PROPERTY CRIME AND LAW ENFORCEMENT IN ITALY. A REGIONAL PANEL ANALYSIS 1980-95.

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ABSTRACT.

In this paper a Cobb-Douglas utility function is introduced and solved for a dynamic equation of property crime supply and its determinants, namely deterrents and income. Thereafter, all variables are empirically tested, by means of a simultaneous equations model, for the sign and magnitude of their mutual relationships in a panel of Italy and its two economically and culturally different areas, the North and the South. The period scrutinized is 1980-95 and the results obtained widely differ among the two. When appropriately modeled and instrumented, in fact, property crime is found to react to police and criminal justice deterrence, and also to incomes, with different parameter magnitudes and significance. The same diversity applies to the parameters related to deterrence, flawed in quite a few cases by scarce law enforcement and productivity, and to those related to local incomes, which still reflect for the South a tendency of crime to substitute for legal activities.

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INTRODUCTION.

The purpose of this paper is to provide a theoretically sound and empirically estimable model of property crime supply and demand. The methodology adopted follows a two-step procedure: *i*) evaluating the theoretical relationships between property crime and its determinants, by means of an optimal control model based on Becker's utilitarian cost/benefit behavior under the constraint of specific incentives, *ii*) extending and improving this model to achieve a full-fledged estimable systemic form.

This procedure fully exploits rationality embedded within each step, since it utilizes the optimizing choices of the first [Becker, 1968] and the information available from both exogenous and instrumental variables of the second [Taylor, 1978; Vandaele, 1978]. The model so obtained provides the necessary structure to empirically estimate all of the relevant crime relationships in the context of a 3SLS simultaneous equation system applied to the case of Italy.

To date, a restricted albeit interesting literature on empirical testing of Italy's crime exists [Marselli and Vannini, 1996, 1997; Scorcu and Cellini, 1998; Lee, 2000], although its results are in general based on estimable models that do not rely on optimizing assumptions, and/or do not adopt system estimators. This practice, however, is not unfrequent for other country analyses as well, e.g. the U.S. [Sjoquist, 1973], England and Wales [Wolpin, 1978; Wong, 1995], Canada [Avio and Clark, 1976], and Germany [Entorf and Spengler, 2000], amongst many more.

This kind of modeling essentially reduces crime dynamics to a single supply-of-crime equation, and by assuming away the issue of rationality, produces estimable forms of crime equations which are suboptimal with respect to Becker's theoretical insights. By consequence, many results are econometrically inconsistent due to simultaneous equation bias and lack of proper instrumentation [Taylor, 1978]. In this paper, instead, the necessary technical underpinnings are supplied to be able to yield a theoretically and empirically consistent estimable system-based model of criminal behavior.

To perform this task, a Cobb-Douglas utility function of property crime and labor allocation with positive and negative incentives will be examined and, given its First-Order Conditions (FOCs), solved for a dynamic equation of crime supply and its determinants, namely the incentives: police prevention, judicial repression and incomes. Of these, the first two represent the demand for crime, while incomes are necessary to close the model.

As previously advanced, the experiment regards Italian total property crime and its correlates for the period 1980-95, and is carried out via a systemic 3SLS fixed-effects panel regression model applied to both national and regional (North and South) data. This discriminant represents an interesting exercise on the different locational relationships that may exist between crime and its determinants in the context of different sociocultural and economic environments, given the well-known relative backwardness of the South [Putnam, 1993] and the socially entrenched 'mafia' phenomenon of some areas therof. The 3SLS model results are finally double checked via a dynamic panel specification to account for endogenous lagged variables therein excluded.

Sect. 1 introduces the utility model and its solution for a dynamic equation of crime supply and its determinants, while Sect. 2 exhibits the taxonomy and descriptive statistics of the major variables involved. Sect. 3 justifies the need for simultaneous equation estimation to capture all the structural and reduced-form feedbacks of the crime model, while Sect. 4 provides the econometric results of both regional areas, characterized by significantly different impacts of incentives over the supply of crime, and of crime and deterrence over incomes as well as different degrees of response of crime demand. Sect. 5 concludes.

Sect. 1. A THEORETICAL MODEL OF PROPERTY CRIME BEHAVIOR.

If criminal agents are assumed to behave rationally by allocating labor and crime in response to given incentives, as the massive literature on crime posits [Becker, 1968; Ehrlich, 1973, 1975, 1996; Taylor, 1978; Wolpin, 1978, Vandaele, 1978; Cameron, 1988; Eide, 1994; DiIulio, 1996; Levitt, 1997, 1999] - just to name a few - then property crime stands alone as being the proper candidate. In fact, property crime in principle fits the rationality issues implied by the utility model to a larger extent than crime against the person (e.g. homicide, assault). The latter is in fact notably less rational, as its plans are normally not influenced by cost/benefit considerations [Taylor, 2000]. For such reasons, the ensuing discussion is limited to the analysis of property crime (henceforth simply denoted as 'crime', unless otherwise specified) and its determinants.

The representative individual - along Becker's lines - is assumed to be free to choose, at any moment of time, to supply a certain amount of crime (C_t, illegal activity) or of labor (L_t, legal dependent or independent employment activity). The framework is couched in terms of a deterministic and discrete dynamic nonseparable Cobb-Douglas utility function (**U**), which constitutes, with due variants depending on the environment (e.g. the discounted CAPM model), a standard toolkit of optimal control and cannot be dismissed without losing important, if not essential, information about the dynamics and the constraints of the process analyzed.

In the present context, the individual maximizes over a finite time span the utility stream stemming from labor (L_t) and crime (C_t), subject to motion constraints of police prevention and criminal justice repression (RP_t), known as 'deterrence' or as 'negative incentives', and of percapita real incomes or wages (Y_t), known as 'positive incentives'.

Technically we have the following maximand:

$$\text{I.} \quad \text{Max } \mathbf{U} = \sum_{t=1}^{T} \left[(C_t^{\nu} L_t^{1-\nu}) + .5\,(\theta_1 RP_t + \theta_2 Y_t)^2 \right]$$

$$\text{s.t.:} \quad \text{II.} \quad RP_{t+1} = \alpha_1 Y_t + \alpha_2 RP_t + \alpha_3 C_t$$

$$\text{III.} \quad Y_{t+1} = \beta_1 Y_t + \beta_2 L_t + \beta_3 C_t$$

where time $t \in T$, C_t and L_t are the control variables, and the other two variables (eqs. II and III) are the state contraints. The first of these (RP_t) may be considered as a strict sense constraint from the viewpoint of criminals and as an implicit demand for crime [Ehrlich, 1996] from the rest of the society. Conversely, the second control (Y_t) is a general incentive (job, wage or income opportunities) from the viewpoint of criminals [Ehrlich, 1973] and a strict-sense constraint from the rest of the society, i.e. a 'state-of-nature' function.

The first bracketed expression in eq. I is the Cobb-Douglas utility function where ν and $1-\nu$ are the imputed shares of the controls C_t and L_t (for $\nu<1$), with unit elasticity of substitution. While on a single individual's basis, selection among them constitutes a typical binary choice problem (i.e. ν is either 0 or 1), in aggregate the share represents the percentage of individuals committing crimes, including recidives. In essence, the utility equation may be viewed as a selective 'supply of crime' function, insofar as the representative agent is free to decide whether to supply labor force or crime [Becker, 1968; Sah, 1991]. As usual, utility is expected to be concave in its arguments, whereby $U'(C_t)$, $U'(L_t) > 0$ and $U''(C_t)$, $U''(L_t) < 0$.

The second bracketed expression is a quadratic weighted sum of the states RP_t and Y_t, where $\Sigma_i \theta_i$, (i=1,2). Hence weight θ_i represents the contributive share of each state variable entering the utility decision making. Different from above, weights θ_i are not determined by binary choices at the single individual's level, but each weight for each individual may freely range from 0 to 1, and be more or less independent from other individuals' choices, as posited by the 'spillover effect' approach [Sah, 1991; van Dijk, 1994].

As to the state equations of motion, parameters α_i (i=1,3) and β_i (i=1,...3) are differently signed depending on the socio-cultural and institutional environment as well as on the current economic conditions of the country examined. In the present context, these parameters will be given a rather rough and introductory definition, which will be made more explicit in Sect. 3.

