# Crime, Different Taxation, Police Spending, and Embodied Human Capital

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**Abstract**

We develop a model with crime, embodied human capital, police spending, and three different taxation. Based on propositions examined analytically, numerically, and empirically using a cross-country panel data on crime, we contribute to the literature by identifying a positive crime-labor income tax nexus and a negative crime-capital income tax nexus. The opposite effect between labor and capital income taxation on crime is novel in the literature. We also document positive association between crime and consumption tax, which suggests that apprehension probability (a proxy for the effectiveness of criminal justice system) is endogenous to fiscal mechanism. These findings have potential policy implications in that, there is a potential role for dedicated tax instruments to be used in supporting conventional crime prevention and deterrence policies.

**JEL Classification Numbers**: H20; H59; K42; O41
**Keywords:** Macroeconomics of Crime; Police Spending; Taxation.

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# 1 Introduction

Ever since the contributions of Becker (1968) and Ehrlich (1973), most contributions in the economics of crime literature have dwelled on the effectiveness of deterrence as measure to combatting crime, as this will raise the apprehension probability and disincentivize crime. A large literature has focused on the role of sanctions and deterrence in altering the behavioral aspects of criminals (Polinsky & Shavell, 2000; Friehe, 2009), while another documented large number of empirical evidence to argue that merely having a larger number of law enforcers and police personnels on the street would have been effective in reducing crime (Corman & Mocan, 2000; Draca et al., 2011). In comparison to its microeconomics counterparts, the macroeconomics literature of crime has branched out in a way that, in addition to the inverse relationship between apprehension probability (a direct outcome of deterrence measures) and crime rate, various studies have documented a negative growth-crime relationship, hence implying the potential significance of various public policies in reducing crime (World Bank, 2006; Càrdenas, 2007; Detotto & Otranto, 2010). In general, recent studies have taken two directions. Based on Pissarides type of search considerations, studies such as Engelhardt et al. (2008) and Engelhardt (2010) focus on the effects of unemployment frictions on crime, and therefore have a predominant labor market policy focus. On the other hand, crime is explored in the context of structural models with endogenous growth (see, for instance, Mocan et al., 2005; Neanidis & Papadopoulou, 2013; Goulas & Zervoyianni, 2015), which indicate potentially greater implications of agents' decisions (time allocation, human and capital investment decisions, consumption choice) in affecting policy effectiveness in reducing crime.

In spite of all these, based on our knowledge, there remain shortcomings in the existing literature, both theoretically and in terms of policies. Theoretically, first, existing studies repeatedly found the importance of policing in deterring crime, yet the fact that police spending is financed by the government revenue from the budget barely receives any attention. Against the backdrop of recent public outcry against austerity-induced police spending cut in certain developed countries, the general equilibrium effects of taxation, which is the main component of government revenue, on crime deserve greater scrutiny. Second, with the exception of a limited number of studies such as Neanidis and Papadopoulou (2013), among all existing macroeconomic models of crime in the tradition of Imrohoroglu et al. (2004, 2006), in that agents are both perpetrators and victims of crime, the direct trade-off between formal market hours and time spent in criminal activities is often not modelled. Third, except for Mocan et al. (2005), who did account to some degree the trade-off between market works and crime (but not in a time allocation framework) by modelling two different types of human capital, most studies do not explicitly model human capital accumulation decision in macroeconomic models with crime and time allocation, even though educational decisions are often in direct trade-off to decision to engage in crime.

To address these *three shortcomings*, we develop and present a general equilibrium model of crime, human capital accumulation, police spending, and three common taxation mechanisms (capital income, labor income, and consumption taxes). In addition to the three crime literature-specific contributions, there are two additional novelties in our theoretical model: (i) on top of the introduction of a Glomm and Ravikumar (1997, 2001) type of human capital elements and the different tax considerations, we model crime as an optimal choice of time allocation by individuals, though with an asymmetric structure in that, crime does not depend on human capital, which generally fits the nature of non-organized crime such as theft/robbery; (ii) human capital is modelled using an embodied approach, specifically as a time-bounded productivity factor instead of a conventional Lucas-type disembodied approach (where human capital stock is allowed to grow without bounds). By implication of the time-bounded specification, we believe this partly mitigates a well-known shortcoming of standard Uzawa-Lucas models, in which human capital is disembodied and allowed to grow infinitely without bounds despite individuals having physical limitations.[1]

[1] Our model is therefore in the same spirit as studies with embodied human capital modelling approach, such as Tanaka and Iwaisako (2009), Agénor and Canuto (2017). These studies with overlapping generations model bind/constraint human capital to a distribution of productivity among the agents, while we provide the counterpart in a hourly context.

