WP 54_13

Eleftherios Goulas
University of Patras, Greece

Athina Zervoyianni
University of Patras, Greece
The Rimini Centre for Economic Analysis (RCEA), Italy

THE GROWTH-CRIME RELATIONSHIP: ARE THERE ANY ASYMMETRIES?

The Growth-Crime Relationship: Are There any Asymmetries?

Eleftherios Goulas* and Athina Zervoyianni**

Department of Economics

University of Patras

University-Campus Rio 26504

Patras, Greece

July 2013

Abstract

We examine the relationship between crime and per-capita output growth in a panel of 26 countries for 1995-2009, focusing on the various channels through which crime can constrain growth and exploring the extent to which these channels are influenced by economic conditions. A simple structural growth model serves as a guide for the empirical specification and a reference point for the interpretation of the empirical results. Our estimates suggest significant potential gains from reducing crime during periods of worsening economic conditions, when market sentiments are pessimistic, and thus uncertainty regarding the return to saving is above average, employment is low, and the strain on government-sector resources through high public-safety spending is already sizable. Crime does not seem to be so harmful to growth when economic conditions are sufficiently satisfactory. In this respect, our results provide an explanation for the inconclusive empirical evidence, based on reduced-form models, regarding the strength of the growth-crime relationship.

Key words: economic growth; crime
JEL Classification: O47, Z13

_____

*Lecturer, Department of Economics, University of Patras, University-Campus Rio, Patras 26504, Greece, Tel.: +30 2610996271, Email: egoulas@upatras.gr

**Associate Professor, Department of Economics, University of Patras, University-Campus Rio, Patras 26504, Greece, Tel.: +30 2610996271, Email: athina@upatras.gr

1. Introduction

Crime imposes a burden on society and an extensive literature currently exists suggesting that the socio-economic costs of crime can be sizable (World Bank, 2006, 2007; Czabanski, 2008; European Commission, 2010). And while in most parts of the world crime rates are today lower compared to those recorded a few decades ago, a large fraction of the population in many countries still experiences crime every year. Moreover, public expenditures on crime prevention and law enforcement remain at high levels, crowding out other, more productive, types of government spending. At the same time, the decline in crime-related activity may not continue at the same pace in the coming years, given the reduction in incomes due to the recent fall in economic activity worldwide. In view of these developments, how crime impacts on economic growth becomes particularly important.

Although the importance of crime in determining a country's progress has long been recognized in the economic-policy literature, empirical studies have not yet produced a definite conclusion regarding the effect of crime on growth. Existing findings are contradictory, with some studies suggesting a strong adverse effect of crime on economic growth while other studies report evidence of no statistically significant impact. A recent World Bank study (World Bank, 2006), using a panel of 43 countries for 1975-2000, reports strong growth-reducing effects from higher crime rates even after controlling for a number of other factors affecting growth, including income inequality which is likely to be causally linked to crime. Càrdenas, 2007, also finds a statistically significant negative association between per-capita output growth and crime in a panel of 65 countries, after allowing for unobserved country-fixed effects and controlling for education and public infrastructure. On the other hand, Peri, 2004, using provincial-level crime data from Italy, reports results indicating non-linearities in the growth-crime relationship, with modest- and low-crime rates showing no statistically significant adverse impact on growth. Burnham *et al.*, 2004, in exploring the effect of central-city crime on US county-level (per-capita) income growth, report results in the same direction, indicating no clear overall growth-crime relationship, with the growth effect of property crime appearing to be weak or perverse. At the same time, Mauro & Carmeci, 2007, using data from 19 Italian regions for 1963-1995 and pooled-mean-group estimation techniques, find that crime impacts negatively on income levels but exerts no statistically significant adverse influence on growth rates. Chatterjee & Ray, 2009, using a large cross-country dataset for 1991-2005 and controlling for human capital and institutional quality, report similar results, as they find no strong evidence of a uniformly negative association between growth and crime, and this applies both to total crime and to sub-categories of crime. Dettoto & Otranto, 2010, applying an autoregressive model, in which GDP growth is explained by past GDP and a crime proxy, to monthly crime data for Italy for 1979-2002, also find a small annualized real-GDP-growth reduction due to crime, with their estimates indicating cyclical components in the growth-crime relationship.

These results suggest that, despite the growing empirical literature, the effects of crime on economic growth still are not well understood and that the growth-crime relationship is more complex

than often assumed in existing studies. Crime may affect growth through four key channels: (i) through lower physical- and human-capital productivity, by undermining confidence in the rule of law and thus discouraging innovation and entrepreneurship and the accumulation of knowledge via education; (ii) through the opportunity cost of public control of crime, as government-sector resources that could be used for productive activities, including education, health and infrastructure, are directed to crime prevention and law enforcement; (iii) through reduced labour supply, to the extent that some individuals are inclined to believe that income can be earned through illegal activities while others deliberately reject certain job types or job locations due to the fear of criminal victimization; (iv) through reduced savings due to less secure property rights, as high crime rates contribute to a general perception of instability and bad business climate. Much of the existing empirical literature uses reduced-form models that cannot shed light on the different channels via which crime impacts on growth and the extent to which the strength of these different channels are influenced by current economic conditions.

This paper adds to the growth literature by distinguishing between the various mechanisms through which crime may have an effect on economic growth and by exploring the sensitivity of the growth-crime relationship to changing economic conditions in an attempt to identify possible asymmetric effects. Using panel data from 26 countries covering the period 1995-2009, we find that the effect of crime on growth is indeed asymmetric: the growth-crime relationship is strongly negative in bad times, when market sentiments are pessimistic and thus uncertainty is high, employment is low and the strain on public-sector resources through public-safety spending is already sizable, and insignificant in good times. In this respect, our results provide an explanation for the inconclusive empirical evidence regarding the strength of the growth-crime relationship when using reduced-form models.

The rest of the paper is organized as follows. In Section 2.1 we identify a simple structural growth model, which serves as a guide for the empirical specification and a reference point for the interpretation of the empirical results, while in Section 2.2 we describe the empirical specification. Section 3 describes the data and presents the estimation results. Section 4 contains concluding comments.