In eq. II, the deterrence state equation, parameter α_1 reflects the income scale effect over the demand for crime. In principle, the sign of the parameter is uncertain due to the individual-property rights tradeoff associated to developing democracies (fn. 1). In fact, higher incomes carry a lower demand for crime in terms of tighter property-rights protection, and at the same time an increased concern for constitutionally granted individual-rights protection of the offender (reduction of police powers, right to legal defense, milder conviction terms, paroling, etc.) We thus expect α_1 to be positive (negative) if the former (latter) instances prevail. In general, however, $\alpha_1 < 0$ because a milder official response to crime causes potential victims to raise personal security expenses (e.g. locks, alarms) or to advocate stiffer self protection, like the right to carry guns. In a cross section of incomes, the magnitude of the parameter is likely to attenuate and even tend do zero with lower-income percentiles, as security expenses become a higher share of earnings [Imrohoroglu et al, 1996; Levitt, 1999].

Parameter α_2 represents the ARX(1) coefficient of the overtime dynamics of RP_t and thus theoretically ranges from $-\infty$ to $+\infty$. Both its sign and magnitude - other things equal - depend upon the generic value the given society assigns to a growing or falling repression and prevention apparatus [Glaeser et al., 1996; Sah, 1991], thereby causing the variable to be positively or negatively trended, respectively.

Parameter α_3 bears a similar assignment concept, which is connected to the societal reaction to current crime. It represents the 'willingness' of the society to respond to delinquency via the appointed institutions, namely police and the judiciary. It is known also as the 'official stigma for crime', and differs somewhat from the 'social stigma', which is included in the utility costs of committing crimes [Glaeser et al., 1996; Rasmusen, 1996]. In general we expect $\alpha_3 > 0$ whose magnitude depends, *coeteris paribus*, on the intensity with which the society intends to react against crime by deploying all of its available and institutionally-granted countermeasures, like police and judiciary staffing, restrictive laws and regulations, etc. Hence, the higher (lower) α_3 the less (more) resilient is sociey towards crime. In more rare cases we can also have $\alpha_3 < 0$, i.e. a society that endorses crime[1].

The deterrence equation may be conceived of as an indirect or implicit demand for crime, henceforth simply denoted as 'demand for crime', with the proviso that the degree of stigma may be hidden not only in parameter α_3, insofar as economic considerations reflect cultural instances, but also in other more specific variables that affect RP_t, as will be made clear in Sect. 3[2].

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[1] Feudal and holigarchic societies, in order to maintain their privileges and parasitary rents, typically endorse several kinds of economic and noneconomic harassment towards nonmembers [Bardhan, 1997]. In addition, sociodemocratic societies by recognizing equal opportunities, individual rights and paroling, either automatically endorse (some amount of) criminal behavior that exploits these rules (*free ridership*), or willingly refrain from pursuing - to different extents - several kinds of offenses and petty crime to avoid social displeasure and gain votes from low-income and low-employment classes. In both cases, a steady-state crime rate on behalf respectively of the dominant and the poor class is ensured.

[2] An explicit demand for crime would be stated in terms related to the market

In eq. III, the income state equation, all other things equal, parameter β_1 represents the ARX(1) coefficient of percapita income dynamics. We expect $\beta_1 \cong 1$ if the process is a martingale and $\beta_1 < (>) 1$ if the process is stationary (nonstationary). These characteristics much depend on the long-term inherent economic conditions of the country like technological progress, human capital, etc., a typical subject matter of growth theory [Barro and Sala-i-Martin]. All in all, whichever growth pattern the country may follow, we generally expect $\beta_1 \neq 0$.

Parameter β_2 is quite intuitively positively signed, since labor constitutes an essential production factor with respect to percapita income, although the equation is not a production function in a strict sense. In fact, not only physical but also service output provides a positive incentive vis-a'-vis crime supply [Ehrlich, 1996]. Parameter β_3 should instead be negatively signed since property crime is normally expected to hamper growth due to the disruption of property rights and subsequent uncertainty about production, investment and consumption plans [Svensson, 1998].

The discrete-state Hamiltonian function (**H**) of all the arguments (the controls and the states) derived from eq. I is the following

$$\mathbf{H} = C_t^{v} L_t^{1-v} + .5\ (\theta_1 RP_t + \theta_2 Y_t)^2 + \lambda_{1,t+1}\ (\alpha_1 Y_t + \alpha_2 RP_t + \alpha_3 C_t) + \lambda_{2,t+1}\ (\beta_1 Y_t + \beta_2 L_t + \beta_3 C_t)$$

where $\lambda_{1,t+1}$ and $\lambda_{2,t+1}$ are the costate variables. After taking the first derivatives with respect to their arguments (FOCs) and performing the necessary time derivations, an equation of motion of the crime rate supply in terms of its determinants can be retrieved (see the Appendix for technical details), as follows:

$$\text{IV.}\quad dc_t = \phi_1 rp_t + \phi_2 y_t + \phi_3 c_t$$

with the following percapita value lowercases which will be henceforth used: $c_t = C_t/L_t$, $dc_t = c_t - c_{t-1}$, $rp_t = RP_t/L_t$, $y_t = Y_t/L_t$. Eq. IV is the theoretical model equation of crime supply, whose parameter values ϕ_i (i=1,...3) by construction depend on the sign and magnitude of parameters α_i (i=1,3) and β_i (i=1,...3) of its own determinants, i.e. the state constraints of eqs. II and III.

As to the first two parameters of eq. IV, it turns out that if the reaction of repression and prevention (negative incentives) to

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for stolen goods [Vandaele, 1978; Ehrlich, 1996]. A proxy thereof is the reported implicit demand for crime which implies that relaxation (tightening) of deterrence raises (lowers) opportunities to buy stolen goods.

crime - the official 'stigma' for crime - is sizable ($\alpha_3 \rightarrow \infty$), and if incomes (positive incentives) are negatively affected by crime ($\beta_3 < 0$), or if in any case the former exceeds the latter ($|\alpha_3| > |\beta_3|$), dc_t is negatively affected by both incentives. If the opposite occurs, $|\alpha_3| \rightarrow 0$ or $|\alpha_3| < |\beta_3|$, their impact is positively signed. In synthesis, a society characterized by stigma for crime and significantly involved at fighting crime will exhibit decreasing returns to crime from greater income opportunities and stiffer deterrence. Under these premises, as necessary and sufficient conditions, both positive and negative incentives are negatively signed in eq. IV.

The sign of the adjustment parameter of the crime rate dynamics, ϕ_3, critically depends on α_1, α_3 and β_3 and is expected to be positive to ensure a positive steady state crime rate level, once dc_t is set to zero. This occurs, for $\alpha_1 < 0$, if $|\alpha_3| > |\beta_3|$, i.e. if the above-stated premises apply.

As advanced in the Introduction, eq. IV clearly enough represents the only viable model to address crime equations in an optimizing environment characterized by the presence of positive and negative incentives, assuming these be simultaneosly endogeneized as well in a supply-demand context.

Apart from that, substitution of income for unemployment (the unit complement to L_t) as a determinant of crime supply - as performed in some more or less recent applied literature - would violate the state and control formats of eq. I, and cause the optimizing model to collapse. The ensuing derivation of eq. IV would thus be impossible, and any forceful representation thereof - be it deterministic or stochastic, even after barring the econometric simultaneity issue (see Sect. 3) - is suboptimal and its results unwarranted. As a result, unemployment should be discarded as a determinant in optimality-based crime equations.

Sect. 2. ITALIAN PROPERTY CRIME AND RELATED STATISTICS.

Italy is a republic founded in 1948 and divided into twenty local administrative units (called *regioni,* henceforth denoted as 'regions'). For historic, social and economic reasons [Putnam, 1993], Italy is traditionally subdivided into two different geographical areas of almost the same amount of population and surface: the North, which includes eleven regions, and the South which includes nine.

The period covered in this essay is 1980-95, the reported data are annual and are drawn from the panel set of all the administrative units. The official source is the National Statistical Institute (ISTAT). The regional crime-related data are available to date, while the economic data do not extend beyond 1996, and quite a few not beyond 1995. Hence the full panel is forcefully restricted to that year, providing a total of 16 observations for each of the twenty regions.

