Discussion Paper Series

Crime, Fertility, and Economic Growth: Theory and Evidence

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February 2012
Number 163

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Abstract

This paper studies the link between crime and fertility and the way by which they jointly impact on economic growth. In a three-period overlapping generations model, where health status in adulthood depends on health in childhood, adult agents allocate their time to work, leisure, child rearing and criminal activities. An autonomous increase in the probability offenders face in escaping apprehension, increases both crime and fertility non-monotonically, giving rise to an ambiguous effect on growth. A cross-country empirical examination, based on data that span four decades, supports the non-linear effects on both crime and fertility. At the same time, it reveals a negative effect on output growth.

Keywords: Apprehension risk; Crime; Fertility; Growth; Non-linearities
JEL Classification Numbers: C23; C33; I12; J13; J22; K42; O41

Contents

1 Introduction

It is well-recognised that criminal activity can influence the pace of economic growth. The channels of transmission include, but are not limited to, a direct rise in the cost of doing business, a decline in competitiveness, a discouragement of foreign investment, a diversion of (private and public) funds toward crime prevention activities that reduce productive capacity, and a limited investment in human capital accumulation. At the same time, the unified growth theory has emphasized the role of fertility and demographic transition, more generally, as an important element of the transition in economic growth regimes. The economic growth literature, however, has treated crime and fertility considerations as independent and unrelated drivers of the growth process. This is so, despite the observed positive association between population growth and crime both at the city and country levels. To account for this stylised fact, in this paper, we build a unifying framework where we examine the link between crime and fertility and, subsequently, their joint influence on economic growth. This link is offered by the probability of crime apprehension, or inversely, the likelihood of escaping criminal arrest.

There is a long-established relationship between the probability of apprehension and criminal outcomes. The seminal contribution by Becker (1968) postulates that a rational individual's decision to engage in criminal activities is a function of the expected returns to crime and the returns to legitimate market opportunities. Optimizing agents have a higher incentive to participate in criminal activity when the financial rewards from crime exceed those obtained from legal work. According to Becker (1968), this would be the case in response to a lower probability of apprehension and conviction, a less severe punishment, and lower legal real wages, other things equal. More recently, Imrohoroglu et al. (2004, 2006) and Engelhardt et al. (2008) by calibrating their models to U.S. property crime data, have stressed that the most important factor for observed changes in crime rates is the apprehension probability. This finding has also received strong empirical support both for the U.S. and across countries. Many studies have shown that increases in the probability of apprehension and punishment, achieved by greater government expenditure on security or a greater number of security officers, decreases the expected return of crime and, therefore, crime (Corman and Mocan (2000), Levitt (2004), Di Tella and Schargrodsky (2004), Evans and Owens (2007), Draca et al. (2011), and Harbaugh et al. (2011)). It is, therefore, the conviction of this line of studies that the likelihood of arrest influences economic growth via its effect on crime rates.

From the perspective of development theorists, central role in economic growth is played by fertility decisions. According to them, a demographic transition represents the underlying mechanism of the passage from a near-zero steady state growth regime to a positive steady state growth regime. The mechanism that allows for this transition dates back to Becker (1960) and features the quantity-quality trade-off for children. The trade-off derives from the assumption that parental utility is a function of both the number of children and of their education or human capital. Since both rearing and educating children are costly, a trade-off between these two activities arises. In this environment, a decline in mortality makes investment in children's human capital more attractive, leading parents to substitute child quantity for child quality. The simultaneous accumulation of human capital and decline in fertility provides a link between transitions in demography and growth. Various versions of this argument has been developed by Galor and Weil (1999), Kalemli-Ozcan (2003), and Falcao and Soares (2008). More recently, Bhattacharya and Qiao (2007) and Agénor (2009) have considered human capital development as a function of investments in health.

This paper jointly studies the connection between crime rates and fertility rates. It then examines the way via which these two variables affect economic growth. In this way, the analysis offers a combination of the two above-mentioned literatures. Thus, this paper can be thought of as combining two pioneering works of Becker (1960, 1968) to illustrate that crime and fertility outcomes are jointly determined by the probability of avoiding apprehension. This is done by developing a theoretical framework and by testing empirically its implications.

To our knowledge, the only study that has tried to (empirically) establish a link between crime and fertility is Gaviria and Pagés (2002). Using crime victimization data for 17 Latin American countries they suggest that higher population growth at the city level raises crime victimization rates. They interpret this finding as being causal, hypothesizing that higher city growth diminishes the effectiveness of law enforcement institutions. Our study, in turn, finds this positive relationship not to be causal but rather an equilibrium outcome stemming from the lower effectiveness of law enforcement, as this is proxied by the higher probability of criminals escaping apprehension.

Our theoretical model comprises two basic relationships. The first relates the probability of escaping apprehension to the level of crime. The second connects the probability of escaping apprehension to child-bearing decisions. In this way, the model illustrates the idea that crime rates and fertility rates are endogenously determined. Their relationship depends on the way the individual (time allocation) and the institutional factors (probability of arrest) that determine outcomes on an individual level, aggregate across the population.

The model contributes to the literature by generating three important results. First, by identifying a non-linear effect of escaping the probability of arrest on criminal activity so that the likelihood of escaping apprehension has a positive effect on crime only after a critical probability threshold. Second, by illustrating that fertility responds positively to higher values of the probability of escaping arrest. Third, by showing that the effect of the apprehension probability on economic growth is ambiguous.

The predictions of the model are then subjected to an empirical evaluation. The empirical analysis considers up to 90 countries with the use of panel data for the period 1970-2008. The methodology utilises both reduced form estimations and joint estimations of the crime, fertility and growth equations. Our results offer support to the theoretical implications as they show a non-monotonic effect of the likelihood of escaping arrest and conviction on crime, with the effect turning positive above a probability in the range of 10-30%. Above this threshold value, we also find evidence of a positive impact of the probability of escaping apprehension on fertility. Further, the effect of this probability on growth is negative, corroborating the studies that document a negative relationship between crime and economic performance.

The remainder of the paper is organised as follows. Section 2 presents the theoretical analysis, setting out and solving our model economy to establish the key implications. Section 3 contains the empirical analysis, describes our methodology and data, presents our main findings and reports the results of various sensitivity checks. Section 4 contains a few concluding remarks.

2 Theory

Consider an OLG economy in which activity extends over an infinite discrete time period. In every period one homogeneous good is produced, which can either be consumed in that period or stored to yield capital at the beginning of the following period. In each generation individuals live for three periods: childhood, adulthood and retirement (or old age). Each individual is endowed with two units of time in adulthood, and zero units when in childhood and old age. Children depend on their parents for consumption and healthcare. Adults supply inelastically one unit of labour at a determined wage rate, which serves to raise children and finance consumption in adulthood and old age. Savings can only be held in the form of physical capital. Agents have no other endowments, except for an initial stock of physical capital, K_0 at time $t = 0$, which is held by an initial generation of retirees.

As an adult, each individual bears n_t children, who are born with the same innate abilities and the same initial health status. However, keeping children healthy involves a cost, both in terms of the parent's time and spending on marketed goods (food, medicines, etc.). Adults face a time allocation problem where they must decide upon the division of their non-work unit of time not only between child rearing and leisure, but also to spending time on criminal-related activities. Following Mocan et al. (2005) and Mauro and Carmeci (2007), we assume that all adult agents commit and are subject to crime in the form of theft (with unitary probability). Stolen resources are a positive function of time spent on criminal activities, while agents face a positive probability of apprehension.

The health status of children depends on the time parents allocate to rearing their offspring, access to publicly-provided health services, and the parents' health, in line with the evidence of Cutler et al. (2006). The latter effect is consistent with the evidence provided by Powdthavee and Vignoles (2008) for Britain, suggesting that parents' physical and mental health (beyond short-term stress and strain) affects their children's wellbeing.[1] For adults, health status is taken to depend solely on health sta-

[1] Alternatively, it could be assumed that cognitive and physical impairments of children may begin *in utero*, due to inadequate nutrition and poor health of the mother. The importance of the prenatal environment is supported by Bloom and Canning (2005) who estimate that 30 million infants are born each year in developing countries with impaired growth due to poor nutrition during fetal life.

tus in childhood, indicating 'state dependence' in health outcomes. This specification is consistent with the evidence offered by Case et al. (2005), according to which children who experience poor health have on average significantly poorer health as adults.

In addition to individuals, the economy is populated by firms and an infinitely-lived government. Firms produce marketed goods using private capital and labour as inputs. The government offers health services and spends on some unproductive items. Health services are provided free of charge and are nonexcludable. They are, however, partially rival due to congestion effects. The government finances expenditure by taxing the wage income of adults and using the confiscated illegal proceeds of apprehended criminals. It cannot borrow and therefore must run a balanced budget in each period. Finally, all markets clear and there are no debts or bequests between generations.

2.1 Population and Labor Supply

Let N_t be the number of adults in period t. Given that at the beginning of their adult life in t, each individual bears n_t children, the total number of children born at the beginning of that period is $n_t N_t$.[2] To avoid convergence of population size toward zero, we assume that $n_t \geq 1$. Thus, children and adult population at the beginning of period t is $(1 + n_t)N_t$. Moreover, the number of old agents in period t is the number of adults from period $t-1$, N_{t-1}, whereas the number of adults in period t is equal to the number of children born in the previous period, that is, $N_t = N_{t-1}n_{t-1}$.

Aggregate population at the beginning of period t, L_t, is thus

$$L_t = \left[1 + (1 + n_t)n_{t-1}\right] N_{t-1}. \tag{1}$$

2.2 Households

As noted above, at the beginning of their adult life in $t+1$, each agent bears n_{t+1} children. Raising a child involves two types of costs. First, parents spend $\varepsilon_{t+1} \in (0,1)$ units of time on each of them to take care of their health (breastfeeding, taking children to medical facilities for vaccines, etc.). Thus, each adult allocates $\varepsilon_{t+1}n_{t+1}$ total units of time to that activity. Second, raising children involves costs in terms of marketed goods. These costs could include feeding children, taking them to medical facilities, buying medicines, etc. Specifically, each individual spends a fraction $\lambda \in (0,1)$ of his disposable income on each child's health. Hence, although access to "out of home" health services *per se* is free, families incur an opportunity cost in terms of foregone wage income and consumption. This opportunity cost creates a trade-off between the quality and quantity of children that is standard in the literature (see, for instance, Becker and Lewis (1973) and Barro and Becker (1989)). The difference though is that here the cost is not in terms of education but in terms of health.

[2]For tractability, the number of children is assumed to be continuous. Integer restrictions are thus neglected.

In addition to raising children and supplying a unit of labour inelastically to firms, adults allocate time (in proportion θ_{t+1}) engaging in criminal activities.[3] We assume that the nature of crime consists of theft. The amount of resources that can be stolen, x_{t+1}, corresponds to a fraction of the victim's after-tax income from legitimate activities, in line with Imrohoroglu et al. (2004), that is increasing in the time agents invest in this activity, as in Lochner (2004). The specification is given by

$$x_{t+1} = (1-\tau)a_{t+1}w_{t+1}\theta_{t+1}, \tag{2}$$

where a_{t+1} is individual labour productivity, w_{t+1} is the real wage rate, and $\tau \in (0,1)$ is the effective-wage tax rate.

Furthermore, it is only adult agents that are assumed to be both perpetrators and victims of crime. This implies that only the economically active share of the population enganges in criminal activities. This assumption is consistent with evidence on the age profile of offenders, which are typically of younger age (see Freeman (1999), Levitt and Lochner (2001), Levitt (2004), Buonanno et al. (2011)). It is further supported by the higher victimization rates experienced by adults, as documented in official crime and victimization surveys (see various issues of the US National Crime Victimization Survey, Demography of Victims; the British Crime Survey; the Irish Crime and Victimization Survey).[4] The assumption is also in line with theoretical studies (see, for instance, Lochner (2004) and Capasso (2005)), where agents do not enter into criminal behaviour during old age. This may reflect a stage in their careers at which time they are done with crime and enjoy retirement.

The above assumption (that adults are both offenders and subjects of crime) has one further implication. Given the homogeneity of agents with respect to potential earnings, productivity, and inclination to commit crime, it is implied that *each* adult acts both as a perpetrator and a victim with probability one. Agent homogeneity and the joint participation in the criminal and legal markets is consistent with the analysis in Mocan et al. (2005) and Mauro and Carmeci (2007), and corresponds to Fagan and Freeman (1999) who state that "[c]rime and legal work are not mutually exclusive choices but represent a continuum of legal and illegal income-generating activities."[5]

Once an adult individual acts illegally, he faces the likelihood of getting caught and punished at the end of period $t+1$. The probability of apprehension and conviction

[3] We could instead assume that a single unit of time is allocated among work, crime, child-rearing, and leisure. This would yield a trade-off between time spent on legal and illegal activities that is consistent with most of the studies in the literature. The decision to disentagle work time from crime time hinges, as will become clear below, on the capacity of child-rearing time to contribute to better health status and higher productivity for future adults. In this way, a trade-off between legal and illegal use of time is produced that has similar properties to the division of time between work and crime.

[4] Assuming that both the adult and the old generations, or only the latter as in Josten (2003), are subject to crime, does not alter the analysis or findings.