2. Growth and crime

2.1. A simple structural model

Insights into how growth may be related to crime can be obtained by examining a simple growth model, with two private input factors, labour, L, and capital, K, along the lines suggested by Barro, 1990, Agénor, 2008, 2010, Blankenau *et al.*, 2007 and Bayraktar & Moreno-Dobson, 2010. In particular, resources claimed by the government can be put into productive uses, such as education, health and infrastructure, which enter into the production function by having the potential to improve the quality of all private input factors, and non-productive uses, such as expenditures on crime prevention and law

enforcement, which do not enter into the production function. Thus, assuming a constant-returns-to-scale technology with respect to L and K, output produced, Y, can be taken to be given by (1a):[1]

$$Y(t) = A g_p*^{\theta} (R_L L(t))^a (R_K K(t))^{(1-a)} \tag{1a}$$

with $\quad R_L = cr^{-\beta}, \quad R_K = cr^{-\delta}, \quad cr = (CR/N), \quad \theta > 0, \quad \beta, \delta \geq 0$

where A is a technology variable (assumed exogenous), $g_p* = (G_p / Y)$ represents productive public-sector spending, measured by the share of the corresponding government expenditures in GDP, and θ measures the return from such spending. R_L and R_K are labour-productivity- and capital-productivity-reducing factors, potentially related to the crime rate cr, to the extent that a high-crime environment is likely to reduce the workers' incentives to accumulate knowledge and enhance their skills as well as the firms' incentives to engage in innovative entrepreneurial activities. cr is defined as the number of crime incidents, CR, to total population N, while $-\beta$ and $-\delta$ reflect the potentially negative returns to output arising from the adverse impact of crime on private-input factors' productivity. Denoting by $y = (Y/N)$ and $k = (K/N)$ per capita output and per-capita capital respectively, output supplied can be expressed in per capita terms as:

$$y(t) = A g_p*^{\theta} cr^{-\gamma} l_p^{a} k(t)^{(1-a)} \tag{1b}$$

with $\gamma = \beta a + \delta(1-a) \geq 0$

where $l_p = (L/N)$ is the labour-force participation rate. To the extent that in a high-crime environment some individuals are likely to perceive that they can make a living by engaging in crime-related activities while others are likely to be reluctant to accept late-night jobs or activities and locations associated with high crime-victimization rates, l_p may fall as cr rises. Thus,

$$l_p = [1 - \phi(cr)] \tag{1c}$$

with $\phi' \geq 0$

At the same time, total government spending as percent of GDP, $g*$, consists of productive and non-productive expenditures $g_{np}*$, including expenditures on crime prevention and law enforcement that are likely to be positively related to the level of crime activity cr:[2]

$$g* = g_p* + g_{np}* \tag{1d}$$

$$g_{np}* = q(cr), \quad q' \geq 0 \tag{1e}$$

Accordingly, on the supply side, combining (1b) with (1c)-(1e), per-capita output is given as:

$$y(t) = A[g* - q(cr)]^{\theta} cr^{-\gamma} [1 - \phi(cr)]^a k(t)^{(1-a)} \tag{2}$$

---

[1] Following much of the recent growth literature, we model productive government spending as a flow variable. Alternatively, it could be specified as a stock variable, in which case g_p in (1a) would correspond to e.g. public investment as percent of GDP and a public-capital accumulation function would have to be added. This would complicate the model, while there would be little difference as far as steady-states were concerned (see e.g. Futagami *et al.,* 1993).

[2] To the extent that the size of government, as measured by the share of overall public spending in GDP, reflects socio-economic considerations and elements related to the decision-making process at the political level, $g*$ is treated as a policy variable, and so it is specified as time-invariant. Over time the government sets g to grow at the same rate as y, so $g*$ is constant.

On the demand side, in the absence of unexpected events, $y(t)$ is the sum of planned private consumption $c(t)$, total planned private investment $i(t)$, and overall government spending $g(t)$, all defined in per capita terms (i.e. $c = C/N, g = G/N, i = I/N$):

$$y(t) = c(t) + i(t) + g(t) \tag{3a}$$

The excess of households' income over consumption, $y(t) - c(t)$, equals private savings, $s(t)$, plus tax payments $\tau(t)$, while planned private investment consists of replacement investment and net additions to the (per capita) capital stock, i.e. $i(t) = (n + \delta) k(t) + \dot{k}(t)$ where δ is the depreciation rate of capital, $n = (dN/dt)(1/N)$ is the rate of population growth (assumed exogenous) and $\dot{k}(t) \equiv dk/dt$. Assuming further that agents save a proportion s_y of their after-tax income $y(t) - \tau(t)$, the equilibrium condition in the goods markets can be expressed as:[3]

$$[s_y(1 - \tau^*) + \tau^* - g^*] y(t) = (n + \delta) k(t) + \dot{k}(t) \tag{3b}$$

where both overall public spending, g^*, and government revenue, τ^*, are scaled in terms of (per capita) GDP. With no public debt,[4] increases in overall public spending to GDP must be financed by higher government revenue, so that

$$g^* = \tau^* \tag{3c}$$

At the same time, a high-crime environment may reduce savings, by undermining the security of property rights and by contributing to negative market sentiments and a general perception of uncertainty regarding the proceeds from savings. Thus, letting π be the probability that the return to savings will be insecure and taking π to be potentially related to the crime rate, cr, we can write:

$$s_y = \sigma_y(1 - \pi(cr)) \tag{3d}$$

with $\sigma_y > 0$, $0 \le \pi < 1$, $\pi' \ge 0$

From (3b)-(3d) and (2), it follows that the rate of capital accumulation $\gamma_k(t) \equiv \dfrac{\dot{k}(t)}{k(t)}$ will be given as:

$$\gamma_k(t) = \frac{\sigma_y(1 - \tau^*)[1 - \pi(cr)] A[\tau^* - q(cr)]^\theta cr^{-\gamma}[1 - \phi(cr)]^a}{k(t)^a} - (n + \delta) \tag{4}$$

with $\theta, a > 0$, $\pi', q', \phi', \gamma \ge 0$

---

[3] Note that since the excess of households' income over consumption equals private savings plus tax payments, we can write (3a) as $s_y(y - \tau) + \tau = i + g$ or $s_y\left(y - \dfrac{\tau}{y} y\right) + \dfrac{\tau}{y} y = i + \dfrac{g}{y} y$. Then, denoting by $\tau^* = \tau/y$ the ratio of tax revenues to GDP and substituting out i, we obtain (3b).

