still constitutes a heavy deterrent both for investment and development. Thus, in order to explicitly account for these differences in our analysis we estimate a crime equation for each of this regional aggregation.

Finally, we consider inertial effects of crime (i.e. persistence over time) and control for endogeneity employing an instrumental variable approach for panel data using the GMM-system estimator that allows us to control for the joint endogeneity between crime rate and the explanatory variables and, also, for measurement errors in crime rates.

Our results show that the determinants of crime rate differ between north-central and southern regions, confirming the existence of a regional dualism. In particular, crime rate in the North-Centre is mainly driven by lagged crime rate and deterrence variable, while crime rate in southern regions is strongly related to socioeconomic variables and in particular to labour market conditions.

To test the robustness of our results we perform a number of exercises. First, we study the correlation between unemployment and, separately, property crime rate, theft rate and total crime rate, always controlling for labour market opportunities (wage rate), the clear-up rate, a set of socioeconomic variables (GDP per capita, growth rate of the GDP, level of education) and a set of sociodemographic variables (percentage of men aged 15-24, share of population living in cities with more than 250.000 inhabitants and percentage of foreigners in the population). Second, we adopt different measures of unemployment (total unemployment rate, unemployment rate of males aged 15-24, male unemployment rate and long term unemployment rate). Finally, as previously mentioned, these results are obtained using an instrumental variable approach that takes advantage of the dynamic properties of our dataset to control for both measurement errors in crime data and joint endogeneity of the explanatory variables.

The paper proceeds as follows. Section 2 presents a review of previous empirical studies. Section 3 describes our dataset and the empirical procedure used. The results are presented in Section 4. Section 5 concludes.

2 Previous Studies

As previously discussed the existing empirical literature fails to reach a consensus on the relationship between unemployment and crime. The robustness and the sign of the crime-unemployment relationship in empirical analysis may be related to different factors such as the level of aggregation, the unemployment and crime measures used and the econometric specification.

The empirical analyses on the effect of labour market opportunities on crime relies typically on four types of data (Freeman, 1994): aggregate time series data, cross-section data, regional panel data and individual level data.

Analyses of the first two types confirm the existence of a positive relationship between unemployment and crime. These studies, even presenting some advantages, are very likely to be affected by biases due to the omission of relevant variables. The use of regional panel data can significantly ameliorate this problem. Recently, Entorf and Spengler (2000), using a regional panel for Germany, find unemployment to have "small, often insignificant and ambiguous signs". Likewise, Papps and Winkelmann (1999) find little effect for a panel of regions from New Zealand, while Raphael and Winter-Ebmer (2001), using U.S. state-level data, indicate that a significant reduction of property crime rates in the U.S. during the 1990s is attributable to the decline in the unemployment rate.

Clearly, the use of individual data would be ideal to study the relationship between unemployment and crime, since these datasets usually provide a large number of controls related to socioeconomic and sociodemographic variables. Unfortunately, individual panel data are rarely available and in their absence the use of regional panel data represents the "second best" methodological option (Papps and Winkelmann, 1999).

As stressed by Gould *et al.* (2002), "previous works on the relationship between labour markets and crime focused mainly on the relationship between unemployment rate and crime, and found inconclusive results. In contrast" it is important to "examine the impact of both wages and unemployment on crime". Research examining the relationship between criminal participation and earnings potential finds stronger effects.

Grogger (1998) estimates a structural model of time allocation between criminal, labour market, and other non market activities and finds strong evidence that higher wages deter criminal activity. Witt et. al (1998) suggest "that continued falls in the relative wages of unskilled men and increases in male unemployment in England and Wales act as incentives to engage in criminal activity." Further evidence supporting the important effect of wages is provided in a panel study of U.S. counties by Gould *et al.* (2002).

The Italian empirical literature on crime is relatively small. Crime has received little attention and has been almost neglected by Italian economists. Campiglio (1990), using 1981 Italian census data at county level, finds a positive relationship between robberies and unemployment. Scorcu and Cellini (1998) analyze the long-run relationships between economic determinants and crime rates in Italy over the period 1951 to 1994 by using the tools provided by cointegration analysis. Their main conclusion is that the level of real per capita consumption better explains homicides and robbery rates, while unemployment rate is the best economic explanatory factor for theft. Marselli and Vannini (1997), using panel dataset at regional level over the period 1980-1990, show that unemployment rate is positively correlated to homicide and robbery rates, while is negatively related to theft. In their following contribution, Marselli and Vannini (2000) specifically focus their attention on the role of unemployment in determining crime rates. Their analysis fails to establish a robust correlation between unemployment rate and crime, even if it "overall supports the hypothesis that unemployment significantly affects crime rate and thus this suggests to pay attention in implementing control police not only to the expected punishment but also to employment possibilities" (p. 296). Marselli *et al.* (1998) study the effect of public intervention on crime rate in Italian regions over the period 1970 to 1990, In particular, they explicitly consider the relevant differences existing between North-Centre and South of Italy developing in the theoretical part of their study a two-regions model, whose implications related to the role of regional immigration and public intervention on crime rate are empirically tested.