[5] See Engelhardt et al.(2008) for a model where both employed and unemployed agents act as victims and offenders at the same time. In addition, drawing a distinction in our model between offenders and victims of crime would not alter the main implications.

is $(1-\pi)$.[6] If apprehended, the stolen resources by an individual are confiscated and used by the government to finance its expenses, with no additional penalties.[7]

There is an actuarially fair annuity market that channels savings to investment in physical capital, K_t, for production in the next period. Let r_{t+2} denote the rental rate of private capital.

Assuming that consumption of children in the first period of life is subsumed in their parents' consumption, lifetime utility at the beginning of period $t+1$ of an agent born at t is specified as

$$U_{t+1} = \ln(c_{t+1}^t) + \ln(1-\varepsilon_{t+1}n_{t+1}-\theta_{t+1}) \qquad (3)$$

$$+\ln(n_{t+1}h_{t+1}^C) + \frac{\ln(c_{t+2}^t)}{1+\rho},$$

where c_{t+j}^i denotes consumption of generation i individuals at date $t+j$ and $\rho>0$ is the discount rate. The term $1-\varepsilon_{t+1}n_{t+1}-\theta_{t+1}$ measures leisure which for simplicity is assumed to be enjoyed only in adulthood. The term $n_{t+1}h_{t+1}^C$is equal to the fertility rate multiplied by the health status of a child, h_t^C. In the standard literature, parents derive utility from the 'raw' production of offspring, whereas here it is the number of healthy children that matters. Although adult health status does not provide any direct utility benefit to the household, as discussed later it affects it indirectly through wages.

Since there is no consumption in childhood, the period-specific budget constraints are

$$c_{t+1}^t + s_{t+1} = (1-\lambda n_{t+1})(1-\tau)a_{t+1}w_{t+1} - Z_{t+1} + \pi x_{t+1}, \qquad (4)$$

$$c_{t+2}^t = (1+r_{t+2})s_{t+1}, \qquad (5)$$

where s_{t+1} is saving, π the probability of escaping apprehension once committing crime, and Z_{t+1} the loss adult agents suffer by being subject to crime.[8]

[6]Following Josten (2003), Imrohoroglu et al. (2004, 2006) and Engelhardt et al. (2008), we assume that the probability of apprehension is independently determined. We could easily incorporate into our analysis that this probability is an increasing function of public expenditure devoted to security and policing. But this assumption would not alter our solution as it has no impact on the individual's optimizing behaviour. It would only unnecessarily complicate the analysis for the derivation of the steady-state growth rate of output. Also note that we do not allow for private insurance or private protection expenditure against theft. See Prohaska and Taylor (1973) for a model of insurance coverage against burglary.

[7]Allowing for a harsher penalty in the form of confiscation of (part of) the legal income of the criminal, or even having him spend time in prison, would not alter the main results of the analysis and of the underlying mechanism. According to Josten (2003), additional monetary penalties may even give rise to a bankruptcy problem so that caught criminals might end up with no current or future income for consumption.

[8]It is clear that the loss of agents due to crime is not a choice variable to them. It is simply an exogenous shock that they have no control of.

Combing equations (4) and (5) yields the consolidated budget constraint[9]

$$c_{t+1}^{t}+\frac{c_{t+2}^{t}}{1+r_{t+2}}=(1-\lambda n_{t+1})(1-\tau)a_{t+1}w_{t+1}-Z_{t+1}+\pi x_{t+1}. \tag{6}$$

Note that although λ itself is not a decision variable, it could be made a function of the health status of children. A sick child would normally require more health care, so that $\lambda=\lambda(h_{t+1}^{C})$, with $\lambda'<0$. This would offer yet another way through which parental time allocation may affect crime, fertility and growth. However, for simplicity, λ will be kept constant throughout the analysis.

2.3 Firms

There is a continuum of identical firms, indexed by $i\in(0,1)$. They produce a single nonstorable good, which is used either for consumption or investment. Production requires the use of private inputs in the form of effective labour and private capital, the latter of which firms rent from the currently old agents. In particular, assuming a Cobb-Douglas technology, the production function of firm i takes the form

$$Y_{t}^{i}=(\frac{\overline{K}_{t}}{N_{t}})^{\alpha}\left(A_{t}N_{t}^{i}\right)^{\beta}(K_{t}^{i})^{1-\beta}, \tag{7}$$

where K_{t}^{i} denotes the firm-specific stock of capital, $\overline{K}_{t}=\int_{0}^{1}K_{t}^{i}di$ the aggregate private capital stock, A_t average, economy-wide labour productivity (which is the same for all firms), N_t^i the number of adult workers employed by firm i, N_t the total number of adults, and α, $\beta\in(0,1)$. Thus, production exhibits constant returns to scale in firm-specific inputs, effective labour $A_tN_t^i$ and capital K_t^i.

By contrast, the aggregate private capital stock is exogenous to each firm's production process and affects all individual producers in a uniform manner. It, thus, acts as an externality in the production of output, similar to the types of externality considered by Shell (1966) and Romer (1986). Its productivity effects, however, are diminished by the size of the adult population. Thus, to eliminate any scale effects, the associated productivity of aggregate private capital stock is subject to congestion.

Markets for both private capital and labour are competitive. Each firm's objective is to maximize profits, Π_t^i, with respect to labour services and private capital, taking A_t and $\overline{K}_t$ as given:

$$\max\Pi_{t}^{i}=Y_{t}^{i}-r_{t}K_{t}^{i}-w_{t}A_{t}N_{t}^{i}. \tag{8}$$

Profit maximization yields

[9] In the absence of a mechanism by the government to detect the origin of the resources of an agent, other than those adults caught during the act of crime, individuals use both their legal and illegal income in the loan market for intertemporal consumption smoothing. See Josten (2003) for a discussion.

$$w_t = \beta Y_t^i / A_t N_t^i, \qquad r_t = (1-\beta) Y_t^i / K_t^i, \tag{9}$$

so that private inputs are paid at their marginal product.

Given that all firms and workers are identical, in a symmetric equilibrium $N_t^i = N_t$ and $K_t^i = K_t = \overline{K}_t$, $\forall i$. Thus, the competitively-determined wage rate and the rental rate of capital become

$$w_t = \beta Y_t / A_t N_t, \qquad r_t = (1-\beta) Y_t / K_t. \tag{10}$$

Because the number of firms is normalized to 1, aggregate output is given by

$$Y_t = \int_0^1 Y_t^i di = (N_t)^{\beta-\alpha}(A_t)^{\beta}(K_t)^{1-\beta+\alpha}. \tag{11}$$

As shown below, A_t is constant in the steady state. To ensure steady-state growth (linearity of output in the private capital stock) and eliminate the scale effect associated with population requires the following assumption:[10]

Assumption : $\alpha = \beta$.

This also allows us to reduce the model to the simplest form of endogenous growth model in which the externality exactly offsets the diminishing marginal returns to private capital in the production process. Under this assumption, equation (11) yields aggregate output as

$$Y_t = (A_t)^{\beta} K_t. \tag{12}$$

Finally, to reduce notational clutter, we assume that private capital depreciates fully in the production of output so that capital accumulation is driven by

$$K_{t+1} = I_t, \tag{13}$$

where I_t is private investment.

2.4 Health Status and Productivity

The health status of children, h_t^C, depends on the share of income spent on goods for each child, the parent's health status, h_t^A, the time allocated by their parent to rearing them, and access to public health services:[11]

$$h_t^C = \lambda (h_t^A)^{\kappa} (\varepsilon_t)^{\nu_C} \left(\frac{H_t^G}{Y_t}\right)^{1-\nu_C}, \tag{14}$$

where H_t^G is the supply of public health services (subject to congestion), and $\kappa, \nu_C \in (0,1)$. First, a child's health status depends linearly on the fraction of resources spent

[10] A similar assumption has been used by Bose et al. (2007).

[11] This section largely draws from Agénor (2009).

by the parent, λ, because it helps to improve his health and nutrition, thereby reducing the likelihood to contract diseases (see for instance Pelletier et al. (2003), Caulfield et al., (2004)). Second, a child's health depends on the parent's health. This may be related to the impact of parents' mental distress and anxiety on children's life satisfaction (see Larson and Gillman 1999 and Downey et al. 1999) but also on their physical ability to take care of their children (which may require walking long distances, on difficult terrain, to take them to medical facilities).[12] Third, the health status of a child depends on the time allocated to him by his parent.[13] Finally, access to public health services has a direct effect on a child's health status. The congestion effect on health services can be justified by assuming that a greater deterioration of the environment (i.e., higher CO_2 emisions), induced by a more intensive aggregate economic activity, diminishes the effectiveness of health services. In other words, the delivery of health services is hampered by excessive private sector activity.[14]

For adults, health status depends linearly on their health status in childhood in line with life-course models of health. There is a general consensus that children who experience poor health have on average significantly poorer health as adults. According to Fogel (1994), better nutrition in childhood in the first half of the twentieth century, had an effect on the health and life-span during the adult years of life. Similarly, Roseboom et al. (2001) have shown that children born just after the Dutch famine at the end of World War II had a higher probability of suffering coronary heart disease at age 50. Given this evidence of health persistence, also considered in de la Croix and Licandro (2007) and Osang and Sarkar (2008), we specify:

$$h_{t+1}^{A} = h_{t}^{C}. \tag{15}$$

Substituting (14) in (15) yields

$$h_{t+1}^{A} = \lambda (h_t^A)^{\kappa} (\varepsilon_t)^{\nu_C} \left(\frac{H_t^G}{Y_t} \right)^{1-\nu_C}. \tag{16}$$

Therefore, due to the fact that a parent's health affects his children's health, or equivalently because adult health depends on own health in childhood, there is serial dependence in h_t^A. In line with Grossman's (1972) approach, health is therefore viewed

[12] It could also reflect Barker's (1998) 'fetal origins hypothesis' which suggests that conditions *in utero* have long-lasting effects on an individual's health. Almond (2006) finds that cohorts *in utero* during the influenza epidemic of 1918, which affected a third of women of child-bearing age, were more likely to be too disabled to work compared to cohorts immediately before or after the epidemic. This channel, however, would require including h_{t-1}^A instead of h_t^A in equation (14). If so, then, one would need to assume that adult health in $t+1$ generates direct utility.

[13] Health status at birth, which could be accounted for by adding a linear term $\bar{h}^C > 0$ in (14), is ignored for tractability. For such an analysis, see Agénor (2011).

[14] Alternatively, the congestion factor could be measured in terms of the number of adults in period t, N_t, or in terms of the total population, L_t. The specification used here, however, is more tractable analytically. Note also that, given the linearity of aggregate output in K_t, using K_t as the congestion factor in (14) would not alter the results in any fundamental way.

as a durable stock. Here an agent's health can be increased not only by spending more on goods but also by allocating more time to taking care of one's brood as well as by improving access to public health services early in life.[15]

In line with empirical evidence, adult productivity is taken to be positively related to health status. Following Agénor (2009), we assume a linear relationship:

$$a_t = h_t^A. \tag{17}$$

2.5 Government

The government obtains revenue by applying a constant tax rate τ on the effective wage of adult agents and by confiscating the stolen resources of the adults that have been apprehended commiting criminal activities.[16] It spends a total of G_t^H on health and G_t^U on unproductive services.[17] As the government cannot issue bonds, it must run a balanced budget:

$$G_t = G_t^H + G_t^U = N_t \tau A_t w_t + N_t(1-\pi)x_t, \tag{18}$$

which, with the use of (2), becomes

$$G_t^H + G_t^U = [\tau + (1-\pi)(1-\tau)\theta_t]\, N_t A_t w_t, \tag{19}$$

where we remind that $(1-\pi)$ is the probability of apprehension.[18]

Shares of government spending are constant fractions of revenue:

$$G_t^h = \upsilon_h\, [\tau + (1-\pi)(1-\tau)\theta_t]\, N_t A_t w_t, \qquad h = H, U \tag{20}$$

where $\upsilon_h \in (0,1)$. Combining (19) and(20) therefore yields

$$\upsilon_H + \upsilon_U = 1. \tag{21}$$

[15] See Becker (2007) for a recent overview of Grossman's approach and the subsequent literature. The analysis could be extended to account for the possibility that the stock of health depreciates with age.

[16] The tax rate is assumed to be announced at the beginning of time and the government commits fully and credibly to it; there is therefore no fundamental time-consistency problem.

[17] We could have assumed another type of government spending in the form of security and policing. This expenditure would increase the probability of apprehension and punishment as supported by a series of empirical studies (Corman and Mocan (2000), Di Tella and Schargrodsky (2004), Evans and Owens (2007), Draca et al. (2011), and Harbaugh et al. (2011)). This consideration, however, would not impact upon the agent's optimal choices in equilibrium, other than complicate the determination of the economic growth rate. For this reason, we opt for analytical tractability by assuming the simplest possible form of apprehension probability (see Josten (2003) and Imrohoroglu et al. (2004, 2006)).

[18] Even though the probabilities of arrest and conviction may well differ empirically, we do not distinguish between them. In our notation, $1-\pi$ best represents the probability that someone committing a crime is punished. We address the distinction between the two probabilities, however, in our empirical section.