[4] The no-public debt assumption can easily be dropped without causing any substantive change in the results as long as debt sustainability is assumed. At the same time, for a number of countries in our sample, the option of debt-financed increases in government expenditures is severely constrained through the Maastricht-Treaty rules, or through national laws (e.g. the 'golden rule' in the UK, see Chote *et al.*, 2009).

Along the balanced-growth path, $\gamma_k(t) = 0$. Imposing this condition and using the resulting expression in (4) to substitute out k from (2), steady-state (per-capita) output, y_∞ is given as:

$$y_\infty = \left[\frac{A^{1/a}[\tau^* - q(cr)]^{\theta/a} cr^{-\gamma/a}[1-\phi(cr)]}{(n+\delta)^{(1-a)/a}} \right] \left(\sigma_y (1-\tau^*)[1-\pi(cr)] \right)^{(1-a)/a} \tag{5a}$$

Outside steady states, the path of (per capita) output is determined by the path of k. Letting $\psi(t)$ be the rate at which the (log of) per-capita capital, $\ln k(t)$, approaches (the log of) its steady-state value, $\ln k_\infty$, and denoting by $\ln y_o$ an initial steady-state (per-capita) output, then outside steady states we can write as an approximation (see e.g. Mankiw *et al.,* 1992; Bassanini & Scarpetta, 2001):

$$\ln y(t) - \ln y_\infty = e^{-(1-a)\psi(t)}(\ln y_o - \ln y_\infty) \tag{5b}$$

or

$$\ln y(t) - \ln y_o = (1 - e^{-(1-a)\psi(t)})(\ln y_\infty - \ln y_o) \tag{5c}$$

Upon substitution into (5c) of a linearized version of (5a) by taking derivatives, we can derive an output-growth equation of the form given by (6):

$$d\ln y(t) = -\upsilon(t)\ln y + \upsilon(t) F\left(A, \sigma_y, \ n+\delta, \ \tau^*, cr \right) \tag{6}$$

where

$$d\ln y(t) = \frac{\ln y(t) - \ln y_0}{t}, \quad \upsilon(t) = \frac{(1-e^{-(1-a)\psi(t)})}{t} > 0$$

and

$$F_A = \frac{1}{aA}, \ \ F_{\sigma_y} = \frac{a_1}{\sigma_y}, \ \ F_{n+\delta} = -\frac{a_1}{(n+\delta)}, \ \ F_{\tau^*} = -\left(\frac{1}{(1-\tau^*)} - \frac{\theta}{g_p^*(1-a)} \right) a_1, \ \ F_{cr} = F_{cr_1} + F_{cr_2} + F_{cr_3} + F_{cr_4},$$

$$F_{cr_1} = -q'\left(\frac{1}{\tau^* - g_{np}^*} \right) \theta_1, \ \ F_{cr_2} = -\pi'\left(\frac{1}{1-\pi} \right) a_1, \ \ F_{cr_3} = -\phi'(\frac{1}{l_p}), \ \ F_{cr_4} = -\gamma_1$$

$$a_1 = \frac{(1-a)}{a} > 0, \ \ \theta_1 = (\frac{\theta}{a}) > 0, \ \ \gamma_1 = \frac{\beta + \delta\alpha_1}{cr} \geq 0, \ \ q', \pi', \phi' \geq 0$$

F_A and F_{σ_y}, the partial derivatives of output growth with respect to technology and the saving rate respectively, are positive, while $F_{n+\delta}$ has a negative sign. F_{τ^*}, the partial derivative of output growth with respect to increases in tax revenues, will also have a negative sign if the adverse impact on capital accumulation of the fall in savings due to the tax-induced reduction in disposable income is large enough to outweigh any favourable output-effect resulting from the higher productive public spending which the additional government revenue can finance. F_{cr}, the partial derivative of output growth with respect to changes in the crime rate, reflects the four key channels through which the determinants of the growth-crime relationship operate. Firstly, for an unchanged government revenue τ^*, increased crime leading to higher public-safety expenditures will divert resources away

from productive uses, causing a fall in steady-state capital and lowering output growth between steady states ($F_{cr_1} < 0$). Other things equal, the reduction in growth will be larger the greater is the existing strain on public-sector resources (i.e. the larger is the initial level of non-productive government spending g_{np} *, including crime-related expenditures, relative to the overall government revenue τ *) and the greater is the opportunity cost of allocating public resources to crime prevention & law enforcement (i.e. the higher is the return to productive public expenditures, θ). Secondly, a higher level of crime activity, by contributing to a general perception of instability and negative market sentiments regarding the security of the return to saving, may cause a fall in growth through a reduced incentive to save ($F_{cr_2} < 0$). The higher is the existing level of uncertainty and of negative market sentiments, as measured by the size of π , the more insecure will be the perceived proceeds from savings following a rise in crime, and thus the larger the absolute magnitude of F_{cr_2} .Thirdly, increased crime is likely to induce individuals to devote a smaller fraction of their time to work, causing a reduction in output growth for a given (per-capita) stock of physical-capital ($F_{cr_3} < 0$). This growth-reducing effect will be more pronounced the greater is the existing shortage of labour resources in the economy and thus the smaller is the initial level of employment relative to overall population (i.e. the lower is l_p in F_{cr_3}). Fourthly, there may be an additional unfavourable influence, captured by $F_{cr_4} < 0$, arising from the productivity-reducing effect of crime, via disincentives to built up knowledge and produce innovative entrepreneurial ideas.

Accordingly, what (6) implies is that the strength of the growth-crime relationship may not be independent of the state of the economy. If the state of the economy is not particularly satisfactory, so that the strain on public-sector resources is already sizable, market pessimism and uncertainty is already high and employment is low, one can expect the terms $(\tau * - g_{np} *)$, $(1 - \pi)$ and l_p to be relatively small, in which case the partial derivatives F_{cr_1} , F_{cr_2} and F_{cr_3} will be large in absolute magnitude and the overall effect of crime on growth, measured by $F_{cr} = F_{cr_1} + F_{cr_2} + F_{cr_3} + F_{cr_4}$, will be strongly negative. In the opposite case, i.e. when economic conditions are satisfactory enough to imply relatively large magnitudes of $(\tau * - g_{np} *)$, $(1 - \pi)$ and (l_p) , the partial derivatives F_{cr_1} , F_{cr_2} and F_{cr_3} may well be small in size, in which case higher crime will operate mainly through the productivity-reducing effect F_{cr_4} , thus causing a much more limited overall response of growth.