3 Data description and Empirical strategy

3.1 Data description

In this section we provide an extensive discussion about the data used in our empirical analysis and about the potential determinants of crime. Our panel dataset comprises annual observations for the 20 Italian regions[2] (NUTS2) over the period 1993 to 2002. Crime data, that represent the dependent variable, are taken from Judicial Statistics, a publication of the Italian Statistics Bureau (ISTAT). In particular, we consider three different crime rates (*Crime*): property crime rate, theft rate and total crime rate. Crime rate is obtained normalizing the total number of crimes in each category by resident population in each region, population is taken from ISTAT. The explanatory variables are separated into four groups: unemployment, deterrence variables, demographic variables and socioeconomic variables.

We use four different measures of unemployment: total unemployment rate (*TotUn*), male unemployment rate (*MaleUn*), unemployment rate for males aged 15-24 (*M24Un*) and long term unemployment rate (*LongUn*). Unemployment data are taken from Labour Forces Survey (LFS), a quarterly survey by ISTAT.

The deterrence variable used is the clear-up rate (*Clear-up*) since this is the only deterrence variable for Italy available at regional level. The clearance rate for each offence group was obtained from the Judicial Statistics from ISTAT. This is given by the ratio of the number of crimes cleared by police to the total number of crimes reported for each region and crime category.

We include among the regressors three demographic variables that are likely to be correlated with crime. These variables, provided by ISTAT, are: the percentage of men aged 15-24 (*Male24*), the share of population living in cities with more than 250.000 inhabitants (*City*) and the percentage of foreigners in the population (*Foreign*). Young men are said to be more prone to engage in criminal activities than the rest of the population. (Freeman, 1991; Grogger, 1998). Recent studies (Entorf and Spengler,

[2]Valle d'Aosta has been aggregated to Piemonte due to its small size.

2000) have included the percentage of foreigners as a possible determinant of crime. In particular, illegal immigrants are more likely to be engaged in crime because they are not eligible for regular works. Due to the fact that data on irregular immigrants are not available we use the percentage of legal immigrants to proxy the phenomenon. We also consider the share of population living in cities with more than 250.000 inhabitants. It is well documented that there is more crime in big cities compared to small cities or rural areas (Glaeser and Sacerdote, 1999). In particular, returns from crime may be higher and the probability of arrest may be lower in urban areas.

We complete our dataset by adding a set of socioeconomic variables provided by ISTAT. In particular, GDP per capita (*GDP*) at 1995 constant prices, the growth rate in the GDP at 1995 constant prices (*Growth*), the average regional wage (*Wage*) at 1995 constant prices and the share of population with high school (*High School*) and university degree (*University*) taken from Labour Forces Survey (LFS).

Following the analysis made by Erlich (1973) we can consider the GDP per capita and the growth rate of the GDP as a proxy for the general level of prosperity in the provinces and thus as an indicator of illegal income opportunities.

Education may affect the decision to engage in criminal activities through several channels. First, higher levels of educational attainment are associated with higher return in the labour market, increasing the opportunity cost of criminal behaviour. Second, education may alter personal preferences in a way that affects decisions to engage in crime. In particular education may have a sort of "civilization" effect. Fajnzylber *et al.* (2002) suggest that education, incorporating a civic component, may increase the individual's moral stance, and then affect the individuals' perception of crime. Usher (1997) stresses that education perpetuates the values endorsed by a society, enculturates people to serve their communities, and promotes the virtues of hard work and honesty. Furthermore, as noted by Lochner and Moretti (2004) schooling generates benefits beyond the private return received by individual.

Finally, we consider dynamics in delinquency. In fact, past experience in criminal activity affects in several ways the decision to commit a crime (Sah, 1991; Glaeser et al., 1996; Fajnzylber et al., 2002); in other words, higher crime today is associated

with higher crime tomorrow (i.e. persistence over time). Furthermore, criminals can learn-by-doing and acquire an adequate criminal know-how level; this acquisition, in turn, makes the costs of carrying out criminal acts to decrease over time (Case and Katz, 1991). Convicted criminals have fewer opportunities of legal employment and a lower expected wage (Grogger, 1995). These arguments strongly suggest the possibility of criminal hysteresis or inertia.

3.2 The empirical procedure

Having as theoretical reference the economic model of crime (Becker, 1968; Ehrlich, 1973), we propose a dynamic panel data econometric model to test the relationship between labour market conditions and crime for Italian regions. The econometric specification that we estimate is given by the equation:

$$Crime_{i,t} = \alpha_t + \beta_1 Crime_{i,t-1} + \beta_2 Unemployment_{i,t} + \beta_3 X_{i,t} + \eta_i + \eta_t + \varepsilon_{i,t} \qquad (1)$$

where the subscripts i and t represent region and time period, respectively; η_i is a region fixed effect, η_t is a time fixed effect, $Crime_{i,t}$ is the number of crimes per region residents, $Unemployment_{i,t}$ is the unemployment rate, $X_{i,t}$ is the set of explanatory variables defined in the previous section and $\varepsilon_{i,t}$ is the error term.