Finally, the production of health services depends linearly on government spending on health:[19]

$$H_t^G = G_t^H. \tag{22}$$

2.6 Market Clearing and Equilibrium

The asset market-clearing condition requires tomorrow's private capital stock to be equal to today's aggregate savings by adults:

$$K_{t+1} = N_t s_t \tag{23}$$

The following definition may therefore be proposed:

Definition 1. *A competitive equilibrium for this economy is a sequence of prices* $\{w_t, r_t\}_{t=0}^{\infty}$*, allocations* $\{c_{t+1}^t, c_{t+2}^t, s_t, \varepsilon_{t+1}, \theta_{t+1}\}_{t=0}^{\infty}$*, private capital stock* $\{K_{t+1}\}_{t=0}^{\infty}$*, health status of children and adults* $\{h_t^C, h_t^A\}_{t=0}^{\infty}$*, and a constant tax rate* τ and *constant spending shares* υ_H, υ_U*, such that, given the initial capital stock* $K_0 > 0$ *and initial health statuses* $h_0^C, h_0^A > 0$*, individuals maximize utility, firms maximize profits, markets clear, and the government budget is balanced.*

In equilibrium, individual productivity must be equal to the economy-wide average productivity, so that $a_t = A_t$. In addition, in equilibrium, the criminal proceeds of each individual are equal to the fraction of income lost by being a victim of crime since all adult agents (i) have identical effective labour income, and (ii) spend the same time on illegal activities. That is, $x_{t+1} = Z_{t+1}$. Therefore, crime in our model can be viewed as a redistribution problem that yields no deadweight loss for the economy.[20]

The following definition characterizes the balanced growth path:

Definition 2. *A balanced growth equilibrium is a competitive equilibrium in which* c_t^t*,* c_{t+1}^t*,* Y_t*, and* K_t*, all grow at the constant rate* $1+\gamma$*, health statuses in childhood and adulthood* h_t^C *and* h_t^A *are constant, and the rate of return on private capital* r_t *is constant.*

It is not unrealistic to assume that health status is constant in the steady state (as in Osang and Sarkar (2008) and Agénor (2011)) as there are limits in the long run as to how much private behaviour and medical science can improve individual health status.

[19] Given that spending on health services in the public sector does not necessarily translate into actual health services being provided, the right side of (22) could be multiplied by a constant parameter that lies in the (0,1) range. As long as this parameter is constant, setting it to one has no effect in the analysis.

[20] This can be seen by consolidating the household and government budget constraints (6) and (19): $Y_t = C_t + K_{t+1} + G_t^H + G_t^U$, where $C_t = N_t(c_t^t + \lambda n_t \alpha_t w_t) + N_{t-1} c_t^{t-1}$ is total consumption spending at t. If we were to assume instead that commiting crime requires use of resources (in terms of planning the hit, hiding the loot, getting a fraction of its value for use, say due to money laundering, etc), then crime would lead to an economic deadweight loss. It is straightforward to incorporate such costs. Their introduction, however, would not influence the main message of the paper.

This implies that health (unlike education) cannot by itself be an engine of permanent growth.

2.7 Crime, Fertility and Growth

Each adult maximizes (3) subject to (6), (2), (14), (15), (22), (16), and (17), with respect to c_{t+1}^t, $c_{t+2}^t, \varepsilon_{t+1}, \theta_{t+1}$ and n_{t+1}, taking τ and H_t^G as given. At the same time, agents take into account the impact of their decisions regarding ε_{t+1} on their own health status (and productivity) and that of their children.

The solution of the household problem is provided in Appendix A. It shows that in equilibrium, $\theta_{t+1,}$ n_{t+1}, and ε_{t+1} are all constant:

$$\tilde{\theta} = \frac{\pi[1+(1-\nu_C)(1-\sigma)]-(1+\nu_C)(1-\sigma)}{\pi[1+(1-\nu_C)(1-\sigma)]-(1+\nu_C)(1-\sigma)(1-\pi)} < 1, \tag{24}$$

$$\tilde{n} = \frac{(1-\nu_C)(1-\sigma)\pi^2}{\lambda\left\{\pi[1+(1-\nu_C)(1-\sigma)]-(1+\nu_C)(1-\sigma)(1-\pi)\right\}}, \tag{25}$$

$$\tilde{\varepsilon}\tilde{n} = \frac{\pi\nu_C(1-\sigma)}{\pi[1+(1-\nu_C)(1-\sigma)]-(1+\nu_C)(1-\sigma)(1-\pi)}, \tag{26}$$

$$\tilde{\varepsilon} = \frac{\lambda\nu_C}{\pi(1-\sigma)}, \tag{27}$$

$$1-\tilde{\varepsilon}\tilde{n}-\tilde{\theta} = \frac{\pi(1-\sigma)}{\pi[1+(1-\nu_C)(1-\sigma)]-(1+\nu_C)(1-\sigma)(1-\pi)}, \tag{28}$$

where σ is the marginal propensity to save. The following assumption must be imposed to ensure that the above endogenous variables are positive in equilibrium:

Assumption 1: $\pi > \pi^*$, where $\pi^* \equiv (1+\nu_C)(1-\sigma)/[1+(1-\nu_C)(1-\sigma)]$.

This implies that if the probability of escaping apprehension exceeds a threshold value, π^*, agents allocate a positive share of their time toward crime-related activities.[21] In equilibrium, this assumption trickles down to the other endogenous variables as well (caring for children, leisure, and fertility). This suggests that the solutions in equililbrium are well-defined only if $\pi > \pi^*$.[22] For π^* to be meaningfull, however, it needs to be less than one. This is satisfied with the following (mild) assumption concerning the size of ν_C:

Assumption 2: $\nu_C < 1/2(1-\sigma)$.

[21] Technically, a positive $\tilde{\theta}$ requires both the numerator and the denominator in equation (24) to be positive. Note though that this is satisfied with the single condition that the numerator is positive as described in Assumption 1.

[22] As shown in Appendix A, Assumption 1 implies that $(1-\lambda\tilde{n})-(1-\pi)\tilde{\theta} > 0$, so that consumption and savings are also positive in equilibrium.

This means that the elasticity of children's health status with respect to the time parents allocate to them cannot be too large. In addition, even though Assumption 1 represents a sufficient condition to generate a positive fertility rate, to avoid convergence of population size toward zero, $\tilde{n} \geq 1$ needs to hold. This is satisfied if:

Assumption 3: $\lambda \leq (1-\nu_C)(1-\sigma)\pi^2/\{\pi[1+(1-\nu_C)(1-\sigma)]-(1+\nu_C)(1-\sigma)(1-\pi)\}$.

Thus, the fraction of income spent on caring for each child cannot be too large. From equations (24)-(28), the following proposition can be established:

Proposition 1. *If $\pi > \pi^*$, an increase in the probability of escaping apprehension increases the time agents allocate to criminal activities. It lowers total and per-child time allocated to child-rearing, as well as leisure time, while it has a non-monotonic effect on the rate of fertility.*

The result that an increase in the probability of escaping apprehension raises criminal activity, by decreasing the opportunity cost of doing crime, is standard in the analytical literature since Becker's (1968) seminal work. It is also consistent with the empirical evidence on the crime-deterent effect of the apprehension likelihood (for recent studies, see Di Tella and Schargrodsky (2004), Evans and Owens (2007), Draca et al. (2011), and Harbaugh et al. (2011)). An important qualification of our result, however, is that the positive relationship between the probability of avoiding apprehension and crime takes shape only above a threshold value of π. This, in turn, implies the existence of a non-linear relationship between the two variables. The presence of a minimum value of π as a requirement for criminal activity arises because of the value agents attach to both child-rearing activities and leisure. For them to invest time in crime, and thus cut down on child-rearing and leisure, a minimum income through such an activity must be likely. Once this happens, higher values of π induce agents to spend more time committing crime and less time on other activities.[23]

In addition, an increase in avoiding apprehension leads to a non-monotonic impact on the rate of fertility. In particular, it lowers fertility when $\pi^* < \pi < \pi^{**}$ and raises fertility for $\pi > \pi^{**}$, where $\pi^{**} \equiv 2(1+\nu_C)(1-\sigma)/[1+2(1-\sigma)]$.[24] This U-shaped effect materializes through the way the probability of escaping apprehension changes the agent's total disposable income. A higher π (above π^*) increases the amount of criminal proceeds, which in turn raises disposable income. But at the same time the increase in π diminishes the time agents distribute to the well-being of their children, leading to their lower health status. As this coincides in equilibrium with a decline in adult health status and a drop in their productivity, effective income decreases. Thus, for values of $\pi \in (\pi^*, \pi^{**})$, the negative effect dominates so that disposable income decreases, leading to lower fertility (recall the decrease of $\tilde{\varepsilon}$). For values of

[23]Engelhardt et al. (2008) have also illustrated a negative effect of the apprehension probability on crime rates (related to larceny, burglary, and motor vehicle theft) with a non-linear feature. As in Imrohoroglu et al. (2004, 2006), however, the relationship at hand is operational throughout the $(0,1)$ interval of the arrest likelihood, thus not taking into account potential threshold effects.

[24]Note that under Assumption 2, both $\pi^{**} < 1$ and $\pi^{**} > \pi^*$.

$\pi > \pi^{**}$, the positive effect dominates raising fertility. In other words, when escaping apprehension is very likely, the higher realised income reduces the 'quantity cost' of children, thereby shifting resources from the quality of children to the quantity of children. This mechanism draws from Becker (1960)'s quantity–quality trade-off for children. The identified relationship is negative for small values of π, while switches to positive for higher values.

Our analysis can also be viewed as offering an alternative interpretation to the findings of Gaviria and Pagés (2002), who for 17 Latin American countries have suggested the positive relationship between city growth and crime levels to be causal running from population growth to crime. In our model, this positive relationship is not causal but is jointly driven by the lower effectiveness of law enforcement. In other words, in Latin America, where the rate of escaping apprehension is relatively high, the positive relationship between crime and fertility is endogenously determined.

The balanced growth rate of the economy is derived in Appendix A, where it is shown that the model can be condensed into an autonomous, first-order linear difference equation in $\hat{h}_t^A = \ln h_t^A$, whose steady-state solution is

$$\tilde{h}^A = \Gamma^{\frac{1}{1-\kappa}}, \tag{29}$$

where $\Gamma \equiv \lambda(\beta \upsilon_H)^{1-\nu_C}(\tilde{\varepsilon})^{\nu_C}\left[\tau + (1-\pi)(1-\tau)\tilde{\theta}\right]^{1-\nu_C}$.

Stability of this equation requires $\kappa < 1$, which is always satisfied. Thus, given concavity, there is a unique, nontrivial and globally stable steady state $\tilde{h}^A$, to which h_t^A converges monotonically.

From (12), (17), and the solution for the growth rate of private capital given in Appendix A, the steady-state growth rate of output is

$$1 + \gamma = (\tilde{h}^A)^\beta \beta\sigma(1-\tau)\left[(1-\lambda\tilde{n}) - (1-\pi)\tilde{\theta}\right], \tag{30}$$

where $\tilde{h}^A$, $\tilde{\theta}$, $\tilde{n}$, and $\tilde{\varepsilon}$ are the solutions of (29), (24), (25) and (27).

The equilibrium solution can be used to examine the impact of a higher probability of escaping apprehension on long-run growth. In particular, the following result can be established:

Proposition 2: *If $\pi > \pi^*$, an increase in the probability of escaping apprehension has an ambiguous effect on the steady-state growth rate of output.*

The reason why an increase in the likelihood of avoiding apprehension has an unclear effect on growth has to do with the conflicting effects that arise through three channels, as shown in Appendix A. Firstly, through the negative effect of avoiding apprehension on the childrearing time that adults allocate to each of their children, which lowers their health status. This, in turn, reduces health status in adulthood, and subsequently the rate of economic growth. Secondly, by the impact of an increase in π on the revenue collected by the government that finances health spending, which enhances health status and productivity. From equation (29) it can be shown that this effect is ambiguous and depends on the size of π, where for $\pi < \pi^{**}$ ($\pi > \pi^{**}$), the growth effect is positive (negative). The third channel through which π influences growth is by its effect on savings. This happens due to the income redistribution effect of π as it essentially acts like a tax. Once again the effect depends on the size of π so that savings and growth increase when π is relatively large to start with ($\pi > \pi^{**}$), while they both decline for lower values ($\pi < \pi^{**}$). Given these offsetting effects, the net effect on the steady-state growth rate, $d(1+\gamma)/d\pi$, cannot be determined *a priori.*

Overall, the analytical results yield some testable implications about the effect of escaping apprehension on criminal activity and on the rates of fertility and economic growth. Specifically, the described effects appear to be of a non-monotonic nature for crime and fertility, while they could go in any direction (positive or negative) with respect to growth. In the next section we evaluate empirically the validity of these implications.

3 Evidence

We now turn to evaluate the impact of the likelihood of escaping apprehension on the rates of crime, fertility and economic growth, while controlling for other potential determinants of these variables discussed in the literature. This empirical evaluation offers a link to our theoretical model as it allows the consideration of non-monotonic effects of the probability of avoiding apprehension. We first describe our estimation methodology and next present our results. To assess the robustness of these results, we conduct a wide range of sensitivity tests, that, among others, involve alternative estimation methods and changes in the definition of variables.