Property crime in Italy, according to ISTAT, includes all forms of officially reported indictable crimes and offenses committed by and against private individuals[3]. It includes theft (larceny and motor vehicle theft), burglary, robbery, extortion, ransom kidnaping, rustling, money laundering and fraud.

All of the property crime figures refer to reported crimes. Their entire-country mean ratio to unreported crimes is unknown, though rough estimates hover around 2/3. The ratio of reported crimes committed by unknown offenders to the total of reported crimes is instead known, and stands slightly above an appalling 90% [CRENOS, 1999]. Finally, the crimes reported include also those committed by nonnationals, of which most are legal and illegal immigrants from non-EC countries.

In absolute terms, the recorded number of total property crimes has passed from 1,433,329 in 1980 (of which 54% in the North) to 2,228,528 in 1995 (of which 50% in the North), an increase of 1.55 times (1.43 in the North and 1.70 in the South). As may be easily seen, no substantial regional differences exist in these numbers, nor is the property crime rate - by and large - any different from West European standards for the period considered [United Nations, 1994][4] .

The Italian penal code distinguishes two forms of arrest: temporary apprehension (*fermo*, which expires within 48 hours if no police filing follows), and arrest (*arresto*, which is subsequent to the former, and involves police filing and immediate incarceration). However, data unavailability and/or reliability and regional disaggregation problems make it impossible to utilize, among others, police arrest figures comparable and compatible with crime rate statistics. Arrests are in fact supplied on a national basis and are aggregated with nonproperty crimes.

The only available proxy for property crime arrests is represented by the regional number of persons apprehended by police, following a reported criminal action and entering prison. This process is commonly denoted as 'liberty deprivation' or simply incarceration. Recorded crimes that are not filed for public prosecution decay within 48 hours and the individual is

[3] Indictment in terms of crime taxonomy and related minimum and maximum penalty is regulated in the national criminal laws contained in the amended Penal Code and in other statutes. Enforcement is assigned to police and to other sector- or area-specific authorities (e.g. town constabularies, rangers, Finance Guard, border police, etc.). The age of criminal responsibility is 18, and any individual is chargeable unless mentally disordered or chronically intoxicated by alcohol and drug abuse. Punishment is usually more severe when the individual is affiliated to organized crime (e.g. mafia). The Penal Code considers the violent crimes of robbery, extortion and ransom kidnaping as property crimes because their main intent is to gain property.

[4] The international United Nations statistics on property crime are not directly comparable due to some countries' undereportings or data unavailability, including Italy itself. For the four major crimes (robbery, total theft, burglary and fraud) and for the selected median year 1986, Italy's tally officially stands 50 to 60% less than the ISTAT figure. Provision made for the necessary correction, the Italian crime rate would lay slightly beneath Germany (Federal Republic) and England and Wales.

automatically acquitted. Otherwise, incarceration is confirmed and hearing, investigation and sentencing follow.

Adequate statistical coverage is provided by the data on the number of incarcerations following police filings, disaggregated both by region and by type of crime. ISTAT tabulates two distinct categories of incarcerations, respectively labeled as 'by region of committed crime' and 'by region and country of birth'. This breakdown enables computing the percentage of crime mobility across regions: in the North, as an average for the entire period, Northern-born citizens committed half of property crimes, while 30% were committed by foreign nationals and the remaining 20% by Southern-born citizens. In the South, comparable statistics associate a 3% figure to Northern-born citizens, 80% to Southern-born residents and the rest to foreign nationals.

In the present context, the first category is chosen since the second is by principle irrelevant to the purposes established in Sect. 1, namely, the analysis of the relationship between extant crime and its determinants. In other words, prevention, repression and incomes operate on the basis of actual observable crimes, not on their geographical provenance. However, this distinction will prove not to be entirely immaterial for the purposes of interpreting some end results in Sect. 4.

Adequate statistical coverage is also available for the number of property crime sentences, which includes also offenses and petty crimes that by law or by common use do not involve incarceration, but usually only fining. Figure availability of incarcerations and sentences enables the breakdown of deterrence rp_t of Sect.1 into its two components: police prevention or 'clearance' (p_t) and judicial repression (r_t)[5].

Table 1 provides the period and both national and regional descriptive mean statistics of total percapita property crime c_t, of incarcerations p_t and of sentences r_t, all expressed in percentage terms over the resident population. Included are also the percapita real GDP levels y_t (real incomes), expressed in thousand Liras (1,000 Liras in 1995 were approximately worth 70 cents of a Dollar), the rate of unemployment u_t expressed in percentage terms - computed by ISTAT as the ratio of unemployment to total active population - and percapita total employment $l_t = L_t/P_t$, where L_t is the sum of dependent and independent workers and P_t is resident population. The period covered by u_t is restricted by data availability and reliability to the years 1983-94. The table includes also the percentage mean annual growth rates of the variables (in brackets) and the Z test statistic for different variable means between the North and the South (*p* values in brackets).

[5] Incarcerations, by definition, are more closely akin to incapacitation than to deterrence, although in practice their effects over the crime rate are indistinguishable, except by means of cross-crime analysis [Levitt, 1998].

Table 1.

Basic crime, judicial, real income and labor statistics, 1980-95.

	c_t	p_t	r_t	y_t	u_t*	l_t
Italy	2.504 (4.92)	.068 (2.39)	.079 (12.7)	20,617 (1.60)	9.95 (2.62)	.400 (-.21)
North	2.593 (4.44)	.063 (2.52)	.077 (12.9)	25,550 (1.74)	7.61 (2.26)	.448 (-.10)
South	2.395 (5.50)	.074 (2.23)	.082 (12.5)	15,854 (1.42)	16.13 (3.61)	.343 (-.33)
Z-test	.108 (.914)	-.258 (.796)	-.110 (.911)	1.835 (.066)	-1.690 (.091)	2.212 (.027)

* Covers the period 1983-94.

As one can easily notice, only the first and third variable level rates do not differ at the regional level within a 10% significance level, while incarcerations (p_t) are somewhat higher in the South as compared to the North, because of a sizably higher quantity of property violent crimes (robberies, extortions, kidnapings) and homicides for which a tougher intervention is customarily required[6]. This difference is manifested by the reported Z-test value whose significance extends well beyond the 10% level, although there seems to be a tendency for the North to pick up with the South, as shown by the growth rates of incarcerations.

Percapita mean real GDP levels and unemployment/employment rates also significantly differ, as evidenced by the Z-test statistics. On average incomes are 70% higher in the North, and the gap is not bound to be closing anytime soon, given almost identical annual growth rates. Unemployment rates also significantly differ across regions in line with incomes, and in the South they appear to be twice as higher as in the North. Employment percapita figures also differ and present a growth pattern significantly unfavorable to the South.

These series are tested for stationarity by means of the

[6] For the entire period considered, the mean percent percapita values of homicides and of violent property crimes (robberies plus extortions plus kidnapings) - all indictable crimes for which incarceration is mandatory - respectively are .02 and .41 in the North and .06 and .79 in the South. Moreover, for the same time stretch, the mean share of violent property crimes over total property crime is 15.5% in the North and 32.1% in the South. Finally, violent property crime recidiveness, computed as the ratio of the number of crimes to the number of offenders on a yearly basis, is 8.90 for the North and 13.50 for the South.

modified Dickey-Fuller test for the null of stationarity across all the national panel individuals [Im et al., 1997], henceforth denoted as IPS test. The series are one-lag first-differenced without and with a trend, while the 'tbar' 5% and 10% critical values for rejection (with 20 individuals, i.e. the Italian regions, and 16 observations) respectively are -1.87 and -1.79, and -2.52 and -2.44. Regional panel results are unreported as they do not significantly differ from the nationwide results, which are exhibited in Table 2, together with growth volatility indexes, computed as the ratio between standard errors and mean growth rates. Volatility expresses the relative magnitude, i.e. the spread, of overtime percent changes, and is a 'safe' measure of cyclical amplitudes.

Table 2.

IPS test statistics for stationarity and volatility indexes of the variables of Table 1. Italy, 1980-95.

	c_t	p_t	r_t	y_t	u_t*	l_t
No trend	-1.233	-2.790	-2.139	-.828	-1.736	-1.728
Trend	-2.161	-2.781	-2.531	-2.260	-1.792	-1.648
Volatility	4.718	12.530	12.730	1.314	8.518	9.825

* Covers the period 1983-94.