From an econometric perspective, several problems may arise in estimating these empirical models. First, it is well-known that, using a panel dataset, OLS coefficients are biased when i) unobservable province-specific effects (η_i) are statistically significant and ii) the regressors and these effects are correlated. Second, as discussed in the previous section, there exists a significant relationship between crime rates in t and $t-1$; to take account of it, we include the lagged dependent variable ($Crime_{i,t-1}$) in our model. In such a framework, OLS results in inconsistent estimates since $Crime_{i,t-1}$ and η_i are necessarily correlated, even if the idiosyncratic component of the error term is serially uncorrelated. An obvious solution to these problems is to eliminate the term η_i by taking first-differences. However, OLS still does not consistently estimate the parameters of interest because first-differencing introduces correlation between the lagged dependent variable and differenced error terms, i.e. $Crime_{i,t-1}$ and $\varepsilon_{i,t}$ are correlated

trough the terms $Crime_{i,t-1}$ and $\varepsilon_{i,t-1}$. The alternative to first differences transformation is the within transformation; however, and although controlling for fixed effects, the within transformation leads to consistent estimates only under the hypothesis of strictly exogenous regressors. Third, it is unlikely that explanatory variables are strictly exogenous; the relationship between crime rates and their determinants is often characterized by a two-way causality. Fourth, it is very likely that crime data may be subject to measurement errors, which induce biases in the estimates.

The econometric problems presented above suggest the use of an instrumental variables procedure applied to a dynamic model of panel data. This paper therefore employs the GMM estimator that uses the dynamic properties of the data to generate proper instrumental variables (Arellano and Bond, 1991; Arellano and Bover, 1995). The GMM technique allows to control for (weak) endogeneity by using the instrumental variables, which consist of appropriate lagged values of the explanatory variables. To deal with the fact that measurement errors are likely to be determined not only by random errors but by specific and persistent characteristics of each region we employ the GMM-system estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) which combines into a single system the regression equation in both differences and levels. The GMM-system estimator allows to control for unobserved region-specific effects that are potentially correlated with the explanatory variables.

The consistency of the parameters obtained by means of the GMM estimator depends crucially on the validity of the instruments. We therefore consider two specification tests suggested by Arellano and Bond (1991) and Arellano and Bover (1995). The first test is the Sargan test of overidentifying restrictions, which tests the null hypothesis of overall validity of the instruments used. Failure to reject this null hypothesis gives support to the choice of the instruments. We also report the test for serial correlation of the error term, which tests the null hypothesis that the differenced error term is first and second order serially correlated. Failure to reject the null hypothesis of no second-order serial correlation implies that the original error term is serially uncorrelated and the moment conditions are correctly specified. Appendix A presents the econometric methodology employed in this paper in details.

As discussed in the introduction of this paper, in order to account for the structural and relevant differences between the north-centre and the south of Italy we estimate the crime equation (1) for each of this regional aggregation, following the same approach used in their analysis by Marselli *et al.* (1998).

As reported in the OECD Territorial Review (2001), "Italy features one of the widest geographical dualisms among OECD Member countries. In the southern regions, unemployment rate is four times higher than in the Centre-North and about twice the Italian average. In the Mezzogiorno (Southern Italy) the labour force participation rate is particularly low for women and young people. The underground economy stands out as a major policy issue: irregular workers account for an estimated 26 per cent of total labour force in the South (which is almost twice the Italian average). Besides, the infrastructure endowment of the southern regions remains far below the national average, especially for railways and airports, and even when the gap is light – as it is the case for housing, education and health care facilities – service quality remains significantly uneven. Moreover, organized crime still constitutes a heavy deterrent both for investment and endogenous development" (p. 13).

In Table 1, we present the average over the period 1993 to 2002 for unemployment rate, GDP per capita and wage rate at national level and for the North-Centre and the South of Italy. A huge disparity appears evident between the north-central regions and the southern regions: unemployment rate is three times higher in southern regions, moreover GDP per capita and wage rate are 40% higher in northern regions.

4 Empirical results

In this section we present our results. First, we present our GMM-system estimates of the crime-unemployment effects for property crime rate, theft rate and total crime rate for the twenty Italian regions. Next, we present our GMM-system estimates considering the regional disparities between a very prosperous North-Centre and a lagging South. Our results are robust to the inclusion of deterrence variable (clear-up rate), sociodemographic variables (percentage of male aged 15-24, urbanization rate and per-

centage of foreigners in the population), endogeneity, changes in the classification of crime and to alternative measures of unemployment.

4.1 Basic results

Table 2 presents our GMM-system estimates for Italian regions where the dependent variable is respectively property crime rate, theft rate and total crime rate. The first four columns report the results for property crime rate, the next four columns report the results for theft rate and finally the last four columns present the results for total crime rate. Columns marked as TotUn, MaleUn, M24Un and LongUn present the results when the measure used for unemployment is respectively overall unemployment rate, male unemployment rate, youth male unemployment rate and long term unemployment rate. In all specifications, all variables including lagged crime rate are treated as endogenous. Four test statistics are reported: (*i*) the Wald test of joint significance of the time dummies; (*ii*) Sargan test of overidentifying restrictions; (*iii*) and (*iv*) first and second order serial correlation test.

Our results show that unemployment rate has a small and often insignificant, even if positive, sign. Only overall unemployment rate and youth male unemployment rate are significantly and positively correlated to property crime rate. Furthermore, wage rate do not exert any significant effect on every classification of crime rate.

The lagged crime rate has a large and significantly positive effect for every classification of crime. In addition, the percentage of population living in cities with more than 250.000 inhabitants, the clear-up rate and the GDP per capita have significant coefficients with the expected signs for both property crimes and thefts. Qualitatively similar results are obtained for total crimes, but in this case the GDP per capita is not significant even if it displays the expected sign, while unexpectedly the percentage of people with high school diploma appears to be significantly and positively correlated with total crime rate. Finally, the percentage of foreigners in the population exhibits a negative effect for every classification of crime, even if it shows a small and often insignificant sign. With regards to the GMM specification tests all regression models

are supported by Sargan test that confirms that the instruments used are valid (i.e. the instrument are not correlated with the error terms). As expected there is evidence for first-order serial correlation, while there is no evidence of second-order serial correlation. Finally, time dummies are jointly significant in all the estimated models.