3.1 Estimation Strategy and Methodology

Consistent with our theoretical analysis that unveils the effects of the likelihood of escaping apprehension, π, on crime, fertility and growth, we employ an empirical specification that conforms to these considerations. For this reason, we estimate three equations corresponding to the crime equation (24), the fertility equation (25), and the growth equation (30). Noting the absence of data on the share of time individuals allocate toward crime-related activities (θ), the estimated crime equation uses as a dependent variable the number of recorded theft rates. This is a natural choice given that more time engaging in criminal activities leads to higher crime and since crime in our model consists of theft. In estimating these three equations independently of each other, the growth equation (30) is first estimated in its reduced form where the probability of escaping apprehension is directly used as a determinant. This implies the substitution of equations (27), (24), (25) and (29) into equation (30). Then, we also consider the structural relationship among the endogenous variables (crime, fertility and growth) and estimate equations (24), (25) and (30) jointly as a system where the rates of theft and fertility appear as determinants in the growth equation.

According to our theoretical model, the probability of escaping apprehension has a positive impact on crime only above a threshold value, π^*. To empirically identify this value, the estimated crime equation controls both for the level of π and its square. Similarly, we add both π and its square in the fertility equation to assess the presence of any non-linearity, in the form of a threshold value π^{**} as suggested by our model. Further, consistent with the implications of the model as to the effect of π on fertility and growth, for the regressions of these two equations we restrict our dataset to values of $\pi > \pi^*$. But we also check the results for the entire sample.

Given the above, our benchmark empirical setup is represented by

$$c_{it} = \alpha_0 + \alpha_1 \pi_{it} + \alpha_2 \pi_{it}^2 + \sum_{k=1}^{m} \delta_k X_{k,it} + \mu_i + \nu_t + \varepsilon_{it}, \tag{31}$$

$$n_{it} = \beta_0 + \beta_1 \pi_{it} + \beta_2 \pi_{it}^2 + \sum_{l=1}^{n} \lambda_l Z_{l,it} + \mu_i + \nu_t + u_{it}, \tag{32}$$

$$g_{it} = \gamma_0 + \gamma_1 \pi_{it} + \sum_{j=1}^{q} \zeta_j W_{j,it} + \mu_i + \nu_t + \upsilon_{it}, \tag{33}$$

where the notation is as follows: i (t) is the country (time) index; c_{it} denotes total recorded theft rates (per 100,000 inhabitants); n_{it} represents the fertility rate; g_{it} stands for the growth rate of per capita real GDP; π_{it} is the probability of escaping apprehension after conducting the crime of theft; while $\{X_{k,it}\}_{k=1}^m$, $\{Z_{l,it}\}_{l=1}^n$, and $\{W_{j,it}\}_{j=1}^q$ represent vectors of conditioning variables that have been identified to explain a substantial variation in the data in studies of crime, fertility, and growth, respectively. Specifically, $\{X_{k,it}\}_{k=1}^m$ includes demographic and socioeconomic variables proxied by the percentage of the population in the age group between 15 and 64, urbanization rate, logarithm of per capita GDP and its square, growth rate of GDP, and unemployment rate; $\{Z_{l,it}\}_{l=1}^n$ includes infant mortality rate, logarithm of per capita GDP, urbanization rate, and unemployment rate; $\{W_{j,it}\}_{j=1}^q$, finally, incorporates the logarithm of per capita GDP, private investment, and indicators of fiscal (budget balance), monetary (inflation) and trade (openness) policies. The crime and fertility rates are also included as controls, with the simultaneous exclusion of π_{it}, when equations (31)-(33) are jointly estimated. Finally, the regressions account for common deterministic trends by incorporating dummies for the different time periods, ν_t, as well as time-invariant country-specific dummies, μ_i, whereas ε_{it}, u_{it}, and υ_{it} are the error terms. Appendix B offers the set of countries and the definition and sources of all the variables involved in the empirical analysis.

The coefficients of interest are related to the effects of the likelihood of escaping apprehension, summarised by α_1, α_2, β_1, β_2, and γ_1. The first two will illustrate whether avoiding apprehension has a non-linear impact on crime, and if so, identify the threshold value of π^*. According to our theory model, this would correspond to a statistically insignificant estimate for α_1 and a positive estimate for α_2. The second two coefficients will show if there exists a non-linear impact of π on fertility and thus locate the value of π^{**}, once the threshold value π^{*} is taken into account. That is, by using values of $\pi > \pi^{*}$. This would be in line with our theoretical illustration if β_1 is negative and β_2 is positive. The final coefficient estimate, γ_1, reflects the growth effect of escaping apprehension, for $\pi > \pi^{*}$, the sign of which is theoretically ambiguous.

We use a variety of econometric procedures to estimate equations (31)-(33). Given the importance of country-specific factors advanced in the related literatures, we start with the fixed effects estimator that controls for unobserved country-specific effects in all our regressions. Then, we also add time fixed effects that capture common variations in crime, fertility and growth across countries. The rest of the estimation procedures are based on techniques that address potential endogeneity of the right-hand-side variables. Our main concern is with the variable of interest, the probability of escaping apprehension. This variable is endogenous by construction in the crime regression as the numerator of the dependent variable (number of theft incidents) is the denominator in the probability of avoiding arrest. This artificially induces a negative correlation between the two variables, a phenomenon known as "ratio bias" in the literature (see Dills etal. (2008)).

One standard approach to deal with endogeneity is to replace contemporaneous variables with two-period lagged variables. Another approach uses as instruments lagged values of the potentially endogenous variable and applies an instrumental variable technique like static GMM and dynamic GMM. We also estimate equations (31)-(33) as a system that considers only the endogeneity of the key variables (crime and fertility) on the growth equation (3SLS).

We make use of all the above single-equation techniques to control for endogeneity. From these, dynamic GMM requires some explanation. There are two versions of this procedure, difference-GMM and system-GMM. The first has been developed by Arellano and Bond (1991) and the second by Arellano and Bover (1995) and Blundell and Bond (1998). The endogenous variables in the difference-GMM estimator are instrumented with lags of their levels, while system-GMM employs a richer set of endogenous instruments, treating the model as a system of equations in first differences and in levels. In the latter, the endogenous variables in the first-difference equation are instrumented with lags of their levels as in difference-GMM, while the endogenous variables in the level equations are instrumented with lags of their first differences. An advantage of these GMM estimators is that they avoid a full specification of the serial correlation and heteroskedasticity properties of the error, or any other distributional assumptions.

An important consideration associated with the two dynamic GMM estimators relates to the number of instruments. According to Roodman (2009), an excessive number of instruments can result in overfitting of the instrumented variables, thereby biasing the results towards those obtained by OLS. As a rule of thumb, therefore, the number of instruments is suggested not to exceed the number of countries. To abide with this condition, we cannot treat all explanatory variables in our regressions as endogenous due to the relatively small number of observations in our sample. For this reason we are selective and instrument for a subset of the control variables that have been pointed out as likely endogenous in the related literatures.[25] This strategy, however, is only feasible for difference-GMM as the system counterpart requires more instruments per instrumented variable. For this reason, we present the results of difference-GMM.

We check the validity of the instruments under difference-GMM by applying two specification tests. The first test is the Hansen (1982) J-test of overidentifying restrictions, which we use to examine the exogeneity of the instruments. The null hypothesis is that the model is correctly specified. The second test is the Arellano and Bond (1991) test for serial correlation of the disturbances up to second order. This test is useful because serial correlation can cause a bias to both the estimated coefficients and standard errors. Given that first differencing induces first order serial correlation in the transformed errors, the appropriate check relates only to the absence of second-order serial correlation. Furthermore, we perform the correction proposed by Windmeijer (2005) for the finite-sample bias of the standard errors in the two-step GMM estimator.

3.2 Data

We construct a dataset containing information on criminal activity, fertility outcomes and output growth across 90 countries for the period 1970-2008. This implies a maximum sample size of more than 3,500 annual observations. Due to missing data, however, we end up working with an unbalanced panel of 457, 443 and 386 observations for equations (31), (32) and (33) respectively. Even though our analysis is originally conducted with annual data, the number of observations is reduced further in the growth regression when we construct five-year period averages so as to minimise business cycle effects (1970-74, 1975-79, ..., 2005-08). As Table B1 illustrates, our data are drawn from a variety of sources.

Table 1 presents summary statistics of the data. It is interesting to note the high mean value and variability of the crime rate as well as the high mean value of the probability of escaping theft apprehension. Figure 1 shows a scatter plot of theft rates against the likelihood of avoiding apprehension for this type of crime. The plot is suggestive of a non-linear relationship with crime rates becoming more prevalent at higher levels of the probability of escaping arrest. Thus, the figure offers visual support to the thesis of our theoretical analysis as to the presence of a threshold value π^* only above which crime rates increase. We now turn to a formal empirical analysis.

3.3 Results

We begin our investigation by estimating equations (31)-(33) one at a time and independently of each other with the single-equation estimation techniques described above.

[25] Other than the probability of avoiding arrest (and its square where it appears), these variables are GDP per capita and its square in the crime equation, infant mortality, GDP per capita and urbanization in the fertility regression, and GDP per capita and investment in the growth equation. The coefficient estimates of these variables appear in bold type in the tables of results.

Then, we allow for a simultaneous estimation of all three equations with 3SLS. Recall that according to the theoretical mechanisms of the preceding section, the likelihood of escaping apprehension has a non-linear impact on crime and fertility, while its effect on output growth is ambiguous. We present the results in this order (crime, fertility, growth), starting with the benchmark crime regressions of equation (31) in Table 2.

3.3.1 Crime

The first two columns of Table 2, in addition to controlling for country fixed effects, involve as a determinant of crime only the probability of escaping arrest. Column (1) in levels and column (2) adding its square. The first column shows the unconditional positive relationship between escaping the arrest likelihood and rates of crime. The second column makes clear that this relationship is not linear but subject to threshold effects. In particular, the relationship becomes positive when the probability escaping arrest exceeds 20%. This turning point is given at the bottom of the table before the diagnostics.

Moving further to the right of Table 2, we add more determinants of crime, control for time fixed effects, and also consider the potential endogeneity of some of the control variables. Once again, the main message of columns (3)-(8) is the presence of a threshold value π^* only above which the effect of π on crime is positive. This value is determined to lie between 9% and 32% depending on the estimation technique. Moreover the coefficient estimate of α_2 is always significant at least at the 5% level – 1% level for difference-GMM. As described in the theory section, the positive influence of the probability of escaping apprehension on criminal activity is a typical finding of the empirical literature that examines the determinants of crime. Our empirical result that this effect takes shape only above a threshold corroborates our theoretical finding which suggests an opportunity cost of committing crime expressed in terms of time allocated for child-rearing and leisure. Given the value attached to these activities, crime becomes appealing only if it pays off, with the relative payoff proxied by the size of π.

Turning to the other control variables, the demographic variables have effects in line with expectations. Specifically, a higher adult population share is associated with higher theft rates. This result conforms with the findings of Neumayer (2003), Bianchi et al. (2011) and Buonanno et al. (2011) for total and violent crime rates, but also with Neumayer (2005) for robbery and theft rates. This finding can also be viewed as justifying our assumption in the theory model about crime being mainly an activity that relates to the economically active share of the population. The second demographic variable, the urbanization rate, when significant also appears to positively influence theft rates and accord with Bianchi et al. (2011) with respect to total and car theft rates, Fajnzylber et al. (2002) for robbery rates, and Kendall and Tamura (2010) for assaults.

The effects of the socioeconomic variables are also intuitive and supportive of the general findings in the literature. The level of development, when properly instrumented, diminishes theft rates (with the effect being smaller in magnitude in more developed economies) and the same applies for the growth rate of an economy's aggregate output. The negative effects of economic activity on crime are related to the legal income opportunities created through higher income and economic growth. As both these variables act as proxies for the expected gains of legal activities, their higher values decrease illegal activities as the opportunity cost of commiting crime increases. This cost of crime increases further if one considers the high incomes foregone when incarcerated. Empirical support of these negative effects on both violent and non-violent types of crime is offered, among others, by Fajnzylber et al. (2002), Neumayer (2003), Kelaher and Sarafidis (2011). The last socioeconomic variable, the rate of unemployment, has an effect that turns negative under difference-GMM. This effect, consistent with the findings of Bianchi et al. (2011), can be explained by a standard assumption of decreasing absolute risk aversion, which suggests that illegal activity decreases with increasing unemployment. The intuition is that unemployment implies a lower income and higher risk aversion, thus leading to lower expected utility of crime.

The final column of Table 2 also accounts for the dynamics of theft rates by including the lagged dependent variable in the set of regressors. This inclusion is justified by the possibility of criminal hysteresis stressed by Glaeser et al. (1996) and Fajnzylber et al. (2002). This inertia could be an outcome of learning-by-doing by criminals so that the accumulation of crime-related knowledge decreases the cost of carrying out criminal acts over time. The regression result supports crime inertia with a coefficient estimate of 0.52, which implies that the half-life of a unit shock lasts for about a year.[26]

To assess the robustness of the findings related to the determinants of crime described so far, we present a set of sensitivity tests in Table 3. All the regressions correspond to the estimation technique reported in column (7) of Table 2, difference-GMM, with the use of alternative proxies for the probability of avoiding apprehension, a different measure of crime, and the addition of further controls.[27] None of these considerations, however, alter the main implication of our findings: a positive crime effect of π for $\pi > \pi^*$.