The picture that emerges from this table is essentially that crime, incomes, unemployment and labor force are significantly (within the 10% bound) trended, letting both forms of deterrence significantly untrended. The here unreported crime supply (dc_t) is stationary, as its no-trend and trend 'tbar' statistics respectively are -2.494 and -2.788.

Moreover, and quite unexpectedly, real GDP growth is less volatile than any other growth variable, including that of the unemployment rate, perhaps because of loopholes or deficiencies in the labor data collection and in the computation of activity rates made by ISTAT. Real GDP growth is also less volatile - though to a minor albeit unexpected extent - than percapita employment, and this holds also at the regional level. In the South the former stands at 1.63 and in the North at 1.09, while the latter at 7.58 and 14.0 respectively.

Even barring the relative shortness of the time span of the unemployment series, which would straitjacket the experiment to a minor number of observations, its high cyclicality corroborates, from the observational viewpoint, the theoretical argument set out in Sect. 1 against using this variable as a regressor in stochastic crime equations.

Sect. 3. ECONOMETRIC METHODOLOGY.

This Section is devoted to the stochastic estimation of eqs. II to IV, given the parameter and the optimizing constraints set out in Sect. 1. These constraints are perfectly consistent with the need to adopt a multiequation approach to empirically estimate the crime dynamics of eq. IV in a supply-demand context.

In fact, simultaneous equation bias and/or errors in variables causes single-equation OLS estimation to produce inconsistent parameter estimates, a commonplace in crime-related models [Taylor, 1978; Wolpin, 1978; Ehrlich and Brower, 1987; Cameron, 1988; Wong, 1995; Ehrlich, 1996; Levitt, 1997]. In quite a number of instances, many variables are simultaneously correlated with each other, e.g. the number of police stationed and crime rates, high incomes and property crime (the 'high-loot' hypothesis), high crime and stiffer sentence terms (the 'backfire' hypothesis) , etc. In particular, the 'high-loot' hypothesis, pioneered by Ehrlich [1973], maintains that - all other things equal i.e. barring income opportunities and security expenses like antitheft devices, locks, policing, etc. - higher incomes call for higher property crimes (parameter $\phi_2 > 0$ in eq. 1). Hence, in general, 'potential criminals can expect more loot in states with a more skewed income distribution' [Taylor, 1978, p.44]. The 'backfire' hypothesis [Clear, 1996] posits that stiffer sentencing, in the form of longer and/or harsher terms of inprisonment, causes higher crime rates due to magnified spillover effects [Sah, 1991; Glaeser et al., 1996] across inmates, especially with the young and/or in presence of overcrowding [Levitt, 1996][7].

By consequence, the assumption of exogeneity does not imply predeterminedness but must imply some structural form imposed by the analyst. In addition, variables measurement errors may not be unfrequent when dealing with number of reported crimes, number of apprehensions, etc., so that recourse to instrumental variables or to other specific techniques is made necessary to avoid the well known fenomenon of parameter attenuation [Taylor, 1978] or negativity [Levitt, 1998].

A systemic 3SLS [Zellner, 1962] multiequation approach to estimate eq. II - IV is therefore appropriate to account for these occurrences and to exploit any information stemming from select instruments. As previously advanced, this consistent type of estimation will regard not only the national but also the regional panels, to be able to discern, if any, the locational differences of the relationship between crime and its determinants.

Because of data unavailability or nonmatching surveys, many interesting socioeconomic determinants of crime cannot be used. Variables such as the percentage of southerners committing crimes in the northern regions, especially in the context of organized

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[7] Empirical research on the 'high-loot' hypothesis produces mixed results, and significantly hinges on income distribution data availability or on econometric methodology [Levitt, 1999; Lee, 2000]. The 'backfire' hypothesis, which is virtually the opposite of incapacitation, encounters the same measurement problems when applied at the aggregate level [Levitt, 1998]. Both hypotheses, quite intuitively, share measurement error and simultaneity bias.

crime (e.g. mafia) and organized gangs, generally involved in robbery, extortions, smuggling and kidnaping, the percentage of families lying in the lowest income percentiles - to account for income distribution effects [Ehrlich, 1973; van Dijk, 1991; Freeman, 1996; Imrohoroglu et al., 1996; Levitt, 1999; Lee, 2000] -, correctional figures like prison and security expenses, inmate population and beds available, or specific victimization data [Levitt, 1999], are unavailable, incomplete or even classified and undisclosed to the general public.

On the other hand, sufficient data series exist for the variables introduced in Sect. 2, like the splitting of the deterrence variable between prevention and repression, and for other data which may be used as predetermined or instrumental variables. Therefore, eqs. II to IV can be endogeneized and duly modified and extended, to produce a stochastic empirically estimable model representation that embeds the parameters of the optimizing model set out in eq. I. We can thus easily construct a systemic model of crime dynamics made up of the four following stochastic equations:

1. $dc_t = \phi_{11} p_t + \phi_{12} r_t + \phi_2 y_t + \phi_3 c_t + \eta_{1,t}$

2. $p_t = \alpha_{11} y_t + \alpha_{12} r_t + \alpha_{13} c_t + \varphi_1 dc_t + \varphi_2 dp_t + \varphi_3 s_t + \eta_{2,t}$

3. $r_t = \alpha_{21} y_t + \alpha_{22} p_t + \alpha_{23} c_t + \vartheta_1 dc_t + \vartheta_2 dr_t + \eta_{3,t}$

4. $y_t = \omega_1 l_t + \omega_2 h_t + \omega_3 dc_t + \omega_4 p_t + \omega_5 r_t + \eta_{4,t}$

where all variables are expressed in logs, dx_t stands for the first difference of variable x_t (any of the variables listed), and parameters ϕ_{11} and ϕ_{12} are clumped together into parameter ϕ_1 of eq. IV, α_{11} and α_{21} into α_1, α_{12} and α_{22} into α_2, and α_{13} and α_{23} into α_3 of eq. II. Other parameters are introduced to fully exploit the simultaneity and the dynamics of the relationships (φ_1), or to express the 'curvature' of the function (φ_2 and ϑ_1), or to add to the model's information with the introduction of variables s_t and h_t, which respectively denote the amount of police staffing and human capital[8]. Of these two, in particular, the former augments the repression equation by capturing a scale effect on the demand for crime [Levitt, 1997], while the latter augments the production function as required by standard growth

[8] Police staffing, i.e. the amount of police stationed, may be viewed as a proxy for the ratio of crimes committed by unknown authors to total reported crimes, a typically measurement-error variable [Marselli and Vannini, 1996, 1997]. The proxy is supposedly unflawed, as a larger presence of police would raise crime reporting by the local population. The human capital variable is computed as the sample period sum of real government current education expenditures, discounted by a constant 5% annual interest rate [Barro and Sala-i-Martin, 1995].

theory modeling [Barro and Sala-i-Martin, 1995]. Other variables were obvious candidates as regressors (e.g. education in eq. 1), but detected multicollinearity caused them to be discarded. Variables $\eta_{1,t}$ to $\eta_{4,t}$ are IID disturbances with zero mean and known sample variance.

While eq. 1 is the stochastic replica of eq. IV with separation of deterrents, and represents the supply of crime, eqs. 2-3 are the implicit demand for crime functions, and eq. 4 is the modified production function [Ehrlich, 1996].

A few words are due on the expected sign and magnitude of the parameters of eqs. 1 to 4.

In eq. 1, parameters ϕ_{11} and ϕ_{12} are negatively signed from the mathematical derivation of ϕ_1 in eq. IV (Sect.1). They respectively represent the 'certainty' and the 'severity' costs associated to illegal property appropriation. In principle, if the potential criminal is rational in Becker's sense and is risk-averse [Ehrlich, 1975, 1996; Taylor, 1987], the probability of apprehension constitutes a major deterrent to crime, as ensuing incarceration would involve a sequel of legal and extralegal costs (legal fees, bailout expenses, social stigma, etc.) to be borne along with conviction and that may be not worthwhile the value of the loot. We thus expect, in a rationality context, $|\phi_{11}| > |\phi_{12}|$.