Based on our novel theoretical model, five analytical propositions with potentially interesting economic policy implications are derived. These are then tested empirically using an unbalanced panel dataset constructed from the various waves of the *United Nations Survey of Crime Trends and Operations of Criminal Justice Systems* (UN-CTS). To preview, despite the uneven data quality of the UN-CTS, we find some empirical supports for a positive crime-labor income tax nexus, a negative crime-capital income tax nexus, and largely positive association between crime and consumption tax. While the empirical results for the human capital-taxation relationship are largely inconclusive, insofar as crime and human capital having statistically significant relationship, the different taxation, through their effects in households' micro-decisions, would have effects on the education-crime trade-off faced by households.

Indeed, the non-linear trade-off between human capital and crime has been well-documented in the microeconomics literature, ranging from developed economies such as the United States (Lochner & Moretti, 2004), England and Wales (Machin et al., 2011), to developing economies such as Mexico (Brown & Velásquez, 2017). However, the role of the different taxation in influencing this trade-off is less understood. Instead of concurring with the rather bleak conclusion of studies such as Levitt (2004) and Buonanno et al. (2014)[2], we attempt to establish the links—albeit indirectly at a macro-level—between conventional tax instruments and opportunistic crime such as thefts and robberies. Indeed, studies such as Goulas and Zervoyianni (2015) documented statistically significant effects of economic condition variables, such as employment level and physical capital accumulation (intricately linked to labor and capital income taxes respectively) in affecting the effectiveness of police spending against criminal activities. Likewise, in the criminology literature, the impacts of business cycles on street crimes have been well-documented (Arvanites & Defina, 2006; Detotto & Otranto, 2012). To the extent that business cycles influence crime rates, the income taxes—

[2]Presenting evidence from the United States and Europe respectively, both studies conclude that the long-term determinants of crime are policy-invariant variables, such as demographic structures, immigration rates, abortion rates, and the levels of incarceration. In other words, they are sceptical of any potential role of standard economic policy tools in combatting crime.

being automatic fiscal stabilizers—is expected to influence the crime-human capital nexus too. On the other hand, for consumption taxes, recent contributions by Draca et al. (2019) has documented significant crime-price elasticities. This therefore serves as our primary policy motivation in examining the crime-consumption tax nexus. In combination, these suggest potential role of conventional tax instruments in influencing the incentives affecting crime.

The rest of the paper is structured as follows. Section 2 presents the model. The model is solved for its equilibrium in Section 3. Section 4 examines the comparative statics of equilibrium crime rate and human capital with respect to the set of policy arrangements, both analytically and numerically. Section 5 considers the extension of endogenizing apprehension probability to police spending. It is then followed by Section 6, which empirically evaluates the derived propositions. Section 7 concludes the article.

# 2 The Model

## 2.1 Preferences

The economy is populated by an infinitely-lived representative household who cares about his/her future level of human capital. The individual solves a dynastic planning problem by maximizing expected discounted utility,

$$U_t = E_t \sum_{t=0}^{\infty} \beta^t u(c_t, l_t, h_{t+1}), \tag{1}$$

where $\beta$ denotes the subjective discount factor, $c_t$, $l_t$, and $h_{t+1}$ refer to consumption, leisure, and the next-period level of human capital. The individual involves in both market work and criminal activity ($\theta_t$), and for simplicity, the individual is assumed to have a maximum $\Gamma$ amount of effective hours endowned in each period $t$. While individual allocates time to raw market work ($n_t$), the actual realized hours for market work is effective in nature because it is productivity-(human capital-)adjusted. The disutility associated with the trade-off from leisure therefore comes from the effective human capital-adjusted market work ($h_t n_t$), the time spent in committing crime ($\theta_t$), and a fixed exogenous amount of time in other activities ($\varepsilon$). This means $l_t = \Gamma - h_t n_t - \theta_t - \varepsilon$, $h_t n_t \leq \Gamma$. This bounded (by time) specification essentially gives a per-hour context to the level of human capital, in which it is measured as a per-hour productivity factor that is only relevant to market work, taken as given by the individuals.[3,4]

As mentioned, we believe this specification improves on more commonly used alternatives, such as $\Gamma = l_t + n_t + \theta_t + \varepsilon$, or $\Gamma = l_t + n_t + \theta_t + h_t + \varepsilon$. The former assumes human capital activity to be completely independent of leisure and market work considerations by households, even though it is customary for a human capital-based model to assume complementarity in the production side. On the other hand, the shortcoming of the latter is that, while it incorporates training as a time allocation choice, it assumes no complementarity between human capital and market work by treating them as a direct trade-off. Our specification accounts for some disutility from human capital activity (via its influence on the actual effective working hours) yet allows for the modelling of a direct trade-off between the productivity-adjusted market hours and the non-human capital related criminal activity (theft/robbery in the context of this model), a key feature dropped in Neanidis and Papadopoulou (2013).