Column (1) replaces the probability of avoiding arrest for committing theft with the probability of escaping conviction for committing theft. The fact that the estimated size of π^* is consistent with the values obtained in Table 2, conforms to our theoretical assumption that π could correspond to the probability of escaping both apprehension and conviction. Column (2) considers a different category of non-violent crime. Replacing both the dependent variable with recorded burglary rates and π with the probability of escaping arrest for burglary, does not alter the main message. This is also true when we add more control variables in columns (3)-(5). These additional variables that relate to demographics (sex ratio and female labour force participation), political institutions (democracy and human rights violations), and the economy (ed-

[26] The half-life of a unit shock is equal to $\ln(0.5)/\ \ln(\delta)$, where δ is the coefficient of the lagged dependent variable (see Fajnzylber et al. (2002)).

[27] The description of each of these additional variables is given in Table B1.

ucation and income inequality) are all significant (except for inequality) and take up signs consistent with intuition and past empirical studies (see, for instance, Neumayer (2003, 2005) and Kendall and Tamura (2010)).

Finally, we have to state that the specification tests in both Table 2 and 3 corroborate the validity of the instruments. Hansen's J-statistic cannot reject the hypothesis that the instruments are uncorrelated with the error term at a standard confidence level. Additionally, the Arellano-Bond (1991) test rejects the hypothesis of no second-order serial correlation in the error term in all regressions at any conventional level of significance.

3.3.2 Fertility

Table 4 presents the benchmark findings of estimating equation (32). The order of the columns follows that of Table 2 in terms of estimation techniques. Column (1) shows a positive association between fertility and the probability of avoiding arrest when there is no restriction on the size of π (i.e., when all available data are used). Next, consistent with our theoretical model, we constrain the value of π to exceed π^*. We choose this value to be located at 20% because this is the average value of the thresholds identified in Table 2. Column (2) reports a higher coefficient estimate for π. Further, we impose a non-linear relationship between fertility and π in column (3) to examine if a threshold value of π^{**} exists. The addition of squared π as a control illustrates the absence of a non-monotonic relationship. This findings does not offer support to our theoretical result as both variables appear with statistically insignifficant coefficients. This could mean either that the threshold value π^{**} is close to π^* so that a regression fails to unveil this non-linearity, or that a higher probability of escaping arrest monotonically increases disposable income above π^*, which leads to higher fertility. Given the absence of identifying a non-linearity, the rest of the estimations revert to a linear specification above π^*.

Adding more fertility regressors and controlling for time effects and endogeneity in columns (4)-(9), does not alter the main finding of a positive impact of π on fertility. The magnitude of the coefficient estimate implies that an increase of a one-standard-deviation in the probability of escaping apprehension (22.24) is associated with a 0.044 percent increase in fertility rates.[28] Clearly, this does not represent a large impact on fertility, but an impact nevertheless. This finding further corroborates our earlier claim on the results obtained by Gaviria and Pagés (2002) regarding the channel through which crime and fertility are interrelated. Our finding of a positive impact of the probability of escaping arrest on both crime and fertility suggests that the positive link between fertility and crime is endogenously determined, rather than running from fertility to crime.

Shifting attention to the other determinants of fertility, probably the most important reflects mortality rates. In theory, higher mortality leads to higher fertility through

[28]With a coefficient of 0.002 from column (8), the effect on fertility is calculated as $0.002 \times 22.24 = 0.044$.

a variety of channels. These channels include factors that relate to the physiological and replacement effect, the hoarding effect, and the quantity-quality trade-off. The physiological channel (Palloni and Rafalimanana (1999)) stresses that the death of a child increases the probability that parents will have a new birth, while the hoarding channel (Kalemli-Ozcan (2003)) prescribes that an environment of high mortality leads parents to insure themselves by having more children. According to the last of the three channels (Becker (1960), Galor and Weil (1999)), high mortality makes investments in children's human capital less attractive by reducing the expected time horizon over which such capital can be used, leading parents to choose child quantity over child quality. The positive effect of mortality on fertility is strongly confirmed in our results, in line with the contributions of Angeles (2010) and Herzer et al. (2010).

The remaining three determinants, described by economic development, urbanization and unemployment, have all figured in the literature as offering explanations of fertility changes. A more developed and technologically advanced economy may offer a higher remuneration for human capital and, thus, induce parents to invest in the education of their children at the expense of their number. At the same time though, children can be regarded as "normal goods," so that higher incomes would lead parents to increase fertility. Urbanization, viewed as an output of modernization, leads to a change in fertility behaviour through changes in people's attitudes and preferences. These relate to perceptions towards fertility control and the role of women during the transition from a traditional paternal society to a modern society. Thus, higher urbanization should be followed by lower fertility. Further, unemployment is thought of leading to lower fertility due to the uncertainty and insecurity it causes regarding the levels of present and future income. Controlling for endogeneity, our results support a positive effect of economic development on fertility, while the impact of urbanization and unemployment are largely insignificant. Finally, column (9) indicates that fertility is subject to strong hysteresis effects that is suggestive of the long time required for people to change their attitudes and values regarding childbearing decisions.

Table 5 shows that the benchmark fertility findings remain robust when we subject them to a number of sensitivity tests. Column (1) uses the probability of escaping conviction for theft as a proxy for π, while column (2) defines crime by burglary rates. Columns (3)-(5) use various measures of fertility (crude birth rate, net fertility rate, and population growth), while columns (6)-(7) change the measure of mortality (under-5 child mortality and life expectancy).[29] Finally, column (8) includes education and the female labour force participation rate as additional controls. Consistent with empirical findings in the literature (Adsera (2004), Angeles (2010)), education diminishes fertility while the increasing financial security of women via participation to the paid labour market increases the number of children.

[29] For instance, Angeles (2010) uses life expectancy since it incorporates mortality rates at all stages in life. In this way, it is viewed as better accounting for the full effects of mortality changes on fertility.

3.3.3 Economic Growth

The empirical literature has not examined directly the impact of the risk of apprehension on economic growth, but has rather focused on the growth impact of crime. Even this relationship, however, is not well documented. A few studies exist at the national level, while there is a lack of studies at the cross-country level, mainly due to two reasons: the innacuracy inherent in crime data and the inconsistency in the definition of crime across countries (Powell et al. (2010)).[30] Nevertheless, the evidence from the existing studies as to the growth effect of criminal activities is quite compeling, as they generally reveal a strong negative effect.[31] Single-country studies include Cárdenas and Rozo (2008) for Colombia, Peri (2004) and Detotto and Otranto (2010) for Italy, Rincke (2010) for US Metropolitan Statistical Areas, while cross-country work has been conducted by Gaibulloev and Sandler (2008) for 18 Western European countries and the World Bank (2006) for up to 43 countries.

Unlike the existing literature on this issue, we focus on the impact of avoiding apprehension on economic growth. For this reason, we estimate the reduced form growth rate equation (33), the results of which appear in Table 6. Starting with the variables included in the set W_j, they are supportive of the general findings in the literature. Specifically, higher levels of private investment, a more outward-oriented trade policy, and a fiscal surplus promote economic growth, while a higher rate of inflation distorts growth. In addition, there is only weak evidence of conditional convergence. Finally, the likelihood of escaping apprehension exerts a negative effect on growth, which is more sizeable when $\pi > 20\%$ and highly significant when instrumented for. This result provides support to the dominance of the effects that materialize via the declines in childrearing time and government revenue which reduce health status and labour productivity, compared to the effect that takes shape through rising savings. The magnitude of the coefficient estimate from column (6) implies that an increase of a one-standard-deviation in the probability of escaping apprehension is associated with a 1.6 percent decrease in growth rates. This is a non-negligible effect.

Following in the steps of the robustness checks conducted with respect to crime and fertility, in Table 7, once again we consider changing the proxy for π (column (1)), the category of non-violent crime (column (2)), and the addition of further control variables (column (3)-(4)). None of these considerations impact upon our core findings. The additional controls also have the expected signs, with education and democracy positively associated with growth (the latter at a diminishing rate). One could argue that the use of annual data in the growth regressions distort the long-run growth impact of the right-hand-side variables, and of π in particular, as there is no control of business cycle effects. Taking this into account, we re-estimate the growth regression by using 5-year period averages of the data. The difference-GMM results appear in columns (5)

[30] Studies typically use intentional homicide rates as a measure of crime because they are thought to be least subject to variation in definition and reporting to authorities.

[31] The sole exception is Mauro and Carmeci (2007) who found crime not to have a statistically significant effect on Italian output per capita growth.

and (6) and illustrate that our benchmark outcomes remain intact despite the smaller number of observations. This is also true in columns (7) and (8) when we use the system-GMM estimation.[32]

3.3.4 Joint Regressions

The final set of regressions we run considers the inter-relationships among the three endogenous variables of our analysis. This amounts to simultaneously estimating the structural equations of our model (24), (25) and (30), treating them as a system. This implies that the probability offenders face in escaping apprehension is not included directly in the growth equation, but its effect on growth materializes through the rates of crime and fertility now incorporated in the growth regression.

Table 8 reports the results of the 3SLS regressions. Conforming to the non-linearities unveiled above, the first set of columns restrict the data to values of $\pi > 20\%$. We find that the likelihood of avoiding arrest positively influences both crime and fertility. At the same time, these two variables distort economic growth. These results corroborate the findings of the single-equation estimations and, once again, confirm the implications of our theoretical model. Further, the estimated effects of the remaining control variables of all three equations do not disprove the earlier results.

The second set of columns utilizes the entire set of observations by including all available data. Now the effect of π is separately considered for values below and above the threshold of 20%. This is done with the introduction of two dummy variables where the first (second) takes the value of 1 when $\pi < 20\%$ ($\pi > 20\%$) and zero otherwise. Then, these dummies are interacted with π to produce its non-linear effect on crime and fertility. Indeed, the results show the statistically significant effect only of the high π values (at the 1% level). These results are matched by the growth-diminishing effects of crime and fertility.

The final set of columns re-runs the restricted version of column (1) by replacing π with its second lagged value to control for endogeneity. This action appears to have no bearing on the sign, significance, and size of the coefficients of interest.

4 Concluding Remarks

The aim of this paper has been to establish a link between crime and fertility and examine the way through which these two variables jointly influence economic growth. The factor that links crime and fertility decisions is the probability of escaping criminal apprehension, or inversely, the likelihood of criminal arrest. We focus on this variable given its importance as a determinant of crime-related activities, stressed both in the theoretical and the empirical literature.

[32] The use of system-GMM is plausible with the averaged data due to the smaller number of instruments required for each instrumented variable. This allow us to instrument for all of the right-hand-side variables.

The paper develops a theoretical model that brings together the above elements of interest. It then proceeds to test empirically the theoretical predictions. The theoretical model is based on an OLG economy where reproductive agents live for three periods: childhood, adulthood and old-age. Adult agents allocate their time into four activities: work, leisure, child-rearing, and crime. Even though work time is exogenously determined, individuals optimally choose their time allocation in the remaining activities. This involves taking into account the returns of crime and of the health status of children. These two jointly influence decisions as to the levels of crime and fertility, which in turn guide the behaviour of economic growth given the linear dependence of adult health status (labour productivity) and children health status.

Our theoretical contribution is three-fold. First, we show that the effect of crime-escaping likelihood on criminal activity (in the form of theft) is non-monotonic. Specifically, only after a critical probability threshold, the likelihood of escaping apprehension has a positive effect on crime. This finding improves upon the current literature which reports a linear positive effect. Second, fertility rises for relatively high values of the probability of escaping arrest, thus giving rise to a positive relationship between crime and fertility. Worthy of note is that this relationship is not causal as suggested in the literature, but arises endogenously through the impact of the arrest probability. Third, the impact of the apprehension probability on economic growth is not straightforward due to the non-linearities and the multitude of channels of influence. Thus, in theory it is plausible that higher crime and fertility rates, due to higher likelihood of avoiding apprehension, have a positive growth effect.

The implications of the theoretical model are tested against data from 90 countries over the period 1970-2008. This involves tracing the impact of escaping the arrest likelihood on the three key variables of the model: crime, fertility, and growth. The empirical methodology considers both reduced form estimations and simultaneous estimations of the system of the three equations. Our results broadly support the theoretical predictions as they suggest a non-linear effect of the probability of escaping apprehension on both crime and fertility rates. The estimated critical value of this probability is found to lie in the neighborhood of 10%-30%. In addition, the impact on growth is consistently found to be negative, making clear that higher rates of crime and fertility distort economic growth. These findings are robust to various sensitivity tests and efforts to control for endogeneity bias.