Parameter ϕ_3 measures the long-run adjustment of crime dynamics with respect to the current crime rate stock. Adjustment spells 'inertial' determination of crime rates, namely, their dynamics as unaffected by the select incentives. It implies nonindependent crime decisions for new entrants and recidives, and measures thus the 'spillover effect' [Sah, 1991; Glaeser et al., 1996] thereby involving the estimation of the steady-state crime supply, by definition closely linked to the long-run customs texture of the society. The parameter in theory bears no specific expectational sign, but must be consistent with the other parameters of the equation so as to produce, by mathematical computation, a positive value of the steady-state crime supply[9].

In eqs. 2 and 3, parameters α_{11} and α_{21} are taken to reflect the impact of income levels over the deterrents, and are expected to be negatively signed as anticipated in Sect. 1 with reference to parameter α_1. In association with higher incomes, in fact, higher demand for civil liberties and rights prompts parliaments and governments to enact laws and regulations addressed at safer and institutionally-granted individual protection. Therefore, sociodemocratic regimes tend to reduce the extent and impact of various forms of prevention and repression, in particular with respect to minor crimes. Examples among others, as discussed in Sect. 1, are the right to legal defense and tighter rules for

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[9] The arithmetic is simple. If we let $dc_t = 0$ in eq. 1 and solve for c_t, the steady-state value of the supply of crime is obtained as $c_t^* = -\phi_3^{-1}[\phi_{11}p_t + \phi_{12}r_t + \phi_2 y_t + \eta_{1,t}]$ such that $c_t^* \to \infty$ as $\phi_3 \to 0$.

apprehension and incarceration, with the obvious emergence of a property-rights protection tradeoff.

Parameters α_{12} and α_{22} represent the mutual relationships between repression and prevention that 'influence the .... enforcement efforts in determining the probabilities of apprehension and conviction' [Ehrlich, 1996, p.60]. More precisely, the parameter in eq. 2 essentially reflects the message or order of penal justice to police as to whether tighten or relax law enforcement by means of incarcerations depending on the current stock and growth rate of sentences, while that of eq. 3 reflects the efficiency and/or workload of penal justice relative to police incarcerations, i.e. the promptness and/or willingness of judges to operate upon existing and incoming incarcerations, known in the professional literature as the 'overload' hypothesis [Rasmusen, 1996].

These two parameters are expected to be positive (negative) if incarcerations can (cannot) grow in line with sentence processing and if the latter can (cannot) grow as a function of total incarcerations. In general, they represent the upshot of implicit - if not explicit - long-term agreements between the authorities to meet political, budgeting or other kinds of requirements (e.g. prison capacity constraints) [Ehrlich and Brower, 1987; Sah, 1991; Ehrlich, 1996; Levitt, 1997] of which typical manifestations are paroling, probation acquittal and general amnesties.

Parameters α_{13} and α_{23}, tucked up into α_3 of eq. II, represent the 'stigma-for-crime' reaction of deterrence, namely, the willingness of society to respond to crime via the appointed institutions or, in other words, the degree to which demand for crime officially reacts to supply [Glaeser et al., 1996; Rasmusen, 1996]). The parameters are expected to be positive, and higher in magnitude the stronger the stigma. In some cases they can be negatively signed ('endorsement of crime'), namely when deterrence is corrupt or inefficient or when the authorities are strongly tied or even identified themselves with organized crime in terms of 'public gangsterism' [Marcoullier and Young, 1995], like in several countries of the dissolved Communist block or of Africa and Latin America.

Parameters φ_1 and ϑ_1 are the 'dynamic' counterparts of α_{13} and α_{23}, and reflect the short-run reaction , i.e. the 'speed', of authorities in keeping up with crime rates, generally dictated by the existence of institutional, economic and even political overt or covert arrangements. In other words, repression and prevention *coeteris paribus* positively (negatively) respond to incoming crime if the authorities can (cannot) imprison and judge more than a given amount of criminals, whether by law, by budgetary reasons, or by other unmeasurable or undetectable reasons [Sah, 1991; Glaeser et al., 1996]. Parameter negativity implies government inefficiency at stemming incoming crime and does not rule out the possibility of corruption and malfeasance between criminals and officials [DellaPorta and Vannucci, 2000][10]. They may be termed

[10] Cyclical and structural productivity 'ceilings' in both forms of deterrence may arise due to local (i.e. precinct), regional or nationwide personnel congestion or overlapping, limited budget allocation and conversely electoral

'crime cyclical ceilings' to deterrence.

Parameters φ_2 and ϑ_2 reflect the 'curvature' of their respective functions to detect their adjustment speed and to assess, by consequence, the nature of their activity returns. In fact, positive (negative) values of the parameters are associated to increasing (decreasing) returns, generally associated to the quality or quantity of staffing and to their pooling capacity. They are similar in kind to the previous two parameters, and may thus be comfortably dubbed as 'productivity cyclical ceilings'.

Finally, with respect to eq. 4, parameter ω_1(which corresponds to β_2 in eq. III) indicates the total labor input elasticity, and reflects the degree to which it is likely to substitute for criminal activity. Parameter ω_2 involves human capital, another substitute for crime and a complement to labor [Barro and Sala-i-Martin, 1995]. Parameters ω_3, ω_4 and ω_5 respectively pick up the effects over incomes of the growth rates of crime, and of the current stocks of prevention and repression. Of these, in theory, the first parameter is negative and the other two are positive, as increasing crime adversely affects economic activity, while extended policing and patroling and stiffer sentencing ensure more efficient protection and defense of property rights, the safest alley to investments and economic growth in a criminal environment [Svensson, 1998].

Sect. 4. ECONOMETRIC RESULTS.

Eqs. 1-4 are estimated by a fixed-effects panel[11] [Baltagi, 1995] 3SLS [Zellner, 1962] instrumental method to produce consistent parameter estimations in the presence of simultaneity bias and errors in variables, and to gain in information from the viewpoint of rational decision makers. The procedure is applied to both national and regional data and the results are exhibited in Table 3.

The 3SLS instrument set includes regional dummies, a trend, first-order lagged values of the endogenous and exogenous variables and of the following socioeconomic and demographic indicators: resident population, GDP shares of industry, agriculture and investments, dependent and independent labor

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cycles, training or educational deficiencies, etc. in the practice of law enforcement [Sah, 1991], all leading to crime demand being unable to keep up with crime supply. Their measurement in the aggregate is virtually impossible as they are contained in the errors in variables [Taylor, 1987], but can pop up in several ways, like the one suggested in the present context.

[11] Fixed-effects panel estimation is prefered to random effects because of the maintained hypothesis of regional diversity in the relationship between crime rates and their correlates. Moreover, a χ^2 Hausman test statistic [Hausman and Taylor, 1981] for the null of no correlation between the exogenous variable vector and the disturbances, applied to the 3SLS model for the entire sample, stands at a value of 5133.29, making random-effects estimates biased and inconsistent within any acceptable significance level [Baltagi, 1995].

force, total government consumption and service activity. The set, however, differs in each unit because differing are the correlations between them and the first-stage OLS residuals of eqs. 1-4. For each unit, only the signifcantly close-to-zero correlations are retained[12].

The 3SLS parameter estimates are exhibited in Table 3, with the three columns respectively corresponding to the entire nation, to the North and to the South, and four major rows corresponding to eqs. 1-4, therein replicated. Also included are the IPS [Im et al., 1997] 'tbar' no-trend stationarity tests (Sect. 2) for each equation's residuals, to check for omitted variables bias. The reader is reminded that the 5% critical value for the nation (20 individuals and 16 observations) is -1.87 and for the two areas (11 and 9 individuals, respectively) is -2.05. The null of stationarity cannot be rejected, apparently, for any residual series.

The 3SLS model is mostly not static by construction, since the first equation is already expressed in dynamic terms (dc_t), while the other two include lags of the first-differenced endogenous variables as regressors (dp_t and dr_t). Only the last equation is static by construction, and incomes are nonstationary, as from Table 2. In such case, its parameter estimates would be biased and inconsistent because of their correlation with the individual-specific effects. This would require a dynamic GMM panel representation of the equation if not, by extension, of the entire model [Anderson and Hsiao, 1981; Arellano and Bond, 1991; Baltagi, 1995]. However, as seen from Table 3, the reported IPS test statistics of disturbances significantly reject the omitted-variable bias hypothesis for all four equations both at the national and regional level. Hence, a dynamic GMM panel run is superfluous, although a double check has been duly performed[13].