Following Mauro and Carmeci (2007) and Neanidis and Papadopoulou (2013), we assume that all individuals allocate time to criminal activities, and that they can be both perpetrators and victims of crime. Similarly, in line with studies such as Imrohoroğlu et al. (2004, 2006), the income from criminal activity, interpretable as either theft or robbery in this context, $x_t$, is specified as

[3]The interpretation to our specification is that, while individuals choose their time allocation to market works ($n_t$), it is the disutility from effective working hours that has to be accounted for in its trade-off with leisure. For example, a researcher or manager contracted for 8 hours of daily work is often required to work more in effective terms, compared to a routine-task administrator who is contracted for the same hours.

[4]Implicitly, to ensure consistency in units of measurement across of the effective time constraint, this also means that individual's participation in criminal activities, leisure, and the other activities involves a time-invariant one unit of human capital, $\bar{h} = 1$.

$$x_t = \theta_t(1-\tau_n)h_t n_t w_t. \tag{2}$$

In addition to legal and illegal income, individuals accumulate assets in the form of physical capital ($k_t$), while also spend $z_t$ amount of resources in education. In each period, an individual's budget constraint is given by

$$(1-\pi_v)(1-\tau_n)h_t n_t w_t + \pi x_t + (r_t^k - \delta)(1-\tau_k)k_{t-1} + k_{t-1} = (1+\tau_c)c_t + k_t + z_t, \tag{3}$$

where $\pi_v$ is the (equal) probability of becoming a victim of crime[5], $\pi \in (0,1)$ the probability of escaping apprehension, $\pi_v \neq \pi$, $w_t$ the real wage rate, $\tau_n$ labor income tax rate, $\tau_c$ consumption tax rate, $\tau_k$ capital income tax rate, $r_t^k$ the market interest rate, and $\delta$ the depreciation rate. Moreover, it is assumed that, when an individual is caught and punished (with probability $1-\pi$), the illegal income from crime is confiscated by the government.

Individuals maximize their intertemporal utility (1) by choosing $c_t$, $n_t$, $z_t$, $\theta_t$, $k_t$, $l_t$, and $h_{t+1}$, subject to the budget constraint (3), yielding first-order conditions that can be summarized by the following:

$$\beta^{-1}\frac{u_{c,t}}{u_{c,t+1}} = 1 + (r_t^k - \delta)(1-\tau_k), \tag{4}$$

$$\frac{u_{c,t}}{(1+\tau_c)} = u_{h,t}h_{z,t}, \tag{5}$$

$$\frac{u_{n,t}}{u_{\theta,t}} = \frac{(1-\pi_v+\pi\theta_t)(1-\tau_n)}{\pi(1-\tau_n)n_t}. \tag{6}$$

Equation (4) gives the standard Euler equation for consumption. (5) states that the marginal rate of substitution between consumption and human capital investment depends on the consumption tax and a partial derivative term on the elasticity of human capital to private educational spending ($h_{z,t}$), while (6) yields the marginal rate of substitution between

[5] Similar to Imrohoglu et al. (2004, 2006), we assume that the incidence of crime is random and the criminals do not have the ability to target victims based on their income. For simplicity, it is also assumed that a victimized individual would lost all her/his after-tax wage income. Consistent with the nature of theft, this specification also essentially assumes that criminals cannot steal physical capital rental income, which is a reasonable assumption.

time allocated to market works and criminal activities, which is a function of apprehension probability ($\pi$), the random probability of victimization ($\pi_v$), hours spent in criminal activities ($\theta_t$), and more importantly, labor income tax ($\tau_n$).