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Appendix A

Technical Appendix

Before solving the individual's maximization problem, rewrite equation (14), with the use of (22), for $t+1$ as

$$h_{t+1}^{C} = \lambda(h_{t+1}^{A})^{\kappa}(\varepsilon_{t+1})^{\nu_C}(\frac{G_{t+1}^{H}}{Y_{t+1}})^{1-\nu_C},$$

and combine with (15) to get

$$h_{t+1}^{C} = \lambda(h_{t}^{C})^{\kappa}(\varepsilon_{t+1})^{\nu_C}(\frac{G_{t+1}^{H}}{Y_{t+1}})^{1-\nu_C}. \tag{A1}$$

From (3), which we rewrite here, each individual maximizes

$$U_{t+1} = \ln(c_{t+1}^{t}) + \ln(1-\varepsilon_{t+1}n_{t+1}-\theta_{t+1}) \tag{A2}$$

$$+\ln(n_{t+1}h_{t+1}^{C}) + \frac{\ln(c_{t+2}^{t})}{1+\rho},$$

with respect to c_{t+1}^{t}, $c_{t+2}^{t}, \varepsilon_{t+1}$, θ_{t+1} and n_{t+1}, subject to (A1), (16), (17) and (2), as well as (6), which is rewritten here for convenience:

$$(1-\lambda n_{t+1})(1-\tau)a_{t+1}w_{t+1} - Z_{t+1} + \pi x_{t+1} - c_{t+1}^{t} - \frac{c_{t+2}^{t}}{1+r_{t+2}} = 0. \tag{A3}$$

First-order conditions yield the familiar Euler equation[33]

$$\frac{c_{t+2}^{t}}{c_{t+1}^{t}} = \frac{1+r_{t+2}}{1+\rho}, \tag{A4}$$

together with

$$\frac{n_{t+1}}{1-\varepsilon_{t+1}n_{t+1}-\theta_{t+1}} = \frac{\nu_C}{\varepsilon_{t+1}}, \tag{A5}$$

$$\frac{1}{1-\varepsilon_{t+1}n_{t+1}-\theta_{t+1}} = \frac{\pi(1-\tau)\alpha_{t+1}w_{t+1}}{c_{t+1}^{t}}, \tag{A6}$$

$$-\frac{\varepsilon_{t+1}}{1-\varepsilon_{t+1}n_{t+1}-\theta_{t+1}} + \frac{1}{n_{t+1}} = \frac{(1-\tau)\lambda\alpha_{t+1}w_{t+1}}{c_{t+1}^{t}}. \tag{A7}$$

Substituting (A4) into the intertemporal budget constraint (A3) yields

$$c_{t+1}^{t} = \left(\frac{1+\rho}{2+\rho}\right)\left[(1-\lambda n_{t+1})(1-\tau)a_{t+1}w_{t+1} - Z_{t+1} + \pi x_{t+1}\right], \tag{A8}$$

[33] Recall that Z_{t+1} is not a choice variable for the individuals as it is out of their control.

which with the use of (2), and the fact that in equilibrium $x_{t+1} = Z_{t+1}$, produces

$$c_{t+1}^{t} = (1-\sigma)\left[(1-\lambda n_{t+1}) - (1-\pi)\theta_{t+1}\right](1-\tau)a_{t+1}w_{t+1}, \tag{A9}$$

where $\sigma = \frac{1}{2+\rho} < 1$.

Equation (A9) implies that saving, $s_{t+1} = (1-\lambda n_{t+1})(1-\tau)a_{t+1}w_{t+1} - Z_{t+1} + \pi x_{t+1} - c_{t+1}^{t}$, is equal to

$$s_{t+1} = \sigma\left[(1-\lambda n_{t+1}) - (1-\pi)\theta_{t+1}\right](1-\tau)a_{t+1}w_{t+1}. \tag{A10}$$

A necessary condition for positive values of first-period consumption and saving is $(1-\lambda n_{t+1}) - (1-\pi)\theta_{t+1} > 0$, which as shown below is satisfied in equilibrium.

Substituting (A9) in (A6) and (A7) yields respectively

$$\frac{1}{1-\varepsilon_{t+1}n_{t+1}-\theta_{t+1}} = \frac{\pi}{(1-\sigma)[(1-\lambda n_{t+1}) - (1-\pi)\theta_{t+1}]}, \tag{A11}$$

$$-\frac{\varepsilon_{t+1}}{1-\varepsilon_{t+1}n_{t+1}-\theta_{t+1}} + \frac{1}{n_{t+1}} = \frac{\lambda}{(1-\sigma)[(1-\lambda n_{t+1}) - (1-\pi)\theta_{t+1}]}. \tag{A12}$$

Now divide (A5) by (A11) to get

$$n_{t+1} = \frac{v_C(1-\sigma)[(1-\lambda n_{t+1}) - (1-\pi)\theta_{t+1}]}{\pi\varepsilon_{t+1}}, \tag{A13}$$

so that

$$\varepsilon_{t+1}n_{t+1} = \Lambda, \tag{A14}$$

where

$$\Lambda \equiv \frac{v_C(1-\sigma)[(1-\lambda n_{t+1}) - (1-\pi)\theta_{t+1}]}{\pi}. \tag{A15}$$

Rearrange (A5) to obtain

$$\frac{\varepsilon_{t+1}n_{t+1}}{1-\varepsilon_{t+1}n_{t+1}-\theta_{t+1}} = \nu_C.$$

Substituting (A14) back in this expression yields

$$\frac{\Lambda}{1-\Lambda-\theta_{t+1}} = \nu_C, \tag{A16}$$

which, with further rearranging, yields an equation in θ_{t+1} and n_{t+1}:

$$\nu_C\theta_{t+1} = \nu_C - (1+\nu_C)\Lambda. \tag{A17}$$

Substituting (A14) in (A12), and using (A16), yields a second equation in θ_{t+1} and n_{t+1}:

$$\lambda n_{t+1}[1 + (1-\nu_C)(1-\sigma)] = (1-\nu_C)(1-\sigma)[1-(1-\pi)\theta_{t+1}]. \tag{A18}$$

Combining equations (A17) and (A18), along with (A15), we jointly solve for the optimal values of θ_{t+1} and n_{t+1}:

$$\tilde{\theta} = \frac{\pi[1+(1-\nu_C)(1-\sigma)] - (1+\nu_C)(1-\sigma)}{\pi[1+(1-\nu_C)(1-\sigma)] - (1+\nu_C)(1-\sigma)(1-\pi)} < 1, \tag{A19}$$

$$\tilde{n} = \frac{(1-\nu_C)(1-\sigma)\pi^2}{\lambda\left\{\pi[1+(1-\nu_C)(1-\sigma)] - (1+\nu_C)(1-\sigma)(1-\pi)\right\}}. \tag{A20}$$

Equation (A19) implies that agents allocate a positive share of their time toward crime-related activities if $\pi[1+(1-\nu_C)(1-\sigma)] - (1+\nu_C)(1-\sigma) > 0$.[34] This, in turn, holds only if the probability of escaping apprehension (π) exceeds a threshold, defined as

$$\pi > \frac{(1+\nu_C)(1-\sigma)}{1+(1-\nu_C)(1-\sigma)} \equiv \pi^*. \tag{A21}$$

For π^* to be meaningfull, it needs to be less than one. This is satisfied with a mild assumption concerning the size of ν_C; $\nu_C < 1/2(1-\sigma)$. This means that the elasticity of children's health status with respect to the time parents allocate to them cannot be too large.

In addition, equation (A20) shows that $\pi > \pi^*$ represents a sufficient condition to generate a positive fertility rate. However, for $\tilde{n} \geq 1$, so to avoid convergence of population size toward zero, an additional assumption is required:

$$\lambda \leq \frac{(1-\nu_C)(1-\sigma)\pi^2}{\pi[1+(1-\nu_C)(1-\sigma)] - (1+\nu_C)(1-\sigma)(1-\pi)}. \tag{A22}$$

Thus, the fraction of income spent on caring for each child cannot be too large.

Substituting the equilibrium values of θ_{t+1} and n_{t+1}, from (A19) and (A20), into (A14), gives rise to the optimal shares of time parents allocate to all their children and to each child individually, $\varepsilon_{t+1}n_{t+1}$ and ε_{t+1}:

$$\tilde{\varepsilon}\tilde{n} = \frac{\pi\nu_C(1-\sigma)}{\pi[1+(1-\nu_C)(1-\sigma)] - (1+\nu_C)(1-\sigma)(1-\pi)}, \tag{A23}$$

$$\tilde{\varepsilon} = \frac{\lambda\nu_C}{\pi(1-\sigma)}. \tag{A24}$$

[34] A positive $\tilde{\theta}$ requires both the numerator and the denominator in equation (A19) to be positive. Note however that this is satisfied with the single condition that the numerator is positive.

From (A23) it can be shown that a sufficient condition for $0 < \tilde{\varepsilon}\tilde{n} < 1$ is $\pi > \pi^*$. From equations (A19) and (A23), it can also be shown that leisure is positive in equilibrium as long as (A21) holds:

$$1 - \tilde{\varepsilon}\tilde{n} - \tilde{\theta} = \frac{\pi(1-\sigma)}{\pi[1+(1-\nu_C)(1-\sigma)] - (1+\nu_C)(1-\sigma)(1-\pi)}. \tag{A25}$$

Finally, from (A19) and (A20) one can show that $(1-\lambda\tilde{n}) - (1-\pi)\tilde{\theta} > 0$ so that consumption and saving are positive in equilibrium.

Equations (A19), (A20), (A23), (A24) and (A25) have the following implications as to the effect of a change in the probability of escaping apprehension:

$$\frac{d\tilde{\theta}}{d\pi} > 0,$$

$$\frac{d\tilde{n}}{d\pi} < 0 \text{ if } \pi^* < \pi < \pi^{**} \equiv \frac{2(1+\nu_C)(1-\sigma)}{1+2(1-\sigma)},$$

$$\frac{d\tilde{n}}{d\pi} > 0 \text{ if } \pi > \pi^{**},$$

$$\frac{d(\tilde{\varepsilon}\tilde{n})}{d\pi} < 0,$$

$$\frac{d\tilde{\varepsilon}}{d\pi} < 0,$$

$$\frac{d(1-\tilde{\varepsilon}\tilde{n}-\tilde{\theta})}{d\pi} < 0.$$

Thus, for $\pi > \pi^*$, an increase in the probability of escaping apprehension raises the time agents allocate to criminal activities $\tilde{\theta}$, while it lowers total $\tilde{\varepsilon}\tilde{n}$ and per-child time $\tilde{\varepsilon}$ allocated to childrearing, as well as leisure time $1 - \tilde{\varepsilon}\tilde{n} - \tilde{\theta}$. At the same time, a higher probability of escaping apprehension, has a non-linear impact on the fertility rate $\tilde{n}$, in the sense that it lowers fertility when $\pi^* < \pi < \pi^{**}$ and raises fertility for $\pi > \pi^{**}$.[35]

To study the dynamics in this economy, substitute (A10) in (23) with $n_t = \tilde{n}$ and $\theta_t = \tilde{\theta}$ $\forall t$, to get

$$K_{t+1} = \sigma\left[(1-\lambda\tilde{n}) - (1-\pi)\tilde{\theta}\right](1-\tau)N_t a_t w_t, \tag{A26}$$

and further substitute for w_t from (10),

[35] Note that under the assumption discussed above $\nu_C < 1/2(1-\sigma)$, both $\pi^{**} < 1$ and $\pi^{**} > \pi^*$.

$$K_{t+1} = \beta\sigma(1-\tau)\left[(1-\lambda\tilde{n}) - (1-\pi)\tilde{\theta}\right] Y_t. \tag{A27}$$

The next step is to calculate G_t^H/Y_t, to determine the dynamics of h_t^A in (16). From (10) and (20),

$$\frac{G_t^H}{Y_t} = \beta\upsilon_H\left[\tau + (1-\pi)(1-\tau)\tilde{\theta}\right]. \tag{A28}$$

The above equation can be substituted into (16) to give,

$$h_{t+1}^A = \lambda(\beta\upsilon_H)^{1-\nu_C}(\tilde{\varepsilon})^{\nu_C}\left[\tau + (1-\pi)(1-\tau)\tilde{\theta}\right]^{1-\nu_C}(h_t^A)^{\kappa}. \tag{A29}$$

Equation (A29) is an autonomous, first-order linear difference equation in $\hat{h}_t^A = \ln h_t^A$, whose steady-state solution is

$$\tilde{h}^A = \Gamma^{\frac{1}{1-\kappa}}, \tag{A30}$$

where $\Gamma = \lambda(\beta\upsilon_H)^{1-\nu_C}(\tilde{\varepsilon})^{\nu_C}\left[\tau + (1-\pi)(1-\tau)\tilde{\theta}\right]^{1-\nu_C}$.

Solving equation (A29) yields

$$\tilde{h}^A = \left(\frac{1-\kappa^t}{1-\kappa}\right)\kappa\ln\Gamma + \kappa^t\hat{h}_0^A.$$

Therefore, for stability we require $\kappa < 1$, which is satisfied by assumption. Thus, h_t^A converges monotonically to $\tilde{h}^A$, and the equilibrium is unique.

The production function equation (12) implies that aggregate output in $t+1$ is

$$Y_{t+1} = A_{t+1}^{\beta}K_{t+1}, \tag{A31}$$

or equivalently, using (17) and (A27),

$$Y_{t+1} = (h_{t+1}^A)^{\beta}\beta\sigma(1-\tau)\left[(1-\lambda\tilde{n}) - (1-\pi)\tilde{\theta}\right] Y_t. \tag{A32}$$

Thus, the steady-state growth rate of output is

$$1+\gamma = (\tilde{h}^A)^{\beta}\beta\sigma(1-\tau)\left[(1-\lambda\tilde{n}) - (1-\pi)\tilde{\theta}\right], \tag{A33}$$

where $\tilde{h}^A$ is given by (A30), and $\tilde{\theta}$, $\tilde{n}$, and $\tilde{\varepsilon}$ are the solutions of (A19), (A20) and (A24).