2.2. Empirical specification

Given (6), the empirical specification we use corresponds to the following model:

$$\left(growth\right)_{j,t} = \delta_1 \ln\left(y\right)_{j,t-1} + \delta_2\left(saving\right)_{j,t} + \delta_3\left(revenue\right)_{j,t} + \delta_4\left(human\right)_{j,t} + \delta_5\left(crime\right)_{j,t} + \delta_6\left(crime*pessimism\right)_{j,t} +$$

$$+ \delta_7\left(crime*low\ employment\right)_{j,t} + \delta_8\left(crime*high\ spending\right)_{j,t} + \sum_{t=1995}^{2009} \tau_t\left(year\right) + \mu_j + \varepsilon_{j,t}$$

$$(7)$$

The $\delta_i's, \tau_i's$ are unknown constant parameters to be estimated, μ_j represents unobserved country-fixed effects and ε is an unobserved spherical disturbance term. The dependent variable, $\left(growth\right)_{j,t}$, is real (per-capita) output growth, while $\ln\left(y\right)_{j,t-1}$, the lagged value of (the logarithm of) GDP per capita, will enter the regression with a negative coefficient δ_1 if conditional convergence applies.[5] $\left(saving\right)_{j,t}$ and $\left(revenue\right)_{j,t}$ represent, respectively, the savings rate and the government revenue to GDP ratio. Thus, we expect $\delta_2 > 0$, $\delta_3 \lessgtr 0$. In line with much of the empirical growth literature, human capital, $\left(human\right)_{j,t}$, is also added as a separate explanatory variable, with the corresponding coefficient δ_4 expected to be positive. We further include time dummies to control for world-wide growth of technology, as well as for other common shocks across countries that might have taken place during the period under consideration, such as monetary-policy changes, including the circulation of the euro. $\left(crime\right)_{j,t}$ is the crime-activity proxy, while $\left(crime*pessimism\right)_{j,t}$, $\left(crime*low\ employment\right)_{j,t}$ and $\left(crime*high\ spending\right)_{j,t}$ are interaction terms representing, respectively, the case of negative market sentiments and thus higher than average uncertainty regarding the proceeds from saving, low employment and high-strain on public-sector resources.

In particular, to examine possible asymmetries in the growth-crime relationship, we proceed by constructing three dummies[6], defined as follows: i) $\left(pessimism\right)_{j,t}$, takes the value of 1 when the percentage annual change of an economic sentiment indicator of a country j in year t is negative, implying that market sentiment and thus uncertainty in the current period is deteriorating relative to the previous period; ii) $\left(low\ employment\right)_{j,t}$, equals the value of 1 when the employment (in industry) to population ratio of a country j in year t is below the median value obtained from the distribution of all countries; iii) $\left(high\ spending\right)_{j,t}$, attains the value of 1 when

---

[5] According to the conditional convergence hypothesis, when macroeconomic policies and other key characteristics across countries and over time are accounted for, low/high levels of income per capita are associated with higher/ lower growth rates in subsequent years.
[6] For studies measuring asymmetries in the same way see e.g. Drakos & Goulas, 2006; Drakos & Kallandranis, 2007 and Guariglia *et al.*, 2013.

the public-order & safety spending to GDP ratio of a country j in year t is above the median value obtained from the distribution of all countries.

Taking into account the key channels through which the growth-crime relationship may operate noted in Sections 1 and 2.1, we anticipate the coefficients on the three interaction terms in (7) to be negative. Thus, under a switch to market sentiments of pessimism, low employment and high public-order & safety spending, the overall responsiveness of growth to increased crime will be given by the sum $\delta_5 + \delta_6 + \delta_7 + \delta_8$. Rejecting the joint hypothesis $H_o : \delta_6 = \delta_7 = \delta_8 = 0$ in favour of the alternative that at least one parameter is significantly negative would provide evidence of asymmetries in the growth-crime relationship, depending on current economic conditions. At the same time, rejecting the hypothesis $H_o : \delta_5 + \delta_6 + \delta_7 + \delta_8 = 0$ in favour of the alternative that the sum of these four coefficients is strongly negative would imply that, under the operation of all four channels, increased crime can severely constrain economic growth.[7]

3. Description of the data and estimation results

We employ a dataset of 26 countries[8] during the period 1995-2009. Following a common practice in the literature (Peri, 2004; World Bank, 2006; Càrdenas, 2007; Detotto & Otranto, 2010), we proxy crime activity using data on intentional homicides per 100,000 population. The data are provided by the *United Nations Office on Drugs and Crime* (*UNODC*). This crime measure possesses the advantage of being the most reliable among other UN crime indicators, as it has the same definition throughout the period under consideration. Moreover, compared to other crime types, it is less likely to be subject to under-reporting bias in a cross-country context, while at the same time it is usually highly correlated with most of the other sub-categories of crime.

Data from the World Bank (*World Development Indicators*) are used to construct real (per capita) output growth (annual percentage change of GDP per capita, US$ constant (2005, PPP) prices), the savings variable, which is proxied by the share of gross domestic savings to GDP, and the human -capital variable, proxied by the ratio of gross tertiary enrolment to the population of the corresponding age group. Data on (general) government revenue come from the IMF (*World Economic Outlook*), which includes tax receipts, social security contributions, grants receivable, and other forms of revenue. Series on public-order & safety spending are constructed from IMF data (*Government Financial Statistics database, GFS*), while the employment (in industry) to population ratio is calculated using data from the International Labour Organization (*Key Indicators of the Labour Market, KILM*). Finally, data on the (seasonally-adjusted) *Economic Sentiment Indicator*

---

[7] Population growth has not been included as an explanatory variable in (7) as the corresponding series for the sample we consider shows little variation across countries and over time.