## 2.2 Human Capital

Following the specification of studies linking human capital and public spending on education, such as Glomm and Ravikumar (1997, 2001), Blankenau et al. (2007), and Agénor (2011), the evolution of human capital depends on private spending on education, efficiency-adjusted public spending on education, and the accumulated stock of human capital, proxied by the average level of human capital in the previous period. Specifically,

$$h_{t+1} = (\chi_E \frac{g_t^E}{Y_t})^{\nu_1} (H_t)^{1-\nu_1-\nu_2} (\frac{z_t}{Y_t})^{\nu_2}, \tag{7}$$

where $\chi_E \in (0,1)$ is an efficiency parameter on government spending, $\nu_1, \nu_2 \geq 0$, and both components of education spending (public, $g_t^E$, and private, $z_t$) are denoted as a percentage of the final output level in the economy. Nevertheless, unlike conventional Lucas-type of growth model, human capital in this model is embodied in nature and has a per hour context (by virtue of the specification, $h_t n_t \leq \Gamma$), and ought to be interpreted only as some sort of per-hour productivity multiplicative factor. Given that (7) depends on $\chi_E$, $g_t^E/Y_t$, and $z_t/Y_t$, all $\in (0,1)$, the boundary condition would hold for all solutions of $h$.

## 2.3 Production

A continuum of identical firms, indexed by $i \in (0,1)$, produce a nonstorable homogeneous final good using private inputs in the form of private physical capital and effective labor. Assuming a Cobb–Douglas technology, the production function is:

$$Y_t = (\bar{k}_t)^{\varpi} k_{i,t}^{\alpha} (H_t n_{i,t})^{1-\alpha}, \tag{8}$$

where $k_{i,t}$ is firm-specific physical capital stock, $n_{i,t}$ the labor hours, $H_t$ the economy-wide human capital level (same across all firms), and $\bar{k}_t = \int_0^1 k_{i,t}di$ the aggregate private capital stock. There is constant return to scale to production, which is also subject to an Arrow-Romer type of production externalities associated with the aggregate private capital stock.

The first-order conditions of firm $i$ are:

$$w_t = (1-\alpha)\frac{Y_{i,t}}{H_t n_{i,t}}, \;\; r_t^k = \alpha \frac{Y_{i,t}}{k_{i,t}}. \tag{9}$$

Given that $Y_t = \int_0^1 Y_{i,t}di$, and that all firms and workers are identical, in a symmetric equilibrium, $n_{i,t} = n_t$, $k_{i,t} = k_t = \bar{k}_t$. Thus, (9) can be rewritten as

$$w_t = (1-\alpha)\frac{Y_t}{H_t n_t}, \;\; r_t^k = \alpha \frac{Y_t}{k_t}. \tag{10}$$

Aggregate output is expressed as $Y_t = (k_t)^{\varpi+\alpha}(H_t n_t)^{1-\alpha}$, which, if we assumed $\alpha+\varpi = 1$, equals

$$\frac{Y_t}{k_t} = (H_t n_t)^{1-\alpha}. \tag{11}$$

Equation (11) shows that, if this model were to have endogenous growth in a typical A-K form, then $H_t$ must be constant in a balanced growth equilibrium, which given the per-hour specification of human capital in (7), is satisfied.

## 2.4 Government

Government revenue is obtained by taxing wages, consumption, and capital income at constant rates of $\tau^n$, $\tau^c$, and $\tau^k$ respectively. When caught and punished, the illegal income of the individuals is confiscated by the government. For simplicity, we assume the government does not borrow.[6] It spends on education ($g_t^E$), public security/police ($g_t^P$), and all other categories ($g_t^O$). In line with Goulas and Zervoyianni (2015), $g_t^P$ is assumed to be non-economic productive in the benchmark model, though we extend the analysis by endogenizing the

[6] A more complicated version of the model with public debt is considered in the working paper version of this article. The analytical results documented are consistent to the simplified version considered here.

probability of escaping apprehension, $\pi$, to depend negatively on $g_t^P$ in later section.

The government's budget constraint is given by

$$g_t^E + g_t^P + g_t^O = \tau_c c_t + \tau_n w_t H_t n_t + \tau_k (r_t^k - \delta) k_{t-1} + (1-\pi)\theta_t (1-\tau_n) h_t n_t w_t, \tag{12}$$

where, in line with studies such as Agénor (2011) and Neanidis and Papadopoulou (2013), each individual component of spending is assumed to be a constant fraction of the total government revenue, as in

$$g_t^h = \upsilon_h [\tau_c c_t + \tau_n w_t H_t n_t + \tau_k (r_t^k - \delta) k_{t-1} + (1-\pi)\theta_t (1-\tau_n) h_t n_t w_t], \tag{13}$$

where $\upsilon_h$, $h = E, P, O$ are constant spending shares for the respective categories, and $\sum \upsilon_h = 1$.[7]