Equation (A33) implies that a change in the probability of escaping apprehension has an ambiguous effect on steady-state output growth:

$$\frac{d(1+\gamma)}{d\pi} = \Gamma^{\frac{\beta}{1-\kappa}}\beta\sigma(1-\tau)\left\{\frac{\beta}{1-\kappa}\frac{\nu_C}{\tilde{\varepsilon}}\frac{d\tilde{\varepsilon}}{d\pi}\left[(1-\lambda\tilde{n}) - (1-\pi)\tilde{\theta}\right]\right. \tag{A34}$$

$$-\frac{\beta}{1-\kappa}\frac{(1-\nu_C)(1-\tau)}{\tau+(1-\pi)(1-\tau)\tilde{\theta}}\left[\tilde{\theta}-(1-\pi)\frac{d\tilde{\theta}}{d\pi}\right]\left[(1-\lambda\tilde{n})-(1-\pi)\tilde{\theta}\right]$$

$$\left.-\lambda\frac{d\tilde{n}}{d\pi}+\tilde{\theta}-(1-\pi)\frac{d\tilde{\theta}}{d\pi}\right\}.$$

This is a result of the negative sign of the first expression in the brackets and the ambiguous signs of the expressions in the following two rows. In particular, the expression in the second row is positive (negative) for $\pi < \pi^{**}$ ($\pi > \pi^{**}$), while the expression in the last row is positive (negative) for $\pi > \pi^{**}$ ($\pi < \pi^{**}$).

Appendix B

Country Sample and Data Sources

Country Sample (90)

Andorra, Australia, Austria, Argentina, Azarbaijan, Bahrain, Belarus, Bermuda, Bulgaria, Canada, Chile, Colombia, Costa Rica, Croatia, Cyprus, Denmark, Ecuador, El Salvador, Egypt, Estonia, Fiji, Finland, France, Georgia, Germany, Greece, Guyana, Hong-Kong, Hungary, Iceland, Ireland, India, Iraq, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Korea Rep., Kuwait, Kyrgyz Rep., Latvia, Lithuania, Macedonia FYR, Madagascar, Malaysia, Maldives, Malta, Marshall Islands, Mauritius, Moldova, Montserrat, Netherlands, New Zealand, Nicaragua, Norway, Occupied Palestinian Territory, Oman, Panama, Papua New Guinea, Paraguay, Peru, Poland, Portugal, Qatar, Romania, Russian Federation, Sao Tome and Principe, Saudi Arabia, Singapore, Slovenia, South Africa, Spain, Sri Lanka, Swaziland, Sweden, Syrian Arab Rep., Tajikistan, Tanzania, Thailand, Tonga, Tunisia, Turkey, Ukraine, United Kingdom, Uganda, Uruguay, Zambia, Zimbabwe.

Table B1
Variables description and sources

Variable	Definition	Source
Basic Set		
Total recorded theft rates	Total recorded thefts per 100,000 inhabitants.	United Nations Surveys on Crime Trends and the Operations of Criminal Justice Systems (*CTS*)
Probability of escaping apprehension for theft (π)	Defined as 1 minus the probability of being apprehended by the police, the latter proxied by the number of arrests per recorded theft.	*CTS*
Population share of ages 15-64	Population ages 15-64 (% of total).	World Bank, *WDI*
Urbanization rate	Urban population (% of total).	World Bank, *WDI*
GDP per capita	GDP per capita in constant 2000 US$.	World Bank, *WDI*
GDP growth rate	Annual percentage growth rate of GDP based on constant local currency.	World Bank, *WDI*
Unemployment rate	Unemployment, total (%of total labor force).	World Bank, *WDI*
Fertility rate	Fertility rate (births per woman), total.	World Bank, *WDI*
Infant mortality rate	Mortality rate, infant (per 1,000 live births).	World Bank, *WDI*
GDP p.c. growth rate	Annual percentage growth rate of GDP per capita based on constant local currency.	World Bank, *WDI*
Inflation rate	Inflation, consumer prices (annual %).	World Bank, *WDI*
Budget balance	Cash surplus/deficit (% of GDP).	International Monetary Fund, *GFS* (1972-1999) & World Bank, *WDI* (1990-2008)
Trade openness	Trade as % of GDP.	World Bank, *WDI*
Investment	Gross fixed capital formation (% of GDP).	World Bank, *WDI*

Sensitivity Set		
Probability of escaping conviction for theft	Defined as 1 minus the probability of being convicted by the judiciary system, the latter proxied by the number of convictions per recorded theft.	*CTS*
Total recorded burglaries rates	Total recorded burglaries per 100,000 inhabitants.	*CTS*
Probability of escaping burglary	Defined as 1 minus the probability of being apprehended by the police, the latter proxied by the number of arrests per recorded burglary.	*CTS*
Sex ratio	Ratio of male-to-female population.	World Bank, *WDI*
Female labour force participation rate	Labour participation rate, female (% of female population ages 15+).	World Bank, *WDI*
Democracy	Sum of two indices that assess the extent to which a country effectively respects political rights and civil liberties, both measured on a 1 to 7 scale. The index is reversed, such that it ranges from 2 (least democratic) to 14 (most democratic).	Freedom House
Human rights violations	Two scales are reported in the source. One is based upon a codification of country information from Amnesty International's annual human rights reports on a scale from 1 (best) to 5 (worst). The second scale is based upon information from the US Department of State's Country Reports on Human Rights Practices. The present study uses the simple average of the two scales.	Purdue Political Terror Scales
Education	School enrollment, tertiary (% gross).	World Bank, *WDI*
Income inequality	Gini coefficient: measures the concentration of incomes between 0 (absolute equality) and 100 (maximum inequality).	UN-WIDER
Crude birth rate	Birth rate, crude (per 1,000 people).	World Bank, *WDI*
Net fertility rate	As the total fertility rate is expressed in births per woman while the mortality rate is expressed in terms of 1,000 live births, the rate of mortality is adjusted in order to be expressed in terms of live births per woman: net fertility rate = total fertility rate – (total fertility rate)*(mortality rate)/1000.	World Bank, *WDI* based on own calculations.
Population growth rate	Population growth (annual %).	World Bank, *WDI*
Under-5 mortality rate	Mortality rate, under-5 (per 1,000).	World Bank, *WDI*
Life expectancy	Life expectancy at birth, total.	World Bank, *WDI*

Table 1
Summary statistics

Variable	Mean	Std. Dev.	Min	Max	Obs
Total recorded theft rates	1432	1587	2.69	8619	457
Probability of escaping apprehension for theft (π)	69.45	22.24	0	99.81	457
Population share of ages 15-64	65.66	4.01	50.86	73.48	457
Urbanization rate	67.16	15.8	13.2	100	457
GDP per capita (log)	8.73	1.2	5.73	10.53	457
GDP growth rate	3.16	4.13	-21.16	12.67	457
Unemployment rate	8.94	4.9	0.6	34.5	457
Fertility rate	1.95	0.874	1.09	6.68	443
Infant mortality rate	15.61	15.95	2.4	98.1	443
GDP p.c. growth rate	2.74	4.03	-16.36	12.95	386
Inflation rate	29.41	149.2	-1.13	2221	386
Budget balance	-2.11	4.44	-23.2	16.44	386
Trade openness	91.6	60.3	15.68	413.4	386
Investment	21.84	5.22	10.47	43.58	386

Notes: All variables are based on annual data. A detailed description of the variables and their sources appears in Table B1.

Figure 1
Probability of escaping apprehension for theft and recorded theft rates

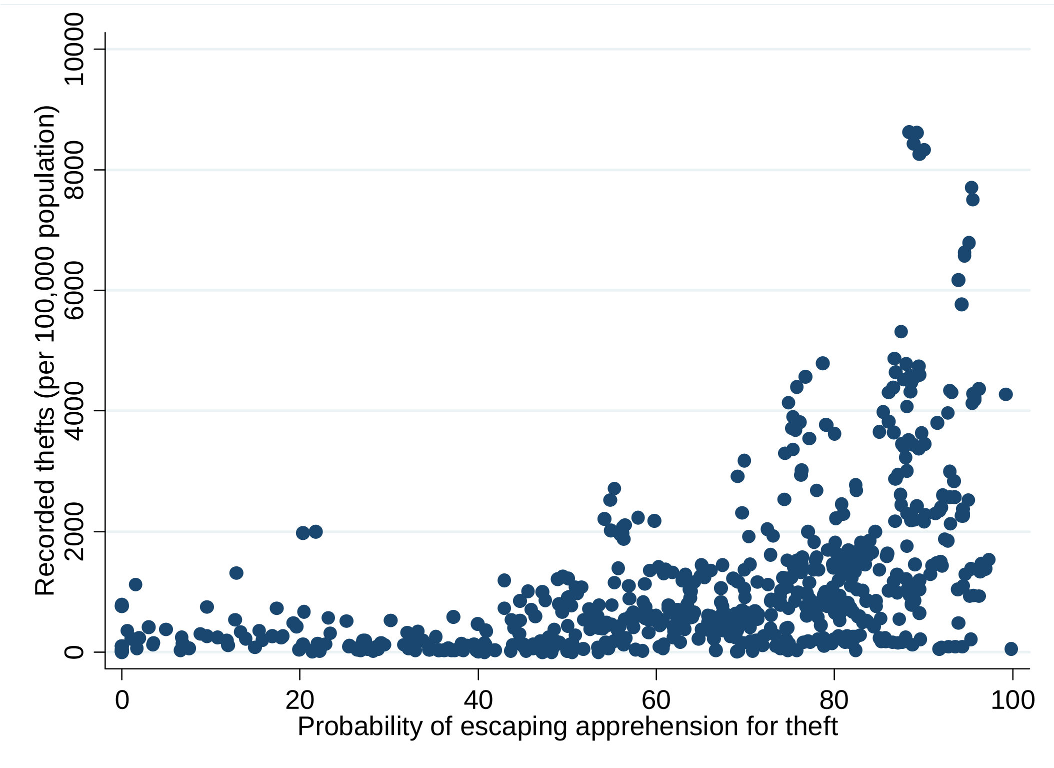

Table 2
Crime regressions: benchmark findings

	(1) FE(i)	**(2) FE(i)**	**(3) FE(i)**	**(4) FE(i,t)**	**(5) FE(i,t)**	**(6) IV-FE(i,t)**	**(7) GMM-DIFF**	**(8) GMM-DIFF**
Lagged crime rate								**0.525**
								(0.000)
π	6.34	-5.27	-12.14	-11.13	**-7.86**	**-96.95**	**-1.26**	**-8.42**
	(0.001)	(0.334)	(0.151)	(0.189)	**(0.354)**	**(0.145)**	**(0.171)**	**(0.000)**
π squared		0.126	0.222	0.210	**0.186**	**1.49**	**0.069**	**0.140**
		(0.023)	(0.009)	(0.014)	**(0.027)**	**(0.021)**	**(0.000)**	**(0.000)**
Population share of ages 15-64			151.1	160.7	104.8	-0.863	171.2	164.4
			(0.000)	(0.000)	(0.014)	(0.991)	(0.000)	(0.000)
Urbanization rate			9.36	27.85	12.92	138.3	-30.47	41.26
			(0.786)	(0.418)	(0.726)	(0.071)	(0.043)	(0.038)
GDP per capita (log)			1922	757.7	3018	3791	**-1839**	**-4449**
			(0.346)	(0.711)	(0.066)	(0.316)	**(0.054)**	**(0.000)**
GDP per capita squared (log)			-91.38	-26.70	-139.1	-310.7	**107.8**	**263.9**
			(0.459)	(0.828)	(0.165)	(0.173)	**(0.058)**	**(0.000)**
GDP growth rate			-13.05	-6.94	-5.47	21.59	-9.80	-4.22
			(0.114)	(0.409)	(0.535)	(0.306)	(0.000)	(0.000)
Unemployment rate			39.46	44.36	44.14	-11.13	-23.06	-44.69
			(0.010)	(0.004)	(0.003)	(0.669)	(0.000)	(0.000)
Implied probability threshold (%)	-	*20.91*	*27.34*	*26.52*	*21.13*	*32.32*	*9.14*	*30.07*
Countries / Observations	88 / 656	88 / 656	71 / 457	71 / 457	64 / 403	48 / 309	63 / 359	54 / 319
R^2	0.229	0.322	0.277	0.278	0.368			
Number of Instruments							54	54
Hansen J-statistic *(p-value)*							0.230	0.422
AR(1) test *(p-value)*							0.030	0.090
AR(2) test *(p-value)*							0.806	0.665

Notes: p-values in parentheses based on robust standard errors. Constant term and country and time dummies not reported. Instrumented variables are in bold type. Regression (5): as regression (4) but uses as a control the second lagged value of π and its square. Instruments in regressions (6)-(8): second lagged values.