[8] Australia, Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom, United States. The country sample follows from data availability for all variables and the objective to have economies with different per-capita income levels but not very dissimilar institutional characteristics.

(*ESI*) provided by Eurostat (*Business & Consumer Surveys,* Economic and Financial Affairs of the EU) are employed to construct a proxy for changing market-sentiments and thus perceived uncertainty regarding the proceeds from savings. The *ESI* is a survey-based composite expectations index, reflecting the opinions regarding the state of the economy, and negative (positive) changes in this index can be taken to represent pessimistic (optimistic) expectations regarding future macroeconomic conditions.[9] This measure of perceived changes in economic conditions can be considered preferable to other indicators to the extent that it is highly forward-looking by being based on surveys of market opinions.[10]

Graph 1 shows the evolution of the mean crime rate for the countries in our sample during 1995-2009, while Graph 2 shows the corresponding series for mean GDP per capita. Crime has fallen on average since 1995, with the sharpest decline occurring in 1999, although the declining trend has been reversed between 2000 and 2001 and from 2008 onwards. From Graphs 1 and 2, there is evidence of a roughly negative relationship between increases in mean per capita GDP and mean crime, with periods of falling crime appearing to correspond on average to periods of rising GDP per capita and vice versa. Graph 3 shows mean changes in the *ESI* by year for the countries in our sample during the period 1995-2009, while Graphs 4 and 5 show, respectively, the behaviour over time of the mean employment-to-population ratio and the mean public-order & safety-spending to GDP. Graph 3 indicates volatile market sentiments from 1995 until 2008, corresponding to short-run fluctuations in economic activity, but deteriorating market sentiments from 2008 onwards. There is also evidence of a falling labour-force-participation ratio after 2007. At the same time, Graph 5 indicates that public-order & safety-spending as percent of GDP has significantly increased in the last few years. Table 1 reports the statistical properties of the dataset.

[Graphs 1-5 & Table 1 about here]

Equation (7) has been estimated by applying the system-GMM technique (Arellano & Bover, 1995; Blundell & Bond, 1998, 2000). This technique is extensively used in panel-data growth studies to allow for unobserved panel heterogeneity and simultaneously control for endogeneity bias arising from the possibility that one or more of the explanatory variables in growth regressions may not be strictly exogenous (see e.g. Bond *et al.*, 2001; Hoeffler, 2002; Guariglia & Poncet, 2008; Saidi & Aloui, 2010; Yamarik, 2010; Rooth & Stenberg, 2012; Christiansen *et al.*, 2013; Aisen & Veiga, 2013). Indeed, a common feature of most empirical growth models is that causation between the dependent and the right-hand-side variables may run in both directions, leading to endogeneity bias. In the system-GMM, suitably lagged levels and lagged first-differences of right-hand-side variables are used as instruments, ensuring that the estimates reflect causation running from the right-hand-side variables to the dependent variables and not vice versa. In our growth regressions,

---

[9] For Australia, Ireland, Israel, Japan, Norway, Switzerland and the USA, we resort to the (amplitude-adjusted) Composite Leading Indicator (*CLI*) obtained from the monthly indicators of the OECD database

[10] For alternative measures of perceived changes in economic conditions in a growth-crime context see e.g. Goulas & Zervoyianni, 2013.

given that most of the explanatory variables, including the crime rate, $(crime)$, may in principle be affected by per-capita output growth, all right-hand-side variables, except the time dummies, have been treated as potentially endogenous and have been accordingly instrumented. The statistical adequacy of the model is established when the generated residuals do not exhibit second-order autocorrelation and the over-identifying restrictions are not rejected.

Estimation results are shown in Table 2 below. Model (1) shows estimates without controlling for influences arising from the state of the economy, while Models (2)-(4) report estimates after controlling for such influences.

[**Table 2, about here**]

In all models, the estimates show a statistically significant positive effect on growth of savings and human capital and a negative effect of higher government revenue, consistent with the results of other studies (Bassanini & Scarpetta, 2001; Morgese-Borys *et al.,* 2008; Afonso & Furceri, 2010; Gemmell *et al.,* 2011; Barro & Redlick, 2011). The coefficient on lagged per-capita GDP is also negative and significant, indicating conditional convergence for the set of countries and time period we consider. Moreover, in all columns, the Sargan test of over-identifying restrictions confirms the joint validity of the instruments used, indicating that the model is well specified. The hypothesis of no second-order serial correlation is also not rejected.

As far as the effect of crime is concerned, Model (1) indicates a negative, although not particularly strong, relationship between per capita output growth and the crime proxy, with the coefficient on $(crime)$ being significant at the 5% level.

In Models (2)-(4), we examine the occurrence of asymmetric effects regarding the growth-crime relationship, stemming from different assumptions as to: i) market sentiments regarding future macroeconomic conditions and thus the degree of uncertainty regarding the proceeds from saving, ii) the employment-to-population ratio in the economy, and iii) the strain on public-sector resources. We thus augment Model (1) by the interaction terms $(crime*pessimism)$, $(crime*low\ employment)$ and $(crime*high\ spending)$.

In Model (2), where the influence of changing market sentiments is accounted for, the coefficient on the interaction term δ_6 is negative and highly significant suggesting that the growth-crime elasticity depends on the degree of pessimism regarding future economic conditions. In particular, under a switch to more pessimistic expectations regarding the state of the economy, and thus the proceeds from saving, the overall effect of crime on growth is given by the sum $\delta_5 + \delta_6$ (-0.0078) and we emphatically reject the hypothesis that the sum of these coefficients equals zero (Hypothesis 1). On the other hand, under a switch to more optimistic expectations, the overall effect of crime is given by the coefficient on $(crime)$, which is significant at the 5% level and equals -0.0037. Determining the relative magnitude of the two coefficients, our results indicate that the

crime effect on growth conditional on optimistic expectations is 47% of the corresponding effect conditional on pessimistic expectations. Thus, pessimistic market sentiments provide a significant amplification mechanism for the adverse effect of crime on growth through the riskiness of savings.