To summarize, our results, obtained estimating the crime equation by using the entire panel dataset Italian regions over the period 1993-2002, suggest that at national level crime rate is mainly driven by lagged crime rate, GDP per capita, urbanization rate and clear-up rate, while unemployment exert little and often non significant effect on every classification of crime rate.

4.2 Accounting for Italian dualism

In this section we account for the marked regional disparities existing between north-central and southern regions. As presented in the previous section, we estimate the crime equation (1) for each regional aggregation. Namely, we estimate a crime equation using a panel dataset for the 11 regions belonging to the North-Centre and a crime equation using a panel dataset for the remaining 8 regions belonging to the South of Italy.

Tables 3 displays coefficient estimates for northern regions. Lagged crime rate has a large and significantly positive effect for every classification of crime. Furthermore urbanization rate exhibits a positive and significant effect on crime rate, indicating that, as well documented in previous studies, the incidence of crime is higher in large cities compared to small cities or rural areas. The results for clearance rate are uniformly negative and significant: increase in the clear-up rate would reduce crime rate. Finally, wage rate exhibits a positive and significant coefficient in the regression for total crime rate. Our results show that crime rate in the North-Centre is mainly driven by lagged crime rate and deterrence variable, while labour market conditions do not exert a significant effect on delinquency.

The picture drastically changes when we consider empirical results for southern regions, as displayed in Table 4. Unemployment and wage rate are very significant

for every classification of crime. Furthermore, the coefficients have the expected signs: increase in the average wages reduce crime rates, and increase in the unemployment rate increase the crime rate. In our empirical analysis we employ different measure for unemployment (overall unemployment rate, male unemployment rate, youth male unemployment rate and long term unemployment rate) to test the robustness of the results. As it emerges from the results presented in Table 4, all the alternative measures of unemployment has a large and significantly positive effect for every classification of crime. Furthermore the signs and the significance of all the other variables are not affected by the measure of unemployment used.

GDP per capita, as expected, is positively and significantly correlated to every classification of crime, indicating that for southern regions improvements in the overall economic condition increase the illegal opportunities, thus increasing crime rates. The clear-up rate exhibits negative effects on crime rates and is significant in all models. Furthermore, the share of male aged 15-24 and the percentage of population living in cities with more than 250.000 inhabitants exerts a positive and statistically significant effect on crime rates in all models, confirming that young males are responsible for a huge amount of crimes. Finally, lagged crime rate is not significant for both property crime rate and theft rate, even presenting a positive sign, while lagged total crime rate exhibits a positive and significant effect.

To summarize, from the analysis of the results it emerges that the determinants of crime rate differ between north-central and southern regions, confirming the existence of a regional dualism. In particular, crime rate in the North-Centre is mainly driven by lagged crime rate and deterrence variable, while crime rate in southern regions is strongly related to socioeconomic variables and in particular to labour market conditions.

5 Conclusions

This papers studies the relationship between crime and the labour market opportunities for Italian regions over the period 1993 to 2002. We employ an instrumental variables

approach to investigate this relationship and we consider different measures of unemployment rate taking account of age, gender and duration. Our empirical analysis shows that at national level crime rate is mainly driven by persistence in crime rate, GDP per capita, urbanization rate and clear-up rate, while unemployment exert little and often insignificant effect on every classification of crime. The picture drastically changes when we consider the structural and relevant socioeconomic disparities existing between southern regions and the rest of Italy. South Italy is affected by chronic problems, in particular a structural backwardness and a pervasive and strong presence of organized crime. The results obtained in this case allow us to better understand and explaining the dichotomy existing between the North-Centre and the South of Italy.

Deterrence variable (clearance rate), lagged crime rate and urbanization rate are significantly correlated to crime rate in the north-central regions, while in the southern regions socioeconomic variables, in particular labour market opportunities (i.e. unemployment rate and wage), and sociodemographic variable (i.e. percentage of male aged 15-24 and urbanization rate) exert a strong and significant effect on every classification of crime.

The Italian situation varies considerably across regions and the existence of a striking socioeconomic dichotomy between a wealthy North-Centre and a lagging South affects crime rate in Italian regions. The distinguishing characteristics and disparities existing between northern and southern regions have to be taken into account in order to properly identify the determinants of crime across Italian regions.