Table 3
Crime regressions: robustness checks

	(1)	(2)	(3)	(4)	(5)
π	**-15.26**	**-14.35**	**2.03**	**-2.54**	**-3.91**
	(0.136)	**(0.000)**	**(0.071)**	**(0.419)**	**(0.329)**
π squared	**0.335**	**0.150**	**0.045**	**0.095**	**0.058**
	(0.000)	**(0.000)**	**(0.000)**	**(0.017)**	**(0.035)**
Population share of ages 15-64	228.3	-34.30	180.1	204.1	-19.59
	(0.000)	(0.181)	(0.000)	(0.000)	(0.726)
Urbanization rate	-79.10	7.87	-210.2	-170.9	-135.6
	(0.000)	(0.616)	(0.000)	(0.000)	(0.124)
GDP per capita (log)	**-3291**	**-3652**	**-1709**	**-3074**	**5391**
	(0.000)	**(0.001)**	**(0.137)**	**(0.001)**	**(0.008)**
GDP per capita squared (log)	**66.56**	**160.3**	**70.9**	**117.1**	**-355.9**
	(0.042)	**(0.010)**	**(0.262)**	**(0.011)**	**(0.006)**
GDP growth rate	3.83	-0.144	-9.14	-1.32	-23.82
	(0.012)	(0.926)	(0.000)	(0.642)	(0.000)
Unemployment rate	-2.94	-8.17	-17.55	-83.85	-51.20
	(0.524)	(0.041)	(0.023)	(0.000)	(0.000)
Sex ratio			81.81		
			(0.006)		
Female labour force participation rate			17.55		
			(0.013)		
Democracy				272.1	
				(0.000)	
Democracy squared				-12.83	
				(0.000)	
Human rights violations				148.5	
				(0.000)	
Education					-23.39
					(0.038)
Income inequality					-3.22
					(0.369)
Implied probability threshold (%)	*22.77*	*44.34*	*23.06*	*13.35*	*33.79*
Countries / Observations	52 / 249	51 / 254	63 / 359	60 / 331	31 / 152
Number of Instruments	46	50	54	54	52
Hansen J-statistic *(p-value)*	0.526	0.962	0.340	0.547	0.988
AR(1) test *(p-value)*	0.070	0.983	0.006	0.006	0.098
AR(2) test *(p-value)*	0.699	0.267	0.850	0.901	0.564

Notes: p-values in parentheses based on robust standard errors. Constant term and country and time dummies not reported. All regression results based on GMM-DIFF technique. Instrumented variables are in bold type. Instruments: second lagged values.

Table 4
Fertility regressions: benchmark findings

	(1) **FE(i)**	**(2)** **FE(i)**	**(3)** **FE(i)**	**(4)** **FE(i)**	**(5)** **FE(i,t)**	**(6)** **FE(i,t)**	**(7)** **IV-FE(i,t)**	**(8)** **GMM-DIFF**	**(9)** **GMM-DIFF**
Lagged fertility rate									**0.670**
									(0.000)
π	0.002	0.003	-0.002	0.002	0.002	**0.001**	**0.004**	**0.002**	**0.001**
	(0.009)	(0.000)	(0.584)	(0.001)	(0.005)	**(0.058)**	**(0.053)**	**(0.000)**	**(0.000)**
π squared			0.00005						
			(0.136)						
Infant mortality rate				0.019	0.020	0.017	0.018	**0.042**	**0.012**
				(0.000)	(0.000)	(0.000)	(0.000)	**(0.000)**	**(0.000)**
GDP per capita (log)				-0.063	-0.149	-0.011	-0.234	**0.984**	**0.318**
				(0.357)	(0.025)	(0.851)	(0.003)	**(0.000)**	**(0.000)**
Urbanization rate				-0.010	-0.008	-0.016	-0.011	**-0.004**	**-0.004**
				(0.053)	(0.122)	(0.002)	(0.066)	**(0.781)**	**(0.437)**
Unemployment rate				-0.017	-0.017	-0.013	-0.015	0.010	0.001
				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.690)
π > 20%	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Countries / Observations	87 / 642	82 / 599	82 / 599	69 / 419	69 / 419	72 / 455	45 / 278	61 / 324	61 / 322
R^2	0.526	0.516	0.518	0.615	0.678	0.638	0.680		
Number of Instruments								55	55
Hansen J-statistic *(p-value)*								0.365	0.478
AR(1) test *(p-value)*								0.102	0.007
AR(2) test *(p-value)*								0.008	0.125

Notes: p-values in parentheses based on robust standard errors. Constant term and country and time dummies not reported. Instrumented variables are in bold type. Regression (6): as regression (5) using as a control the second lagged value of π and its square. Instruments in regressions (7)-(9): second lagged values. Regressions (8)-(9): not controlling for endogeneity of unemployment to avoid overfitting of too many instruments.

Table 5
Fertility regressions: robustness checks

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
π	**0.010**	**0.002**	**0.007**	**0.002**	**0.006**	**0.002**	**0.001**	**0.002**
	(0.000)	**(0.000)**	**(0.004)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Infant mortality rate	**0.035**	**0.062**	**0.256**	**0.037**	**0.050**			**0.035**
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**			**(0.000)**
GDP per capita (log)	**1.01**	**0.877**	**4.60**	**0.943**	**1.22**	**0.904**	**0.995**	**0.042**
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.455)**
Urbanization rate	**-0.037**	-0.024	**0.236**	**0.003**	**0.460**	**0.002**	**-0.007**	-0.028
	(0.000)	(0.000)	**(0.001)**	**(0.835)**	**(0.000)**	**(0.848)**	**(0.510)**	(0.004)
Unemployment rate	0.021	0.020	0.005	0.010	-0.002	0.009	0.015	-0.004
	(0.000)	(0.000)	(0.511)	(0.000)	(0.487)	(0.000)	(0.000)	(0.323)
Under-5 child mortality rate						**0.032**		
						(0.000)		
Life expectancy							**0.039**	
							(0.000)	
Female labor force participation rate								0.013
								(0.000)
Education								-0.001
								(0.034)
π > 20%	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Countries / Observations	50 / 230	48 / 232	62 / 334	61 / 324	62 / 334	61 / 324	62 / 334	53 / 255
Number of Instruments	47	41	55	55	55	55	55	41
Hansen J-statistic *(p-value)*	0.465	0.397	0.487	0.370	0.584	0.379	0.345	0.213
AR(1) test *(p-value)*	0.945	0.116	0.625	0.107	0.236	0.090	0.026	0.018
AR(2) test *(p-value)*	0.031	0.072	0.012	0.008	0.063	0.007	0.003	0.076

Notes: p-values in parentheses based on robust standard errors. Constant term and country and time dummies not reported. All regression results based on GMM-DIFF technique. Instrumented variables are in bold type. Instruments: second lagged values.

Table 6
Growth regressions: benchmark findings

	(1) FE(i)	(2) FE(i)	(3) FE(i,t)	(4) FE(i,t)	(5) IV-FE(i,t)	(6) GMM-DIFF	(7) GMM-DIFF
Lagged growth rate							**-0.112**
							(0.012)
π	-0.052	-0.091	-0.072	**-0.033**	**-0.208**	**-0.074**	**-0.077**
	(0.011)	(0.001)	(0.006)	**(0.053)**	**(0.087)**	**(0.000)**	**(0.000)**
GDP per capita (log)	-2.60	-2.99	-1.78	1.18	-7.36	**-6.85**	**0.285**
	(0.353)	(0.286)	(0.524)	(0.406)	(0.061)	**(0.069)**	**(0.944)**
Inflation rate	-0.011	-0.011	-0.011	-0.011	-0.011	-0.008	-0.009
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Budget balance	0.196	0.189	0.172	0.345	0.241	0.179	0.176
	(0.001)	(0.002)	(0.004)	(0.000)	(0.007)	(0.009)	(0.010)
Trade openness	0.034	0.029	0.021	0.042	0.032	0.108	0.139
	(0.038)	(0.075)	(0.185)	(0.002)	(0.199)	(0.000)	(0.000)
Investment	0.275	0.255	0.215	0.127	0.116	**0.402**	**0.428**
	(0.000)	(0.001)	(0.006)	(0.026)	(0.260)	**(0.000)**	**(0.000)**
π > 20%	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Countries / Observations	66 / 386	63 / 368	63 / 368	68 / 397	41 / 245	51 / 279	51 / 278
R^2	0.313	0.333	0.411	0.434	0.436		
Number of Instruments						41	41
Hansen J-statistic *(p-value)*						0.272	0.168
AR(1) test *(p-value)*						0.013	0.031
AR(2) test *(p-value)*						0.537	0.189

Notes: p-values in parentheses based on robust standard errors. Constant term and country and time dummies not reported. Instrumented variables are in bold type. Regression (4): as regression (3) using as a control the second lagged value of π and its square. Instruments in regressions (6)-(8): second lagged values.

Table 7
Growth regressions: robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged growth rate						**0.016**		**-0.205**
						(0.878)		**(0.000)**
π	**-0.147**	**-0.038**	**-0.058**	**-0.068**	**-0.148**	**-0.107**	**-0.100**	**-0.050**
	(0.013)	**(0.000)**	**(0.005)**	**(0.001)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
GDP per capita (log)	**15.59**	**9.32**	**-5.02**	**-4.01**	**-3.16**	**-9.63**	**-0.096**	**0.116**
	(0.000)	**(0.000)**	**(0.082)**	**(0.290)**	**(0.168)**	**(0.035)**	**(0.331)**	**(0.308)**
Inflation rate	-0.004	-0.004	-0.010	-0.012	**-0.019**	**-0.050**	**-0.011**	**-0.007**
	(0.000)	(0.000)	(0.000)	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Budget balance	-0.003	-0.123	0.178	0.152	**0.151**	**0.076**	**0.282**	**0.232**
	(0.960)	(0.000)	(0.005)	(0.088)	**(0.024)**	**(0.323)**	**(0.000)**	**(0.000)**
Trade openness	0.053	0.074	0.024	0.030	**0.043**	**-0.007**	**-0.013**	**-0.010**
	(0.000)	(0.000)	(0.191)	(0.144)	**(0.076)**	**(0.752)**	**(0.000)**	**(0.006)**
Investment	**0.017**	**0.621**	**0.518**	**0.454**	**0.542**	**0.271**	**0.224**	**0.355**
	(0.751)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Education			0.196	0.124				
			(0.001)	(0.037)				
Democracy				2.56				
				(0.018)				
Democracy squared				-0.244				
				(0.004)				
π > 20%	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Countries / Observations	40 / 192	47 / 207	46 / 226	46 / 226	34 / 51	34 / 46	68 / 121	67 / 115
Number of Instruments	35	41	41	41	31	31	48	57
Hansen J-statistic *(p-value)*	0.204	0.290	0.175	0.137	0.183	0.271	0.413	0.717
AR(1) test *(p-value)*	0.231	0.146	0.023	0.026	0.130	0.506	0.538	0.536
AR(2) test *(p-value)*	0.840	0.724	0.446	0.441	-	-	-	-

Notes: p-values in parentheses based on robust standard errors. Constant term and country and time dummies not reported. Regressions (1)-(4) based on annual data, while regressions (5)-(8) based on 5-year averaged data. Regressions (1)-(6) based on GMM-DIFF technique and (7)-(8) based on GMM-SYS technique. Instrumented variables are in bold type. Instruments for GMM-DIFF: second lagged values. Instruments for GMM-SYS: second-to-fourth lagged values.

Table 8
System of equations regressions (3SLS)

	(1)			(2)			(3)		
	Crime	**Fertility**	**Growth**	**Crime**	**Fertility**	**Growth**	**Crime**	**Fertility**	**Growth**
π < *20%*				30.73	-0.002				
				(0.244)	(0.860)				
π > *20%*	11.69	0.004		8.98	0.005		**10.60**	**0.005**	
	(0.005)	(0.034)		(0.009)	(0.005)		**(0.003)**	**(0.002)**	
Population share of ages 15-64	-24.27			-20.36			-26.77		
	(0.249)			(0.321)			(0.222)		
Urbanization rate	15.31	-0.001		15.07	-0.001		20.25	0.001	
	(0.001)	(0.822)		(0.001)	(0.700)		(0.000)	(0.790)	
GDP per capita (log)	-3003	0.076	0.593	-3012	0.057	0.663	-3195	0.129	-0.298
	(0.000)	(0.055)	(0.115)	(0.000)	(0.140)	(0.079)	(0.000)	(0.000)	(0.398)
GDP per capita squared (log)	211.2			212.5			219.3		
	(0.000)			(0.000)			(0.000)		
GDP growth rate	-246.7			-240.1			-163.7		
	(0.000)			(0.000)			(0.000)		
Unemployment rate	-9.44	-0.033		-10.88	-0.032		-16.76	-0.028	
	(0.489)	(0.000)		(0.410)	(0.000)		(0.248)	(0.000)	
Infant mortality rate		0.046			0.044			0.045	
		(0.000)			(0.000)			(0.000)	
Total recorded theft rates			**-0.002**			**-0.002**			**-0.001**
			(0.000)			**(0.000)**			**(0.023)**
Fertility			**-0.642**			**-0.587**			**-1.04**
			(0.037)			**(0.058)**			**(0.001)**
Inflation rate			-0.007			-0.007			-0.010
			(0.002)			(0.004)			(0.000)
Budget balance			0.138			0.158			0.211
			(0.001)			(0.000)			(0.000)
Trade openness			0.001			0.001			-0.001
			(0.641)			(0.671)			(0.919)
Investment			0.011			0.009			0.112
			(0.804)			(0.842)			(0.021)
Observations	301	301	301	315	315	315	278	278	278
R^2	0.420	0.684	0.046	0.428	0.673	0.052	0.470	0.653	0.317

Notes: p-values in parentheses based on standard errors. Constant term and country and time dummies not reported. All regression results based on 3SLS technique with annual data. Instrumented variables are in bold type. Regression (2): as regression (1) introducing values for π below and above 20% with the use of dummies interacted with π. Regression (3): as regression (1) using as a control the second lagged value of π.