### 2.5 Closing the economy

To close the model, the economy-wide resource constraint is given by $Y_t = c_t + g_t + k_t - (1 - \delta) k_{t-1}$, which, after substituting in (12), is equivalent to

$$Y_t = (1+\tau_c) c_t + [\tau_n + (1-\pi)\theta_t (1-\tau_n)] w_t H_t n_t + k_t - [(1-\delta) - \tau_k (r_t^k - \delta)] k_{t-1}. \tag{14}$$

## 3 Model Solutions and Equilibrium Conditions

Assuming a log-utility function for (1), the model is solved in the Appendix, yielding a dynamic system characterizing the model solutions. Further, we define the following equilibrium conditions:

**Definition 1:** A *competitive equilibrium* is a sequence of allocations $\{c_t, n_t, z_t, \theta_t\}_{t=0}^{\infty}$, prices $\{w_t, r_t^k, r_t^B\}_{t=0}^{\infty}$, physical capital stock $\{k_t\}_{t=0}^{\infty}$, and human capital$\{h_t\}_{t=0}^{\infty}$ such that, given initial stocks $k_0, h_0 > 0$, a set of policy arrangements $\{\tau_c, \tau_n, \tau_k, \upsilon_E, \upsilon_P, \upsilon_O\}$, and an

[7] By specification of (13), both government spending on public security/police and education are therefore endogenous in the model.

(escape) apprehension probability $\pi$, all individuals maximize utility, all firms maximize profits, the government maintains its budget, and all markets clear. In addition, individual human capital level must be equal to the economy-wide average level of human capital, so that $h_t = H_t, \forall t$.

**Definition 2:** A *stationary equilibrium* is a competitive equilibrium in which: (i) the choice variables $(c_t, n_t, z_t, \theta_t)$, physical capital $(k_t)$, human capital $(h_t)$, final output $(Y_t)$ are constant $\forall t$, (ii) rates of return $(r_t^k)$ are constant, and (iii) individual and aggregate behavior are consistent. In addition, the probability of victimization equals the aggregate crime incidence rate, that is $\pi_v = \frac{\theta_t}{\Gamma}$(see Imrohoroğlu *et al.*, 2004).

In the stationary equilibrium, we also know that $\theta_t = \tilde{\theta}$, $k_t = \tilde{k}$, $\forall t$. As also derived in Appendix, the stationary equilibrium solution is characterized by the two key equations describing the equilibrium crime rate $(\tilde{\theta})$ and the equilibrium level of human capital $(\tilde{H})$, given by

$$\begin{aligned} f(\tilde{\theta}) &= (1-\alpha)\tau_n - 1 + \alpha\tau_k + (1+\tau_c)(\Phi_1)^{-1}[(\Gamma - \pi^{-1} - \varepsilon) \\ &\quad + \left[\Phi_2 + (1+\tau_c)(\Phi_1)^{-1}((\Gamma\pi)^{-1} - 2)\right]\tilde{\theta} + \delta(1-\tau_k)\left[\pi^{-1} + (1-(\Gamma\pi)^{-1})\tilde{\theta}\right]^{\alpha-1} \\ &= 0, \quad \text{and} \end{aligned} \tag{15}$$

$$\tilde{H} = (\Phi_E)^{\frac{1}{\nu_1+\nu_2}}(\Phi_1)^{-\frac{\nu_2}{\nu_1+\nu_2}}(\frac{\tilde{g}^E}{\tilde{Y}})^{\frac{\nu_1}{\nu_1+\nu_2}}\left[\Gamma - \frac{1}{\pi} - \varepsilon + \tilde{\theta}[(\Gamma\pi)^{-1} - 2]\right]^{\frac{\nu_2}{\nu_1+\nu_2}}, \tag{16}$$

where $\Phi_1 = \psi(1+\tau_c)[\eta_C\pi(1-\tau_n)(1-\alpha)]^{-1}$, and these correspond to (A25) and (A27) in the Appendix.