Simple eyeballing reveals differing parameter magnitudes and/or signs among the North and the South, as a result of area-specific fixed effects. A significance test of the null hypothesis of no parameter diversity among regions is performed by means of a

[12] With a procedure similar to standard instrument identification testing [Staiger and Stock, 1997], each available instrument was regressed against the first-stage OLS residual vector of eqs. 1-4. The null of zero-parameter vector (as a proxy for zero correlation) was tested by means of a standard exclusion F-test: when significantly different from zero the instrument was dropped. As a result, most if not all of the instruments were dropped for the South, while quite a few were retained for the North.

[13] The dynamic panel representation of eqs. 1-4 is performed by applying the method required for persistent series [Bond et al, 2001], a variant of standard modeling [e.g. Arellano and Bond, 1991] where the endogenous and exogenous variables are expressed in levels, lags of the endogenous variables are included, and the instruments are suitably lagged levels and first differences of both. This procedure enables to retain the same structure as the 3SLS model - thereby not imposing first differencing in the constituent equations - and to create moment conditions with instruments uncorrelated with the individual-specific effects. The (unreported) results are all in line with those shown in Table 3 as they exhibit the same parameter signs, a proof that the dynamics imposed upon the equations of the 3SLS model produces consistent and unbiased estimates and no mispecification bias.

Hausman test, distributed under the null as a χ^2 statistic with as many degrees of freedom as the number of parameters in the system, which is 20. Its value is 410.33, leading to rejection of equality of the parameters within any plausible significance level.

Generally speaking, at both national and regional area levels the parameter estimates produced the following *prima facie* results:

1. Nationwide and in Northern Italy, judicial repression plays no significant role at styming property crime supply, contrary to police prevention and to percapita incomes whose impacts bear the expected signs. In Southern Italy, instead, only police prevention works well, whereas percapita incomes are insufficiently able at driving potential crime entrants away and, even more so, justice appears to significantly foster crime rather than to reduce it. The 'high-loot' hypothesis (according to which higher incomes attract crime) and the 'backfire' hypothesis (harsher judicial repression causes higher crime via prison inmate spillovers) do not thus hold nationwide and in Northern Italy, but significantly hold for Southern Italy.

2. Not unexpectedly from the above results, the steady-state supply of crime is higher in the South due to local spillovers, typically associated to high violent crime shares and recidiveness (fn. 6) and ultimately to organized crime.

3. Demand for crime, i.e. law and order enforcement enacted by the appointed institutions, is affected by lack of stigma only in the South, while overload and other forms of inefficiencies and deficiencies are quite evenly distributed across the country, especially with judicial repression. In spite of that, noteworthy is the commitment of police toward stemming the difficult crime situation in the South.

4. Also evenly distributed across the nation - with no significant regional diversity - is the response of demand for crime to income incentives, in terms of institutionally granted lower deterrence and tighter rules against apprehension and incarceration that tend to trade off property rights with individual rights. With the benefit of historical hindsight that traces back to the early Seventies, this evidence is the end result of controversial socio-political arrangements oftentimes hotly debated, amended and enacted with parliamentary laws, a phenomenon typical of young evolving democracies [Putnam, 1993].

5. The income equation is highly diversified at the regional level: there is strong evidence in the South of crime still substituting for legal activities (i.e. labor supply), as a collateral effect of violent and organized crime, wheras prevention fails to foster local economic growth.

These general results are more specifically analyzed and scrutinized in the subsequent comments that relate to the single equations, according to their ascending order presented in Sect. 3.

Some of the results are shared by comparable analyses for Italy [Marselli and Vannini, 1996, 1997] and other countries as well [Ehrlich and Brower, 1987; Taylor, 1978; Wolpin, 1978; Wong, 1995; Entorf and Spengler, 2000]. Specifically, however, the split effect of deterrence variables in eq. 1 (parameters ϕ_{11} and ϕ_{12})

is very different in all columns: while police prevention negatively affects crime supply within any acceptable level of significance, judicial repression plays no significant role whatsoever, and in the South it even lends support to an unpleasant 'backfire' effect, certainly double-linked with mafia-type imprisonment spillovers [Clear, 1996][14].

No better fares for Southern Italy the income-level positive 'incentive effect' implied by parameter ϕ_2. It carries the expected negative sign only nationwide and in Northern Italy, wherein higher incomes involve greater earning and job opportunities that substitute for crime, and drive potential criminals off the illegal market [Ehrlich and Brower, 1987; van Dijk, 1994]. The income parameter in the South is essentially insignificant, and may thus to a certain extent call for the nonrejection of the 'high-loot' hypothesis. On top of that, stands for the South a steady-state crime supply higher than in the North, derivable from the inertial adjustment parameter ϕ_3. Mechanical application of the rule to predict it (see fn. 9), places the South some 35% higher than the North. Local 'spillovers' [Sah, 1991; van Dijk, 1994] stemming from organized crime (e.g. mafia) that continually foster new entrants and recidiveness are most likely responsible for this evidence.

As to demand for crime (eqs. 2-3), only in the North do both deterrents exhibit a significantly positive 'stigma-for-crime' degree, expressed as the official willingness to fight crime [Cameron, 1996] (parameters α_{13} and α_{23}), measured in the present context as the number of extant incarcerations and sentences with respect to the extant crime stock, a gauge of quantitative state response to crime. These parameters are instead insignificantly different from zero in the South. This result may be influenced, other things equal, by the different social texture of some areas of the South which exhibit ample mafia-type spillovers and where local customs provide an off-limits situation to state intervention, with consequential retrenchment of the authorities' presence [Putnam, 1993].

Income incentives over deterrence (parameters α_{11} and α_{21}) are everywhere negatively signed (except for the police in the South, where they are not significantly different from zero), to unmistakeably herald that the individual-property rights tradeoff hypothesis tightly and significantly holds and is decidedly tilted in favor of individual rights in the form of reduced police incarcerations and judiciary sentencing. In practice, defense and protection of individual rights receive a priority lane with respect to property rights, except for police prevention in the South where a heavy-handed control of organized and violent crime appears preferable.

The parameters representing the 'overload' hypothesis (α_{12}

[14] The larger and definitely more significant impact of prevention with respect to repression conforms with the certainty/severity hypothesis applicable to a risk-averse potential property criminal, rationally engaged at outweighing the probability of being caught with the legal and extralegal costs associated to conviction [Becker, 1968; Ehrlich, 1975, 1996; Taylor, 1987].

and α_{22}) attest everywhere to the existence of mutual agreements toward reducing the degree of law enforcement. One notable exception is police in the South: this posture appears to be tightly related to its commitment at defending property rights, as noted above, with no ensuing interference from other sources. The judiciary, instead, appear to be seriously committed at shunning property crime incarceration processing with particular emphasis in the South, thereby offsetting the preventive stance of police, and lending support to some anedoctal evidence that wants career crminals - most of which associated to mafia groups - being oftentimes granted benefits and waivers uncommon even in other democratic societies. In general, however, overload in Italy is associated with serious prison capacity constraints, general amnesties and reduction of sentence terms, coupled with political vested interests, electoral targets and local fund mismanagement[15].

The parameters representing the cyclical ceilings to crime (φ_1 and ϑ_1) and the productivity ceilings (φ_2 and ϑ_2) yield mixed results. The reader is cursorily reminded that the former kind of ceilings is taken to reflect the adjustment speed with which authorities respond to incoming crime, i.e. the inprisonment and judgement response rates of the appointed authorities. Similarly, the productivity ceilings - other things equal - reflect their activity returns, i.e. the curvature of their own production function.

At both the national and regional levels, the crime ceiling is not significant for the judiciary but significantly negative for the police, except for the South. Intuitively, the first of these results appears to be quite obvious insofar as treatment of incoming crime does not institutionally pertain to the judiciary. Judges are in fact held responsible for acting upon extant and not incoming apprehended criminals, which are customarily first-filtered through the police.

The negativity of the crime ceiling parameter, instead, casts a shadow on the efficiency of police to keep up with crime-supply dynamics, with special reference to Northern Italy whose parameter is high in absolute terms and compares with the non significance of its counterpart in Southern Italy. This evidence underlies a shift of police commitment to ensure law and order from less to more dangerous crime situations and/or areas like the South, characterized by higher homicide and violent property crime rates (fn. 6).