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Appendix A

Generalyzed Method of Moments Methodology[3]

We use a dynamic model to test the relationship between unemployment and crime rates. Our model is:

$$y^*_{i,t} = \alpha y^*_{i,t-1} + \beta'_1 UNEM_{i,t} + \beta'_2 X_{i,t} + \eta_i + \vartheta_{i,t} \tag{2}$$

where y^* is the "true" crime (property, theft and total) rate, $UNEM$ is the unemployment variable, X is the set of explanatory variables other then unemployment, ϑ is the error term and η_i is a region-specific unobserved effect, that may be correlated to the explanatory variables. The subscripts i and t denote region and time period, respectively. As discussed in the paper, crime data are likely to be affected by measurement errors. In what follows we assume that measurement errors are determined not only by random errors but by specific and persistent characteristics of each region. Then, we define the measurement error as:

$$y_{i,t} = y^*_{i,t} + \upsilon_{i,t} + \lambda_i \quad \text{and} \quad \upsilon_{i,t} \text{ is i.i.d.} \tag{3}$$

where y is crime rate recorded and observed and λ is a region-specific effect. Then we can rewrite equation (2) as

$$y_{i,t} = \alpha y_{i,t-1} + \beta'_1 UNEM_{i,t} + \beta'_2 X_{i,t} + \omega_i + \varepsilon_{i,t} \tag{4}$$

where

$$\omega_i = \eta_i + (1-\alpha)\lambda_i \quad \text{and} \quad \varepsilon_{i,t} = \vartheta_{i,t} + \upsilon_{i,t} - \alpha\upsilon_{i,t-1} \tag{5}$$

The model that we test is represented by equation (4). There are several important estimation issues that may arise in the dynamic panel data specification employed in this paper. First, in the presence of region-specific unobserved effect, OLS coefficient will be biased when regressor and η_i are correlated. Second, OLS estimator will result

[3]This section is heavily based on the Appendix D of Fajnzylber, Lederman and Loayza (2002).

in inconsistent parameter estimates since $y_{i,t-1}$ is correlated by construction with $\upsilon_{i,t-1}$. Then, consistent estimates required the use of an instrumental variables approach applied to dynamic panel data model. Therefore, we employ the GMM-system estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998) that joins in a single system the regression equation in both differences and levels, using the proper set instrumental variables.

Following Fajnzylber, Lederman and Loayza (2002) we present each part of the system separately, although estimation is performed using the whole system jointly. First, taking the first differences of equation (4) allows us to eliminate the region-specific effects. Then we can write the regression equation as

$$y_{i,t}-y_{i,t-1} = \alpha(y_{i,t-1}-y_{i,t-2})+\beta_1'(UNEM_{i,t}-UNEM_{i,t-1})+\beta_2'(X_{i,t}-X_{i,t-1})+(\varepsilon_{i,t}-\varepsilon_{i,t-1}) \tag{6}$$

On the other hand, first difference transformation introduce correlation between the new error term, $(\varepsilon_{i,t} - \varepsilon_{i,t-1})$, and the differenced lagged dependent variable, $(y_{i,t-1} - y_{i,t-2})$, then we need to use instruments to deal with this problem. Moreover, the likely endogeneity of the explanatory variables, $UNEM$ and X, and the random measurement error of the lagged crime rate require the use of instruments. We assume weak exogeneity and no serial correlation in the error term, then the moment conditions are:

$$E\left[y_{i,t-s} \text{ x } (\varepsilon_{i,t} - \varepsilon_{i,t-1})\right] = 0 \quad \text{for} \quad s \geqslant 3 \tag{7}$$

and

$$E\left[X_{i,t-s} \text{ x } (\varepsilon_{i,t} - \varepsilon_{i,t-1})\right] = 0 \quad \text{for} \quad s \geqslant 2 \tag{8}$$

The GMM estimator based on the moment conditions represented by equations (7) and (8) is called the differences estimator. This estimator, although asymptotically consistent, has low asymptotic precision and large biases in small samples (Blundell and Bond (1998)), then to overcome this problem we need to complement it with the regression equation in levels. The regression in levels does not allow the elimination of the region-specific effect, then we need to control for using instrumental variables. The instruments used are the lagged differences of the corresponding variables. It is worth

to notice that even if the levels of the right-hand-side variables and the country-specific effect may be correlated, the differences of these variables and the country-specific effect are uncorrelated. This assumption results from the following stationarity property:

$$E\left[y_{i,t+p} \text{ x } \eta_i\right] = E\left[y_{i,t+q} \text{ x } \eta_i\right] \quad \text{and} \quad E\left[X_{i,t+p} \text{ x } \eta_i\right] = E\left[X_{i,t+q} \text{ x } \eta_i\right] \tag{9}$$

for all p and q.

Moreover, we need to consider the additional moment conditions for the regression in levels that are give by:

$$E\left[(y_{i,t-s} - y_{i,t-s-1}) \text{ x } (\eta_i + \varepsilon_{i,t})\right] = 0 \quad \text{for} \quad s = 2 \tag{10}$$

and

$$E\left[(X_{i,t-s} - X_{i,t-s-1}) \text{ x } (\eta_i + \varepsilon_{i,t})\right] = 0 \quad \text{for} \quad s = 1 \tag{11}$$

The consistency of the parameters obtained by means of the GMM estimator depends crucially on the validity of the instruments. We therefore consider two specification tests suggested by Arellano and Bond (1991) and Arellano and Bover (1995). The first test is the Sargan test of overidentifying restrictions, which tests the null hypothesis of overall validity of the instruments used. Failure to reject this null hypothesis gives support to the choice of the instruments. We also consider the test for serial correlation of the error term, which tests the null hypothesis that the differenced error term is first and second order serially correlated. Failure to reject the null hypothesis of no second-order serial correlation implies that the original error term is serially uncorrelated and the moment conditions are correctly specified.

Table 1 - Italian economic dichotomy (average 1993-2002)

	TotUn	MaleUn	M24Un	LongUn	GDP	Wage
North-Centre	6,6%	4,4%	16,3%	3,0%	118,6	116,4
South	20,1%	15,8%	47,4%	13,0%	67,5	71,4
Italy	10,9%	8,3%	28,2	4,5%	100	100

Note: Italy GDP and Wage are normalized to 100.