# 4 Analytical Propositions

By applying the implicit function theorem to the two key equations, (15) and (16), we can examine the effects of the various policy arrangements on the crime incidence $(\tilde{\theta})$ and the level of human capital $(\tilde{H})$ in stationary equilibrium. The comparative statics of the equilibrium $\tilde{\theta}$ and $\tilde{H}$ with respect to $\pi$, $\tau_c$, $\tau_k$, $\tau_n$ are derived analytically in the Appendix. For the steady-state crime incidence ($\tilde{\theta}$), the implicit function theorem is applied as follows:

$$\frac{\partial\tilde{\theta}}{\partial\pi} = -\frac{f_\pi}{f_\theta}, \frac{\partial\tilde{\theta}}{\partial\tau_c} = -\frac{f_{\tau_c}}{f_\theta}, \frac{\partial\tilde{\theta}}{\partial\tau_n} = -\frac{f_{\tau_n}}{f_\theta}, \frac{\partial\tilde{\theta}}{\partial\tau_k} = -\frac{f_{\tau_k}}{f_\theta}, \tag{17}$$

where $f_\theta$, $f_\pi$, $f_{\tau_n}$, $f_{\tau_k}$, $f_{\tau_c}$ are partial derivatives of (A25) with respect to equilibrium crime rate, apprehension probability, labor income tax, physical capital income tax, and consumption tax. As seen in the proof in the Appendix, analytically, we can easily derive **Proposition 1** below, but to sign the other partial derivatives, we will require numerical evaluations.

**Proposition 1:** $\partial\tilde{\theta}/\partial\tau_c = 0$. The equilibrium crime rate is independent of the consumption tax.

This intuition of this proposition is as follow. In the households' first-order conditions, the consumption tax ($\tau_c$) feeds into the marginal rate of substitution between consumption and human capital investment, but not the Euler equation. The latter is due to the constant tax rate cancelling out in different periods, hence not inducing any inter-temporal substitution effect. While the intra-temporal substitution effect does affect human capital investment made by individuals, by implication of criminal activities being non-human capital dependent, $f_{\tau_c} = 0$. The decision of individuals to engage in criminal activities in equilibrium is therefore independent of the consumption tax rate.

Before numerically evaluating the remaining policy parameters, for the equilibrium human capital level ($\tilde{H}$), similar comparative statics ($\frac{\partial\tilde{H}}{\partial\pi}$, $\frac{\partial\tilde{H}}{\partial\tau_c}$, $\frac{\partial\tilde{H}}{\partial\tau_n}$, $\frac{\partial\tilde{H}}{\partial\tau_k}$, $\frac{\partial\tilde{H}}{\partial\tilde{\theta}}$) are derived in the Appendix. Analytically, we can establish that $\partial\tilde{H}/\partial\tau_c > 0$ since the terms, $\Gamma - \frac{1}{\pi} - \varepsilon + \tilde{\theta}[(\Gamma\pi)^{-1} - 2]$ in (A42), which corresponds to the equilibrium level of leisure ($\tilde{l}$) is non-zero. The signs of the remaining partial derivatives cannot be established analytically and are therefore also evaluated numerically.

For the numerical evaluations, recognizing data constraints with regards to some variables, we parameterize the model economy by matching the first moments of variables and policy parameters to be as realistic as possible. The elasticity of final output with respect to private capital, $\alpha$, is set at 0.3, which is a standard value applied in parameterized growth models (Agénor & Montiel, 2015). The two parameters in human capital production function, $\nu_1$ for government spending and $\nu_2$ for household spending, are set at 0.2, which is consistent with the empirical estimate of Blankenau et al. (2007) and parameter values used by Chen (2005) and Agénor (2011). For the tax variables, we use the G7-average in the OECD tax database, and set $\tau_k = 0.282$ (in line with the corporate income tax rate), $\tau_c = 0.126$ (in line with the goods and services tax rate), and $\tau_n = 0.276$ (in line with all-in average personal income tax rate).

For the time allocation, first we know that $\Gamma = 24$. Assuming 6 hours of sleep (non-leisure hours), for the remaining time spent on effective work, leisure, and crime, the parameterization is bounded by $(\Gamma - \varepsilon) = \tilde{l} + \tilde{h}\tilde{n} + \tilde{\theta}$, as well as the equilibrium condition, $\tilde{h}\tilde{n} = \pi^{-1} + \tilde{\theta}[1 - (\Gamma\pi)^{-1}]$, $\pi \in (0, 1)$. We first set $\pi = 0.1$, and then determine simultaneously $\tilde{\theta}$ and $\tilde{h}\tilde{n}$. To simplify matters, we set a normalized value $\tilde{H} = \tilde{h} = 1$. Let victimization probability, $\pi_v$, be one-third, $\tilde{\theta} = 4$ is set, which means $\tilde{h}\tilde{n} = 13$ is solved for[8]. For the marginal propensity parameters, $\eta_C = 1.0$ and $\psi = 0.6$ are set in line with annual models with time allocation constraint, such as Imrohoroğlu et al. (2004, 2006). Finally, in line with the numbers presented in the latter, the depreciation rate, $\delta$, is set at 0.03.