In Model (3), where the effect of low employment is controlled for, both the coefficient on $(crime)$ and the coefficient on the interaction term $(crime * low\ employment)$ are statistically significant, giving an overall growth-effect of crime of $\delta_5 + \delta_7$ (-0.0074), with the hypothesis that the sum of these coefficients equals zero again being strongly rejected (Hypothesis 2). On the other hand, when the employment-to-population ratio in the economy is higher than average the overall effect of crime on growth is given by the coefficient on $(crime)$, which is significant only at the 10% level and equals -0.0037. The crime effect on growth conditional on low employment is twice as large as the corresponding effect conditional on high employment, indicating that there is an asymmetric reaction of economic growth to crime depending on the use of labour resources in the economy.

In Model (4), where public-sector-resource strain is taken into account, the coefficient on $(crime)$, while it loses its significance at standard levels, still has a negative sign. Moving now to the interaction term, we document a negative and significant coefficient at the 5% level, rejecting the hypothesis that the sum of coefficients $\delta_5 + \delta_8$ (-0.0045) equals zero (Hypothesis 3). Thus, when public-safety spending is higher than average, the overall effect of crime on growth is 44 times larger, signifying another asymmetric source through which crime could be harmful to growth.

Finally, in Model (5) we present the results from the joint estimation of all sources of potential asymmetry, i.e. all three interaction terms are included. The coefficients on the interaction terms are statistically significant indicating that all sources of asymmetries are in operation. Assuming a switch to market sentiments of pessimism and thus higher uncertainty, a low level of employment and a high level of public-order & safety expenditures relative to GDP, the overall growth-effect of crime amounts to $\delta_5 + \delta_6 + \delta_7 + \delta_8$ (-0.0113). This finding suggests that if we jointly consider all factors that affect the growth-crime elasticity, the adverse effect of crime on growth is much amplified in terms of magnitude. Here, we emphatically reject the hypothesis that the sum of these coefficients equals zero (Hypothesis 4) as well as the hypothesis $H_0 : \delta_6 = \delta_7 = \delta_8 = 0$, i.e. that jointly the coefficients of the asymmetric terms equal zero (Hypothesis 5). This means that under the operation of all asymmetric factors, the effect of crime on growth is negative, highly significant, and of the largest magnitude compared to Models (2)-(4). On the contrary, when all dummies attain the value of zero i.e. under the assumption of optimistic market sentiments, high employment and low public-order & safety expenditures to GDP, the growth-crime elasticity is given by δ_5 (0.0018), which is positive but statistically insignificant at conventional levels.

Overall, the results in Table 2 suggest that the growth effect of crime is strongly asymmetric in that the state of the economy matters: crime reduces growth in 'bad times', when expectations regarding future economic conditions worsen, aggregate employment is low and the strain on public-sector resources resulting from public-safety spending is already sizable. Crime does not seem to be harmful to growth when economic conditions are sufficiently satisfactory, i.e. when the growth-crime relationship operates mainly through private-input factors' productivity.

This finding has important policy implications. Since the global economic crisis of 2008-2009 and the European debt crisis of 2009-2011, market pessimism regarding macroeconomic performance and thus perceived uncertainty regarding the return to savings, in many countries has increased. Also, labour-market performance remains fragile, with many economies currently showing lower employment levels compared to those in previous years. Moreover, the strain on public-sector resources has recently become more pronounced, as many countries have set constraints on overall public expenditures, either as part of area agreements, such as the Stability & Growth Pact in Europe, or in an attempt to avoid rising interest rates on public debt and speculative attacks on their currencies. At the same time, given the recent slowdown in economic activity worldwide, the opportunity cost of engaging in crime-related activities has fallen for a number of individuals who have experienced a reduction in income, so increased crime is a possibility. The combined effect of a pessimistic market environment, lower-than-average employment and higher-than-average strain on public-sector resources may well be a further slowdown in economic growth due to crime in the coming years.

4. Concluding comments

Despite the fact that the importance of crime in determining a country's economic progress has long been recognized both among policymakers and in academic circles, the existing empirical evidence on the growth-crime relationship is inconclusive: while some studies present results suggesting a strong adverse influence of crime on growth, other studies report evidence indicating a weak negative effect or no effect at all. Much of this literature is based on reduced-form models that cannot shed light on the different channels via which crime impacts on growth and the extent to which the strength of these different channels are influenced by current economic conditions.

We do not find a general strong negative relationship between per-capita output growth and crime. This is because, in addition to its potentially adverse effect on private-input factors' productivity, increased crime raises the level of insecurity in the economy and this is more likely to reduce growth i) the higher is the initial level of uncertainty regarding the perceived return to savings, and thus the more pessimistic are market sentiments regarding the future state of the economy, ii) the higher is the existing opportunity cost of financing the required crime-prevention & law-enforcement expenditures, and iii) the smaller is workers' opportunity cost of engaging in crime-related activities and therefore the lower is aggregate employment. Indeed, taking explicitly into

account the major channels linking growth to crime, we find evidence suggesting significant potential gains from reducing crime in 'bad times', i.e. during periods of worsening economic conditions, when the strain on public-sector resources resulting from already large public-safety expenditures is significant, when the existing employment-to-population ratio is below average and when the state of expectations is getting worse. Under such circumstances, our estimates imply that countries could raise per capita output growth by about one percent per year if they were to reduce crime rates by 10 percent.

REFERENCES

Afonso, A. and Furceri, D., 2010. Government Size, Composition, Volatility and Economic Growth, European Journal of Political Economy. 26(4), 517-532.

Agénor, P.R., 2008. Health and Infrastructure in a Model of Endogenous Growth. Journal of Macroeconomics. 30(4), 1407-1422.

Agénor, P.R., 2010. A Theory of Infrastructure-led Development. Journal of Economic Dynamics and Control. 34(5), 932-950.

Aisen, A. and Veiga, F.J., 2013. How Does Political Instability Affect Economic Growth?. European Journal of Political Economy. 30(1), 151-167.

Arellano, M.and Bover, O., 1995. Another Look at the Instrumental Variable Estimation of Error-Component Models. Journal of Econometrics. 68(1), 29-45.

Barro, R.,1990. Government Spending in a Simple Model of Endogenous Growth. Journal of Political Economy. 98(5), 103-125.