Table 2
GMM regression for Italy

	Property Crimes				Thefts				Total Crimes			
	TotUn	MaleUn	M24Un	LongUn	TotUn	MaleUn	M24Un	LongUn	TotUn	MaleUn	M24Un	LongUn
$Crime_{-1}$	0.2673	0.2760	0.2809	0.2807	0.2698	0.2749	0.2736	0.2866	0.3803	0.3799	0.3725	0.3764
	(5.39)***	(5.66)***	(5.67)***	(5.52)***	(5.26)***	(5.77)***	(5.66)***	(5.64)***	(4.79)***	(4.38)***	(4.25)***	(4.49)***
Unemployment	0.0433	0.0521	0.0223	0.0380	0.0344	0.0444	0.0168	0.0300	0.0333	0.0263	0.0152	0.0196
	(1.65)*	(1.58)	(1.81)*	(1.15)	(1.31)	(1.33)	(1.44)	(0.979)	(0.953)	(0.588)	(0.865)	(0.493)
Wage	0.0006	0.0004	-0.0001	0.0005	0.001	-0.0001	-0.0004	-0.0001	0.0023	0.0024	0.0017	0.0022
	(0.467)	(0.320)	(-0.105)	(0.384)	(0.035)	(-0.139)	(-0.455)	(-0.116)	(1.40)	(1.40)	(1.09)	(1.25)
GDP	0.0014	0.0014	0.0014	0.0012	0.0015	0.0015	0.0015	0.0013	0.0011	0.0009	0.0011	0.0009
	(2.16)**	(2.33)**	(2.22)**	(2.12)**	(2.65)***	(2.91)***	(2.77)***	(2.71)***	(1.39)	(1.18)	(1.26)	(1.39)
Growth	0.0114	0.0079	0.0133	0.0160	-0.0067	-0.0111	-0.0033	-0.0020	0.0003	-0.0003	0.0082	0.0125
	(0.467)	(0.347)	(0.545)	(0.723)	(-0.289)	(-0.488)	(-0.130)	(-0.087)	(0.006)	(-0.009)	(0.187)	(0.323)
High School	0.0771	0.0772	0.0612	0.0771	0.0521	0.0494	0.0406	0.0506	0.150	0.1475	0.1530	0.1627
	(1.56)	(1.59)	(1.25)	(1.73)*	(1.30)	(1.24)	(0.949)	(1.35)	(2.26)**	(2.37)**	(2.43)**	(2.50)**
University	0.0857	0.0863	0.0024	0.0877	0.0983	0.1090	0.0444	0.0908	0.1696	0.137	0.0412	0.1071
	(0.763)	(0.713)	(0.025)	(0.792)	(1.08)	(1.13)	(0.566)	(1.01)	(0.769)	(0.617)	(0.216)	(0.544)
Male24	0.090	0.1018	0.0472	0.1339	0.1391	0.1489	0.0168	0.1714	0.127	0.1620	0.0633	0.1556
	(0.499)	(0.532)	(0.322)	(0.744)	(0.851)	(0.866)	(1.44)	(1.08)	(0.515)	(0.606)	(0.294)	(0.660)
Foreigners	-0.2001	-0.1914	-0.1295	-0.2113	-0.1186	-0.1175	-0.0746	-0.1104	-0.2943	-0.2676	-0.2313	-0.2674
	(-1.77)*	(-1.90)*	(-1.22)	(-1.91)*	(-1.18)	(-1.30)	(-0.802)	(-1.13)	(-1.79)*	(-1.74)*	(-1.48)	(-1.63)
City	0.0306	0.0281	0.0285	0.0295	0.0271	0.0251	0.0255	0.0266	0.0219	0.0207	0.0230	0.0244
	(4.98)***	(4.48)***	(3.84)***	(5.10)***	(5.20)***	(4.50)***	(3.97)***	(5.14)***	(1.84)*	(1.68)*	(1.57)	(2.02)**
Clear-up	-0.0887	-0.0926	-0.0897	-0.0893	-0.0807	-0.0873	-0.0894	-0.0809	-0.0490	-0.0548	-0.0518	-0.0467
	(-4.15)***	(-3.93)***	(-4.16)***	(-4.10)***	(-3.14)	(-2.81)***	(-2.91)***	(-3.01)***	(-3.38)***	(-3.76)***	(-3.99)***	(-3.28)***
Wald (Time)	55.90**	57.15**	59.30**	47.57**	57.50**	56.95**	63.51**	54.38**	35.79**	34.16**	32.60**	39.61
Specification tests												
Sargan Test	348.1	355.9	382.6	360.2	347.7	349.1	366.8	363.5	330.8	344.9	349.8	339.3
Serial Correlation												
First Order	-3.079**	-3.050**	-3.061**	-3.068**	-3.039**	-3.021**	-3.028**	-3.025**	-2.753**	-2.715**	-2.712**	-2.721**
Second Order	1.359	1.313	1.410	1.390	0.9817	0.93180.	0.9899	1.037	0.7312	0.7191	0.7408	0.7340

Notes: First Order and Second Order Test are test statistics for first and second order autocorrelations in residuals, respectively, distributed as standard normal N(0,1) under the null of no serial correlation. Sargan test is a test of overidentifying restrictions, distributed as chi-square under the null of instrument validity. T-values are reported in parentheses. T-values are robust to heteroscedasticity and autocorrelation (Arellano, 1987). ***, ** and * indicate coefficient significant at the 1%, 5% and 10% levels, respectively. All variables are instrumented using lag t-2. Number of regions:19; number of observations: 190. Time span: 1993-2002.