Productivity ceilings negatively affect the judiciary sentencing output everywhere in the country and across regions with and indisputable level of significance, a fact that supports the widely-held anedoctal evidence of traditionally lenghty backlog-ridden procedures in the vast majority of courts of the country[16].

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[15] Systematic lack or coverup of relevant data regarding prison expenses and beds available in Italy, made public in many nations [United Nations, 1994], is one possible example of local fund mismanagement.

[16] Reliable statistics [CRENOS, 1999] reveal that, for the period scrutinized and for the entire nation, the mean length of a criminal case from police filing to first-degree ruling (Low Court) is 140 days, and from the latter down to the

Police staffing, that is, the amount of police stationed (parameter φ_3 in eq. 2) bears no significant contribution to prevention both nationwide and in the North, while in the South it carries a negative sign whose significance stands well within 10%. Such mixed results are shared by some studies on other countries [Taylor, 1987; Levitt, 1997], but not by other studies on Italy in which police staffing enters as a regressor of the supply-of-crime equation [Marselli and Vannini, 1996, 1997]. As an alternative to the current specification, inclusion of police numbers into eq. 1 in previous regression runs produced very similar results. Structural long-run motives such as general education and training, especially in patroling, apprehension and investigation practices, are likely candidates for the outcome. For the South, overmanning due to high-crime exigencies is an additional candidate, obviously linked to the high degree of law enforcement commitment encountered above[17].

Eq. 4, finally, exhibits the expected signs and acceptable significance levels of both parameters of labor force and human capital (ω_1 and ω_2) only for the entire nation and for both regional areas as well, but in the South labor exhibits a much lower elasticity than in the North[18]. Moreover, crime supply (parameter ω_3) acts as a hamper to economic growth by carrying the correct sign only in the South, whereas elsewhere it is positively signed.

This latter unexpected feature begs a thorny answer that may reside in the following explanation: since crime supply is negatively affected only by police deterrence and unaffected by income incentives in the South, labor force is still partly driven away from contributing to income - as confirmed by its low

final-degree ruling (Court of Appeals and Supreme Court) is 680 days. This puts the average trial length well beyond 2 years, including also the mean time served in prison ahead of the first court hearing. In addition, and for the same period, the current percent share of completed to incumbent procedures is roughly 70% for first-degree sentences and less than 40% for the other.

[17] Levitt [1997] cites budget and electoral ciclicality as the main causes of low enforcement productivity of police staffing. In the present context, however, cyclicalities are excluded because previous regression runs found them to be insignificant. This occurs because in Italy, different from the United States, budgeting of police and courts is determined by the central government and enacted with parliamentary laws, that bear no relationship with local constituency periodical elections. Further, failure of police staffing to significantly affect incarcerations may be consistent with the low percentage of reported to unreported crimes, insofar as the former acts as a proxy of the latter [Marselli and Vannini, 1996, 1997], (fn. 8).

[18] The sizably higher labor elasticity detected in the North with respect to that of the South (parameter ω_1) originates from a larger covariance/variance ratio of incomes and employment of the panel-transformed series, which respectively amount to .735 and .153. While industrial output would surely furnish a better representation of a production function (a matter that cannot be pursued here), measurement errors of the employment variable (Sect. 2) could be responsible for the result. One fact stands clear however: per capita incomes, as a rough proxy of mean productivity, are significantly higher in the North (Sect. 2), thereby providing a justification for the large regional differential of parameter ω_1.

elasticity - and simultaneously acts as a significant substitute for legal activities, especially in some areas under the control of mafia-type groups. On the contrary, crime in the North is a complement to labor, which sizably contributes to incomes as evidenced by the magnitude of its elasticity. In that area, in practice, crime supply is superimposed on the existing labor force, as it sizably originates from elsewhere, due to crime mobility from the South and from abroad (Sect. 2).

At the same time, the deterrence parameters (ω_4 and ω_5) positively affect incomes, acting as a property-rights protection vehicle, only for the entire nation and for Northern Italy, leaving the South wrong-signed with one of the two. This result is consistent with the higher degree of property-rights retrenchment in the South by the authorities (parameters α_{11} and α_{21}) and with the magnitude and significance of the productivity ceilings (φ_2 and ϑ_2)

Incidentally, the signs of the reported parameters related to the incentives of eq. 1 are consistent (after discounting for statistical errors) with their theoretical construct shown in Sect. 1 and in the Appendix. In fact, as shown above, the signs of the 'stigma' for crime and of the impacts of labor and crime supply over incomes are all positive for the North and differently signed in the South, thereby providing the necessary and sufficient condition for the crime incentive parameters to take the actually reported signs. In other words, since stigma is absent in the South and crime partly substitutes for labor in determining incomes, the latter in turn - coupled with a significant 'backfire' - provide on average perverse incentive effects over the crime supply.

Sect. 5. CONCLUSIONS.

The empirical results of a supply-demand simultaneous model of property crime behavior and law enforcement applied to the entire nation and to its two culturally different regions - the North and the South - in spite of some problems in data availability and reporting, errors in variables and regional differences in the estimated parameters, leads to the following general conclusions:

i. Crime supply is effectively checked only by police prevention at any geographical level, while judiciary repression bears no role or even causes criminal spillovers in the South, while in that area income levels are affected by crime-for-labor substitution and thus, in turn, provide no serious check to crime supply itself. Certainty scores a much higher and definitely more significant rank with respect to severity as a tap to crime.

ii. The steady-state crime supply is higher in the South as the upshot of a social texture traditionally more open to spillovers, in the form of crime entries and recidives, and ultimately to violent and organized crime. No wonder, by consequence, if the contribution of legal activities to Southern incomes is low as compared to the North, and if crime still significantly substitutes for labor.

iii. Crime demand everywhere in the country produces a generally low official state response, and is afflicted by several inefficiencies and deficiencies like lack of stigma in the South, a remarkable tilt toward defense of individual rights as opposed to property rights (especially in the North), operational overload except with police in the South, sluggish if not collusive response to crime by the judiciary, and low productivity of police staffing.

If the stepping up of a rampant property crime rate is regarded as a relevant issue at the national level as well as in the administrative and political authorities' agenda, several policy suggestions addressed at strengthening law enforcement are in order, amongst which of major relevance are the need of: raising the training and educational standards of the appointed institutions; relaxing, if not thwarting, the collusive arrangements among them and between them and the offenders; and finally fostering economic growth in the South as a substitute for potential crime entry and for local, and even nationwide, spillovers.

Table 3.

Fixed-effects 3SLS parameters of eqs. 1-4, Italy, North and South, period 1980-95 (standard errors in brackets), and IPS 'tbar' test statistics of regression residuals.

	ITALY (1)	NORTH (2)	SOUTH (3)
Eq.1. $dc_t = \phi_{11} p_t + \phi_{12} r_t + \phi_2 y_t + \phi_3 c_t + \eta_{1,t}$	(1)	(2)	(3)
ϕ_{11}	-.668 (.01)	-.778 (.08)	-.538 (.18)
ϕ_{12}	-.085 (.07)**	-.153 (.13)**	.185 (.08)
ϕ_2	-1.416 (.24)	-.986 (.34)	.575 (.38)**
ϕ_3	.734 (.11)	.531 (.11)	-.318 (.10)
IPS	-2.572	-2.779	-2.298
Eq.2. $p_t = \alpha_{11} y_t + \alpha_{12} r_t + \alpha_{13} c_t + \varphi_1 dc_t + \varphi_2 dp_t + \varphi_3 s_t + \eta_{2,t}$	(1)	(2)	(3)
α_{11}	-2.116 (.36)	-1.621 (.42)	-.538 (.18)**
α_{12}	-.139 (.11)**	-.383 (.14)	.114 (.08)**
α_{13}	1.102 (.16)	.711 (.15)	.390 (.28)**
φ_1	-1.497 (.02)	-1.133 (.12)	.060 (.42)**
φ_2	.001 (.01)**	.009 (.03)**	-.452 (.19)
φ_3	-.005 (.01)**	.100 (.09)**	-.452 (.17)*
IPS	-2.329	-2.585	-2.907
Eq.3. $r_t = \alpha_{21} y_t + \alpha_{22} p_t + \alpha_{23} c_t + \vartheta_1 dc_t + \vartheta_2 dr_t + \eta_{3,t}$	(1)	(2)	(3)
α_{21}	-2.113 (.36)	-1.687 (.08)	-2.558 (.59)
α_{22}	-.672 (.39)*	-.599 (.29)	-.916 (.44)
α_{23}	.879 (.34)	.605 (.33)*	.180 (.22)**
ϑ_1	-.635 (.62)**	-.181 (.39)**	.035 (.48)**
ϑ_2	-.501 (.13)	-.163 (.09)*	-.966 (.21)
IPS	-2.609	-2.438	-2.581
Eq. 4. $y_t = \omega_1 l_t + \omega_2 h_t + \omega_3 dc_t + \omega_4 p_t + \omega_5 r_t + \eta_{4,t}$	(1)	(2)	(3)
ω_1	.640 (.13)	.879 (.29)	.270 (.12)
ω_2	.157 (.01)	.164 (.01)	.128 (.01)
ω_3	.149 (.05)	.478 (.06)	-.082 (.04)
ω_4	.069 (.03)	.285 (.05)	-.148 (.03)