Given the set of benchmark parameter values, $f_\theta = 0.322$, $f_\pi = 10.378$, $f_{\tau_n} = -3.494$, and $f_{\tau_k} = 0.294$. From (17), this means $\partial\tilde{\theta}/\partial\pi < 0$, $\partial\tilde{\theta}/\partial\tau_c = 0$, $\partial\tilde{\theta}/\partial\tau_n > 0$, and $\partial\tilde{\theta}/\partial\tau_k < 0$. In words, these mean the equilibrium crime rate decreases as the probability of escaping apprehension increases, the labor income tax rate increases, and the capital income tax rate decreases. For the comparative statics of the equilibrium human capital level ($\tilde{H}$), $\partial\tilde{H}/\partial\pi < 0$, $\partial\tilde{H}/\partial\tau_c < 0$, $\partial\tilde{H}/\partial\tau_n > 0$, and $\partial\tilde{H}/\partial\tau_k < 0$. These mean that the equilibrium human capital level is higher, the lower the probability of escaping apprehension, the higher the consumption tax, the higher the labor income tax, and the lower the capital income tax rate.

[8] This means, for an individual involving in **both** criminal activities and market works, 1/6 of the time are spent in crime and 13/24 are in market work. Both are reasonable values to be applied for a "*first-cut*" analytical examination prior to empirical analysis.

The signs of these comparative statics are stable across the range of most parameter values, save for the probability of escaping apprehension, $\pi$, which turns out to a key parameter inducing nonlinearity to the effects of labor and capital income taxation on crime, and therefore the equilibrium crime-human capital nexus. For the different values of $\pi$ the signs of the comparative statics in (17) are summarized in Table 1. The numerical evaluations allow us to establish:

**Proposition 2:** There exists a threshold probability, $\pi^*$, above which the equilibrium crime rate, $\tilde{\theta}$, depends positively on the probability of escaping punishment, $\pi$.

**Proposition 3:** For reasonable rate of escape probability ($\pi < 0.25$), the labor (capital) income tax has positive (negative) effect on both the equilibrium crime rate and human capital level. In addition, labor and capital income taxes always have opposite effects on both equilibrium crime rate and human capital level, independent of the value of $\pi$.

*Proposition 2* is consistent with the results uncovered in Neanidis and Papadopoulou (2013). It shows that the non-linearity between crime rate and apprehension probability is preserved even in a model with human capital but not child-rearing. *Proposition 3*, which states opposite effects of capital and labor income tax on equilibrium crime rate, is new to the literature. Although the benchmark positive relationship between labor income tax and crime is intuitive and consistent with existing evidence (see, for example, studies on crime-inequality nexus, such as Kelly, 2000; Burdett et al., 2003), the economic intuition can be explained as follows. An increase in the labor income tax rate [which affects primarily (6), which states the marginal rate of substitution between time allocated to market works and criminal activities] implies that, not only the substitution effect of working dominates the wealth effect of leisure, there is also higher marginal utility to be gained by individuals to engage in criminal activities, resulting in a higher equilibrium crime rate. Nevertheless, as there is also more time spent in market works, this means at a given *effective* hours spent, lower human capital level is required. At the equilibrium, this is reflected in lower private investment in human capital, and therefore lower equilibrium human capital level. On the contrary, higher capital tax rate means lower *effective* returns to savings for the individuals. Comparatively, it is more attractive for individuals to invest in human capital, therefore translating to a higher equilibrium human capital level. At the optimality condition, this means individuals also spend less time in *both* market works and criminal activities, hence the lower equilibrium crime rate.

# 5 Endogenous escape probability & police spending

A natural extension is to endogenize the probability of escaping apprehension, $\pi$, so that it depends negatively on police spending, $g_t^P/Y_t$.[9] This means $\partial\pi/\partial v_P < 0$. While it is straightforward to derive and sign $\partial\tilde{\theta}/\partial v_P = (\partial\tilde{\theta}/\partial\pi)(\partial\pi/\partial v_P)$, we need to re-derive all the other comparative statics examined given that policy spending is in itself, funded by the different tax rates. This means the endogeneity of policy spending will also have to be accounted for in deriving analytically the comparative statics.