Table 3
GMM regression for North-Centre

	Property Crimes				Thefts				Total Crimes			
	TotUn	MaleUn	M24Un	LongUn	TotUn	MaleUn	M24Un	LongUn	TotUn	MaleUn	M24Un	LongUn
$Crime_{-1}$	0.3097	0.3219	0.3160	0.3146	0.2832	0.2965	0.2934	0.2764	0.3808	0.3856	0.3771	0.4018
	(4.57)***	(4.59)***	(4.41)***	(4.30)***	(4.16)***	(4.16)***	(4.12)***	(3.58)***	(3.90)***	(3.80)***	(3.82)***	(4.34)***
Unemployment	0.0320	0.0506	-0.0149	-0.0446	0.0133	0.0251	-0.0078	-0.1101	-0.0681	-0.0570	-0.0278	-0.0929
	(0.312)	(0.350)	(-0.543)	(-0.339)	(0.140)	(0.195)	(-0.309)	(0.867)	(-0.426)	(-0.280)	(-0.705)	(-0.447)
Wage	0.0024	0.0020	0.0020	0.0023	0.0018	0.0015	0.0012	0.0018	0.0054	0.0052	0.0055	0.0043
	(1.58)	(1.35)	(1.58)	(1.46)	(1.30)	(1.06)	(1.03)	(1.33)	(1.98)*	(2.05)**	(2.26)**	(1.68)*
GDP	-0.0007	-0.0007	-0.0010	-0.0008	-0.0003	-0.0003	-0.0003	-0.0006	-0.0024	-0.0021	-0.0023	-0.0015
	(-0.717)	(-0.875)	(-1.24)	(-0.766)	(-0.389)	(-0.494)	(-0.428)	(-0.666)	(-1.45)	(-1.52)	(-1.63)	(-0.975)
Growth	0.0626	0.0649	0.0659	0.0539	0.0135	0.0134	0.0132	0.0084	0.0660	0.0612	0.0620	0.0357
	(1.29)	(1.35)	(1.46)	(1.18)	(0.319)	(0.318)	(0.307)	(0.212)	(0.880)	(0.812)	(0.834)	(0.490)
High School	0.0187	0.0107	0.0241	0.0399	0.0258	0.0141	0.0337	0.0485	0.0643	0.0526	0.0698	0.0889
	(0.257)	(0.162)	(0.378)	(0.536)	(0.488)	(0.308)	(0.784)	(1.09)	(0.617)	(0.496)	(0.664)	(0.890)
University	0.0935	0.0791	0.0842	0.0874	0.0886	0.0755	0.0963	0.0757	0.0813	0.0869	0.0759	0.1248
	(0.772)	(0.162)	(0.682)	(0.629)	(0.874)	(0.712)	(0.927)	(0.700)	(0.434)	(0.439)	(0.384)	(0.655)
Male24	-0.0155	-0.0101	-0.0700	-0.0300	0.1004	0.1184	0.0650	0.1078	0.0624	0.1021	0.0500	0.0895
	(-0.139)	(-0.088)	(-0.652)	(-0.222)	(1.17)	(1.22)	(0.678)	(0.957)	(0.447)	(0.674)	(0.377)	(0.493)
Foreigners	-0.1435	-0.0925	-0.0337	-0.1667	-0.0889	-0.0415	-0.0219	-0.1028	-0.0681	-0.0713	-0.0477	-0.1575
	(-1.16)	(-0.633)	(-0.210)	(-1.30)	(-0.884)	(-0.351)	(-0.162)	(-0.919)	(-0.372)	(-0.349)	(-0.219)	(-0.956)
City	0.0228	0.0217	0.0316	0.0279	0.0224	0.0221	0.0265	0.0317	0.0304	0.0296	0.0356	0.0312
	(1.93)*	(1.55)	(2.41)**	(2.17)**	(2.23)**	(1.85)*	(2.16)**	(2.78)***	(1.88)*	(1.53)	(1.86)*	(1.94)*
Clear-up	-0.2159	-0.2257	-0.2166	-0.2141	-0.3070	-0.3264	-0.3274	-0.3157	-0.0558	-0.0554	-0.0532	-0.0479
	(-4.05)***	(-4.16)***	(-4.23)***	(-4.00)***	(-4.23)***	(-4.46)***	(-4.39)***	(-4.24)***	(-1.98)*	(-1.90)*	(-1.91)*	(-1.87)*
Wald (Time)	213.0**	96.41**	68.17**	151.2**	29.35**	32.49**	27.28**	29.95**	180.3**	186.5	287.2**	169.3
Specification tests												
Sargan Test	238.2	246.5	240.7	225.9	239.3	248.6	244.6	227.8	249.0	253.4	253.8	225.7
Serial Correlation												
First Order	-2.361**	-2.346*	-2.345**	-2.356**	-2.032**	-1.986*	-2.038**	-2.023**	-2.228*	-2.234*	-2.228*	-2.304*
Second Order	1.209	1.2240.	1.192	1.208	0.9170	0.9321	0.9367	0.8231	0.2586	0.2689	0.2629	0.2489

Notes: see note to Table 2. Number of regions:11; number of observations: 110. Time span: 1993-2002.