ω_5	.070 (.01)	.105 (.05)	.041 (.01)
IPS	-1.951	-3.149	-2.215

* Parameter not significant at 5% *p* value.
** Parameter not significant at 10% *p* value.

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APPENDIX.

Let the discrete-state Hamiltonian function (**H**) derived from eq. I (Sect. 1) be

$$\mathbf{H} = C_t^{\nu} L_t^{1-\nu} + .5\,(\theta_1 RP_t + \theta_2 Y_t)^2 + \lambda_{1,t+1}\,(\alpha_1 Y_t + \alpha_2 RP_t + \alpha_3 C_t) + \lambda_{2,t+1}\,(\beta_1 Y_t + \beta_2 L_t + \beta_3 C_t)$$

with C_t and L_t the controls, RP_t and Y_t the states, $\lambda_{1,t+1}$ and $\lambda_{2,t+1}$ the costates, and time $t \in T$. The Hamiltonian first derivatives with respect to its arguments are:

A1. $\delta \mathbf{H}/\delta C_t = 0 = U'(C_t) + \alpha_3 \lambda_{1,t+1} + \beta_3 \lambda_{2,t+1}$

A2. $\delta \mathbf{H}/\delta L_t = 0 = U'(L_t) + \beta_2 \lambda_{2,t+1}$

A3. $\delta \mathbf{H}/\delta RP_t = \lambda_{1,t+1} - \lambda_{1,t} = -(\theta_1 RP_t + \theta_2 Y_t + \alpha_2 \lambda_{1,t+1})$

A4. $\delta \mathbf{H}/\delta Y_t = \lambda_{2,t+1} - \lambda_{2,t} = -(\theta_1 RP_t + \theta_2 Y_t + \alpha_1 \lambda_{1,t+1} + \beta_1 \lambda_{2,t+1})$

with the transversality condition $\lim_{t\to\infty} (\lambda_{1,t} RP_t + \lambda_{2,t} Y_t) = 0$, and where, from the Cobb-Douglas utility function in eq. I (Sect.1)

$U'(C_t) = \nu (L_t/C_t)^{1-\nu} > 0$, $U'(L_t) = (1-\nu)(C_t/L_t)^{\nu} > 0$;

$U''(C_t) = -\nu(1-\nu) C_t^{\nu-2} L_t^{1-\nu} < 0$, $U''(L_t) = -\nu(1-\nu) C_t^{\nu} L_t^{-(1+\nu)} < 0$.

From eqs. A1 and A2 we have

A11. $\lambda_{1,t+1} = -[U'(C_t) + \beta_3 \lambda_{2,t+1}]/\alpha_3 = -[\beta_2 U'(C_t) + \beta_3 U'(L_t)]/\alpha_3 \beta_2]$

A21. $\lambda_{2,t+1} = -[U'(L_t)/\beta_2]$

whose time first-differencing yields

A13. $\lambda_{1,t+1} - \lambda_{1,t} = -[U''(C_t)(dC_t/dt)/\alpha_3] + [\beta_3 U''(L_t)(dL_t/dt)/\alpha_3 \beta_2]$

A23. $\lambda_{2,t+1} - \lambda_{2,t} = -[U''(L_t)(dL_t/dt)/\beta_2]$

where dC_t/dt and dL_t/dt are the first differences of the implied variables with respect to time t. Equating A13 and A23 to A3 and A4, respectively, yields after some manipulation, the following pair

$$dC_t/dt = (\alpha_3/U''(C_t))\Big\{ [\beta_3 U''(L_t)(dL_t/dt)/\alpha_3 \beta_2] + (\theta_1 RP_t + \theta_2 Y_t) - [\alpha_2 U'(C_t)/\alpha_3] + [\alpha_2 U'(L_t)/\alpha_3 \beta_2] \Big\}$$

$$dL_t/dt = [\beta_2(\theta_1 RP_t + \theta_2 Y_t)/U''(L_t)] - [\alpha_1\beta_2 U'(C_t)/\alpha_3 U''(L_t)] - [\gamma U''(L_t)/\alpha_3\beta_2]$$

where $\gamma = \alpha_3\beta_1 + \alpha_1\beta_3$.

Substituting the second equation into the first and then solving for $dc_t = dC_t/dt - dL_t/dt$, the time derivative of percapita crime, yields

A5. $$dc_t = \{[(\alpha_3+\beta_3)/U''(C_t)] - (\beta_2/U''(L_t))\}(\theta_1 RP_t + \theta_2 Y_t) - [\alpha_1(\alpha_3+\beta_3)/\alpha_3(1-\nu)][U'(C_t)/U''(C_t)] + [\beta_3(\gamma\beta_2+\alpha_1\beta_3)/\beta_2][U'(L_t)/U''(C_t)] - [\alpha_1\gamma\beta_2 U'(L_t) - \alpha_1\beta_2 U'(C_t)]/\alpha_3 U''(L_t)$$

Since $U'(C_t)/U''(C_t) = -(C_t)/(1-\nu)$, substitution of this value into A5 and division of its RHS elements by L_t, to conform with percapita requirement imposed by use of dc_t, finally yields the following supply-of-crime equation

A6. $$dc_t = \{[(\alpha_3+\beta_3)/U''(C_t)] - (\beta_2/U''(L_t))\}(\theta_1 RP_t/L_t + \theta_2 Y_t/L_t) + [\alpha_1(\alpha_3+\beta_3)/\alpha_3(1-\nu)](C_t/L_t) + B$$

where $B = [\beta_3(\gamma\beta_2+\alpha_1\beta_3)/\beta_2][U'(L_t)/U''(C_t)] - [\alpha_1\gamma\beta_2 U'(L_t) - \alpha_1\beta_2 U'(C_t)]/\alpha_3 U''(L_t)$

Eq. A6 exactly corresponds to eq. IV of Sect.1. The term $(\alpha_3+\beta_3)/U''(C_t)]-(\beta_2/U''(L_t))$, which relates crime supply to both incentives (RP_t/L_t and Y_t/L_t), is expected to be negative if α_3, $\beta_2>0$ and $\beta_3<0$ and $|\alpha_3| > |\beta_3|$, or simply if $\alpha_3, \beta_2, \beta_3>0$. In addition, as a sufficient condition, we should have $U''(C_t) < U''(L_t)$, i.e. the marginal utility of crime falls at a more rapid pace than that of labor (crime 'pays' less than labor). Numerical experiments with available percapita data show that for the entire nation, on average, assuming $\nu = .05$, $U''(C_t) = -.004$ and $U''(L_t) = -.134$. The ratio does not significantly change for higher values of ν. Hence the entire term is outrightly negative, unless $|\alpha_3| \cong |\beta_3|$ and, adjusted by θ_1 and θ_2, theoretically corresponds to parameters ϕ_1 and ϕ_2 of eq. IV.

The term $\alpha_1(\alpha_3+\beta_3)/\alpha_3(1-\nu)$ represents the crime dynamics adjustment parameter ϕ_3 of eq. IV. Depending on the signs of $\alpha_3, \beta_2, \beta_3$ it may take a positive or negative value, but must in any case ensure by construction positive values of the steady-state crime stock (fn. 9). The constant term B, as constructed, is undefined in sign but irrelevant, especially in the light of fixed-effect panel estimation.