Barro R.J. and Redlick C.J., 2011. Macroeconomic Effects from Government Purchases and Taxes. Quarterly Journal of Economics. 126(1)**,** 51-102.

Bassanini, A.and Scarpetta,S., 2001. The Driving Forces of Economic Growth: Panel Data Evidence for the OECD Countries. OECD Economic Studies No. 33.

Bayraktar, N. and Moreno-Dodson, B., 2010. How Can Public Spending Help You Grow? An Empirical Analysis for Developing Countries. Policy Research Working Paper No. 5367, World Bank.

Blankenau, W., Simpson N. and Tomljanovich, M., 2007. Public Education Expenditure, Taxation, and Growth: Linking Data to Theory. American Economic Review. 97(2), 393-397.

Blundell, R. and Bond, S.,1998. Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. Journal of Econometrics. 87(1), 115-143.

Blundell, R.and Bond, S.,2000. GMM Estimation with Persistent Panel Data: An Application to Production Functions. Econometric Reviews. 19(3), 321-340.

Bond, S.R., Hoeffler, A. and Temple, J., 2001. GMM Estimation of Empirical Growth Models. CEPR Discussion Paper No. 3048. Centre for Economic Policy Research, London, UK.

Burnham, R., Feinberg R. and Husted, T., 2004. Central City Crime and Suburban Economic Growth. Applied Economics. 36(9), 917-922.

Càrdenas, M., 2007. Economic Growth in Columbia: A Reversal of Fortune? Ensayos Sobre Poltíica Económica. 25(53), 220-259.

Chatterjee, I.and Ray, R., 2009. Crime, Corruption and Institutions. Working Paper No. 20, Monash University.

Chote, R., Emmerson C. and Tetlow, G., 2009.The Fiscal Rules and Policy Framework. In R.Chote, C.Emmerson, D.Miles and J.Shaw (eds.),The IFS Green Budget, January 2009. Institute for Fiscal Studies, UK.

Christiansen, L. Schindler, M. and Tressel, T., 2013. Growth and Structural Reforms: A New Assessment. Journal of International Economics. 89(2), 347-356.

Czabanski, J., 2008. Estimates of Costs of Crime: History, Methodologies and Implications. Springer, Berlin.

Detotto, C. and Otranto, E., 2010. Does Crime Affect Economic Growth? Kyklos. 63(3), 330-345.

Drakos, K. and Goulas, E., 2006. Investment and Conditional Uncertainty: The Role of Market Power, Irreversibility and Returns-to-Scale. Economics Letters. 96(2), 169-175.

Drakos, K. and Kallandranis, C., 2007. State-Dependent Response of Investment to Cash Flow: Evidence for Asymmetry in European Manufacturing. Applied Financial Economics. 17(14), 1191-1200.

European Commission, 2010. Review of Costs of Crime Literature. Available at http://www.costsofcrime.org/AnnotedBibliography.php.

Futagami, K., Morita, Y. and Shibata, A., 1993. Dynamic Analysis of an Endogenous Growth Model with Public Capital. Scandinavian Journal of Economics. 95(4), 607-625.

Gemmell, N., Kneller, R. and Sanz, I., 2011. The Timing and Persistence of Fiscal Policy Impacts on Growth: Evidence from OECD Countries. Economic Journal. 121(1), 33-58.

Goulas, E. and Zervoyianni, A., 2013. Economic Growth and Crime: Does Uncertainty Matters? Applied Economics Letters. 20(5), 420-427.

Guariglia, A. and Poncet, S., 2008. Could Financial Distortions be no Impediment to Economic Growth after All? Evidence from China. Journal of Comparative Economics. 36(4), 633-657.

Guariglia, A., Tsoukalas, J., and Tsoukas, S., 2013. Investment, Irreversibility and Financing Constraints: Evidence from a Panel of Transition Economies. Economics Letters. 117(3), 582-584.

Hoeffler, A., 2002. The Augmented Solow Model and the African Growth Debate. Oxford Bulletin of Economics and Statistics. 64(2), 135-158.

Mankiw, G., Romer D. and Weil, D., 1992. A Contribution to the Empirics of Economic Growth. Quarterly Journal of Economics. 107(2), 407-437.

Mauro, L. and Carmeci, G., 2007. A Poverty Trap of Crime and Unemployment. Review of Development Economics. 110(3), 681-712.

Morgese-Borys, M., Polgàr É.K. and Zlate, A., 2008. Real Convergence and the Determinants of Growth in EU Candidate and Potential Candidate Countries-A Panel Data Approach. ECB Occasional Paper No. 86.

Peri, G., 2004. Socio-Cultural Variables and Economic Success: Evidence from Italian Provinces 1951-1991. The B.E. Journal of Macroeconomics. 4(1), 1-34.

Rooth, D. and Stenberg, A., 2012. The Shape of the Income Distribution and Economic Growth: Evidence from Swedish Labor Market Regions. Scottish Journal of Political Economy. 59(2), 196-223.

Saidi, H. and Aloui, C., 2010. Capital Account Liberalization and Economic Growth: GMM System Analysis. International Journal of Economics and Finance. 2(5), 122-131.

Yamarik, S., 2010. Human Capital and State-Level Economic Growth: What is the Contribution of Schooling? Annals of Regional Science. 47(1), 195-211.

World Bank, 2006. Crime, Violence and Economic Development in Brazil: Elements for Effective Public Policy. Report No. 36525. World Bank, Washington D.C.

World Bank, 2007. Crime, Violence and Development: Trends, Costs and Policy Options in Caribbean. Report No. 37820. World Bank, Washington D.C.

Table 1. Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
GDP per capita growth	285	0.0236	0.0342	-0.1427	0.1207
savings rate	285	0.2294	0.0641	0.0919	0.4175
government revenue to GDP	285	0.4281	0.0800	0.2791	0.5853
human capital	285	0.6043	0.1306	0.2658	0.9507
crime rate	285	2.1677	2.4083	0.4000	15.1000
public–order & safety spending to GDP	285	0.0172	0.0042	0.0062	0.0293
annual (percentage) change in the ESI	285	-0.0130	0.0735	-0.2332	0.1728
employment in industry to population	285	0.1439	0.0236	0.0953	0.2129

Notes: The sample consists of 26 countries over the period 1995-2009. All variables are expressed in percentage terms except the crime rate, which is defined as intentional homicides per 100,000 persons.