Table 4
GMM regression for South

	Property Crimes				Thefts				Total Crimes			
	TotUn	MaleUn	M24Un	LongUn	TotUn	MaleUn	M24Un	LongUn	TotUn	MaleUn	M24Un	LongUn
$Crime_{-1}$	0.1170	0.0916	0.1188	0.1227	0.0441	0.0225	0.0517	0.0628	0.2094	0.1990	0.2030	0.2023
	(1.68)*	(1.18)	(1.41)	(1.57)	(0.552)	(0.278)	(0.560)	(0.753)	(2.70)***	(2.41)***	(2.36)**	(2.55)**
Unemployment	0.0968	0.1398	0.0480	0.1349	0.0768	0.1119	0.0386	0.1005	0.0663	0.0902	0.0357	0.1111
	(3.01)***	(3.38)***	(2.87)***	(2.72)***	(2.86)***	(3.38)***	(2.69)***	(2.57)**	(3.33)***	(2.88)***	(2.80)***	(2.96)***
Wage	-0.0022	-0.0029	-0.0027	-0.0020	-0.0023	-0.0029	-0.0028	-0.0020	-0.0027	-0.0030	-0.0033	-0.0030
	(-1.88)*	(-2.33)**	(-1.94)*	(-1.48)	(-2.34)**	(-2.71)***	(-2.30)**	(-1.91)*	(-2.61)**	(-2.59)**	(-2.58)**	(-2.50)**
GDP	0.0061	0.0070	0.0061	0.0052	0.0064	0.0072	0.0064	0.0055	0.0060	0.0064	0.0062	0.0058
	(2.69)***	(2.85)***	(2.55)**	(2.58)**	(3.19)***	(3.39)***	(3.06)***	(3.26)***	(2.81)***	(2.70)***	(2.64)**	(2.86)***
Growth	0.0201	0.0205	0.0272	0.0254	0.0140	0.0136	0.0194	0.0184	0.0274	0.0287	0.0324	0.0301
	(0.985)	(0.933)	(1.14)	(1.42)	(0.820)	(0.715)	(1.00)	(1.15)	(1.09)	(1.12)	(1.33)	(1.27)
High School	0.0799	0.0923	0.0270	0.0272	0.0445	0.0540	0.0022	0.0029	0.1318	0.1386	0.0960	0.0963
	(0.788)	(0.938)	(0.343)	(0.334)	(0.603)	(0.784)	(0.041)	(0.048)	(1.29)	(1.34)	(1.08)	(1.09)
University	0.0329	-0.0195	0.0079	0.0188	0.1173	0.0712	0.0914	0.1106	-0.0854	-0.1087	-0.1097	-0.1111
	(0.245)	(-0.141)	(0.056)	(0.143)	(1.06)	(0.656)	(0.797)	(1.00)	(-0.591)	(-0.691)	(-0.743)	(-0.832)
Male24	0.8813	0.8745	0.8416	0.7253	1.014	0.999	0.9668	0.8842	0.7720	0.7732	0.7439	0.6381
	(2.10)**	(2.13)**	(2.42)**	(2.03)**	(2.80)***	(2.91)***	(3.28)***	(2.77)***	(1.86)*	(1.89)*	(2.02)**	(1.69)*
Foreigners	0.1855	0.1456	0.3100	0.3346	0.1433	0.1113	0.2412	0.2559	-0.1308	-0.1565	-0.0412	-0.0139
	(0.524)	(0.382)	(0.893)	(1.06)	(0.541)	(0.394)	(0.954)	(1.09)	(-0.344)	(-0.398)	(-0.107)	(-0.038)
City	0.0299	0.0294	0.0262	0.0171	0.0321	0.0315	0.0288	0.0214	0.0352	0.0343	0.0335	0.0274
	(1.95)*	(1.90)*	(1.78)*	(1.43)	(2.36)**	(2.38)**	(2.25)**	(2.05)**	(2.53)**	(2.32)**	(2.27)**	(2.17)**
Clear-up	-0.0736	-0.0709	-0.0704	-0.0711	-0.0787	-0.0762	-0.0756	-0.752	-0.0595	-0.0579	-0.0582	-0.0570
	(-4.05)***	(-6.25)***	(-7.38)***	(-7.09)***	(-5.98)***	(-6.31)***	(-6.31)***	(-6.39)***	(-5.67)***	(-5.57)***	(-6.39)***	(-5.74)***
Wald (Time)	257.0**	331.9**	560.8**	275.5**	304.9**	380.1**	1069**	209.6	92.73**	38.73**	70.53**	19.87*
Specification tests												
Sargan Test	182.0	183.2	184.5	182.7	194.1	194.9	194.5	193.4	182.9	184.1	184.9	182.5
Serial Correlation												
First Order	-2.082*	-2.134*	-2.218*	-2.137*	-2.208*	-2.254*	-2.295*	-2.245*	-2.196*	-2.219*	-2.256*	-2.243*
Second Order	0.3116	0.1586	0.8947	0.4766	-1.547	-1.533	-1.253	-1.537	0.5866	0.5793	0.7231	0.6008

Notes: see note to Table 2. Number of regions:8; number of observations: 80. Time span: 1993-2002.