Table 2. System-GMM estimates of the growth model. Dependent variable $(growth)_{j,t}$.

| Regressors	Model 1	Model 2	Model 3	Model 4	Model 5
$\ln(y)_{j,t-1}$	-0.0735***	-0.0725***	-0.0679***	-0.0767***	-0.0623***
	(-3.94)	(-4.03)	(-3.34)	(-3.77)	(-3.36)
$(saving)_{j,t}$	0.4663***	0.4709***	0.4129***	0.4647***	0.3724***
	(3.65)	(3.68)	(3.19)	(3.40)	(3.10)
$(revenue)_{j,t}$	-0.3468***	-0.3478***	-0.3451***	-0.3677***	-0.3213***
	(-2.62)	(-2.75)	(-2.72)	(-2.66)	(-2.70)
$(human)_{j,t}$	0.1411***	0.1403***	0.1383***	0.1481***	0.1192***
	(3.99)	(4.11)	(3.60)	(3.63)	(3.76)
$(crime)_{j,t}$	**-0.0041****	**-0.0037****	**-0.0037***	**-0.0001**	**0.0018**
	(-2.28)	**(-2.39)**	**(-1.80)**	**(-0.06)**	**(0.63)**
$(crime*pessimism)_{j,t}$	-	**-0.0041*****	-	-	**-0.0044*****
		(-4.74)			**(-4.78)**
$(crime*low\ employment)_{j,t}$	-	-	**-0.0037*****	-	**-0.0047*****
			(-2.89)		**(-4.48)**
$(crime*high\ spending)_{j,t}$	-	-	-	**-0.0044****	**-0.0040****
				(-2.17)	**(-2.05)**
Observations	285	285	285	285	285
m_1	-2.48**	-2.57**	-2.37**	-2.43**	-2.49**
m_2	0.40	1.20	0.27	0.99	0.97
Sargan Test	121.62	144.26	135.65	121.63	161.03
	(p-val. 0.94)	(p-val. 0.52)	(p-val. 0.72)	(p-val. 0.93)	(p-val. 0.16)
(1) $H_0 : \delta_5 + \delta_6 = 0$	-	$x^2 = 15.94$***	-	-	-
(2) $H_0 : \delta_5 + \delta_7 = 0$	-	-	$x^2 = 15.52$***	-	-
(3) $H_0 : \delta_5 + \delta_8 = 0$	-	-	-	$x^2 = 6.56$**	-
(4) $H_0 : \delta_5 + \delta_6 + \delta_7 + \delta_8 = 0$	-	-	-	-	$x^2 = 23.76$***
(5) $H_0 : \delta_6 = \delta_7 = \delta_8 = 0$	-	-	-	-	$x^2 = 41.01$***

Notes: Numbers in parentheses denote z-scores, m_1 and m_2 are residual first and second order serial correlation tests, while Sargan stands for the over-identifying restrictions test. One, two, three asterisks denote significance at the 10, 5, and 1 percent level respectively. All models allow for robust standard errors. Time dummies are included in all specifications.
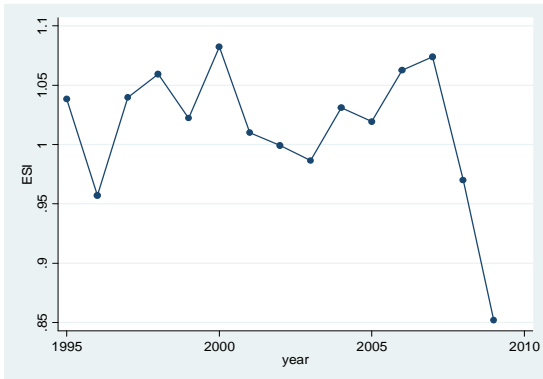
GRAPHS

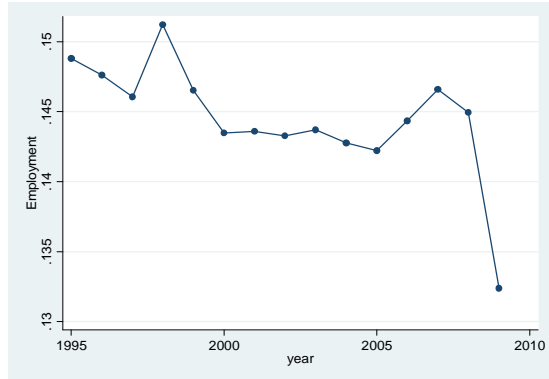**Graph 1.** Mean GDP per capita by year
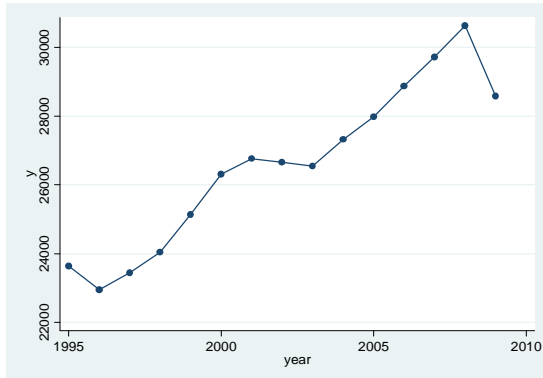
Graph 2. Mean crime rate by year
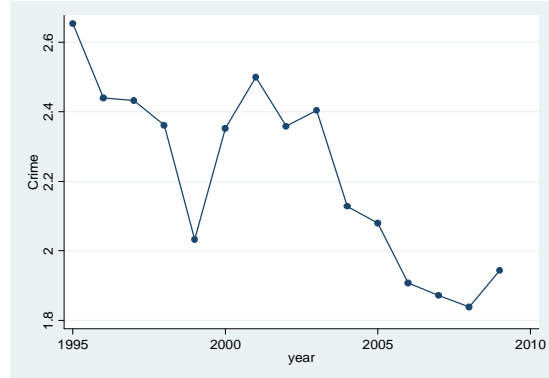
Graph 3. Mean Economic Sentiment Indicator by year

Graph 4. Mean employment-to-population ratio by year

Graph 5. Mean public-order & safety spending to GDP ratio by year