Suppose that the functional form, $\pi = \pi_0 \left(\frac{\tilde{g}^P}{Y}\right)^{-\kappa}$, $\pi_0 \in (0,1)$, $\kappa > 0$ is assumed. The re-derivations of the comparative statics are referred to the Appendix again, specifically (A47)-(A56). Based on the same set of parameter values considered in the benchmark analysis, plus setting $v_P = 0.1$, $\kappa = 0.2$, and $\tilde{g}^P/Y_t = 0.02$ (consistent with OECD economies' spending share), we again numerically evaluate the comparative statics, with key results summarized in Table 2.[10] The derived *Propositions 1-3* from the benchmark case still largely hold, with the threshold value of escape-probability remains significant. Nevertheless, with the endogeneity introduced, there are 2 different results that diverge from benchmark propositions: (i) the change in consumption tax has material, and consistently positive effect on the equilibrium crime rate; (ii) although the opposite effect of capital versus labor income taxes on crime

[9] An argument can also be made that the victimization probability ($\pi_v$) should also be made endogenous to policy spending. However, unlike $\pi$, it is worth noting that, $\pi_v$, is purely random and not a policy parameter in the model. In a stationary equilibrium, $\pi_v = \tilde{\theta}$, and therefore cannot be made endogenous to police spending.

[10] Noted that similar exercise can be explored using the share of educational spending, $v_E$, instead. As long as the function of the endogenous $\pi$ is specified to be the same, the comparative static effects would yield similar signs.

remains, both taxation now asserts a consistent negative effect on equilibrium level of human capital. These lead to the following propositions:

**Proposition 4:** When the probability, $\pi$, is endogenous to police spending, the equilibrium crime rate depends positively on consumption tax, $\tau_C$. In contrast, equilibrium human capital always depends positively on consumption tax, $\tau_C$.

Intuitively, this is potentially explainable as follows. When individuals internalize the fact that the escape-probability affects how much government decides to spend on policing, this affects their intertemporal allocation of time to both market and criminal activities, as they will now be more sensitive to the fiscal budget. The intertemporal effect of consumption tax on crime is therefore no longer zero. A higher consumption tax would then necessarily induce individuals to spend more time in crime or investing in human capital, so as to sustain the same amount of consumption.

Lastly, from Table 2, we also derive another proposition that links the signs of the comparative static effects to the initial level of government spending on public security/police, based on the numerical evaluations, as follows.

**Proposition 5:** When the (escape) apprehension probability, $\pi$, is endogenous to police spending, there exists a threshold level of police spending (share of GDP), $(g^P/Y_t)^*$, above (below) which the equilibrium crime-human capital relationship is positive (negative).

Intuitively, this proposition might reflect the likelihood that, an economy with positive co-movement of crime and formal human capital is likely one with high rate of organized criminal syndicates, therefore causing the government to spend more on public order and safety. Given that it is new to the literature, we therefore proceed with empirical testing for this threshold too, in addition to the other 4 propositions.

# 6 Empirical Analysis

## 6.1 Empirical set-up

To empirically evaluate the five analytical propositions, we first review some of the results suggested by our analytical findings: (i) positive crime-labor income tax nexus; (ii) negative crime-capital income tax nexus; (iii) independence of crime from consumption tax, but potentially positive crime-consumption tax nexus if escape probability is endogenous to police spending. In addition, there is: (iv) the existence of a threshold escape probability above which the negative relationship between crime and punishment would take place, implying a U-shape curve for $(\theta, \pi)$. Moreover, the impact of labor and capital income tax on crime should always be of the opposite sign. To empirically evaluate these findings, we follow the approach of Neanidis and Papadopoulou (2013) and derive linearized versions of (15) and (16), which represent the two key equations characterizing the equilibrium solution of the model. In the empirical form, two features are of note: (i) the non-linearized terms for $\pi$ is captured by a quadratic term of (escape) punishment probability ($\pi_{jt}^2$); and (ii) $\tilde{H}$ does not appear in the analytical solution of (15), which means the crime equation should be specified as independent of human capital. More specifically, the empirical forms to be tested are represented by:

$$\begin{aligned} \theta_{jt} \quad &= \quad \alpha_0 + \alpha_1 \pi_{jt} + \alpha_2 \pi_{jt}^2 + \alpha_3 \tau_{n_{jt}} + \alpha_4 \tau_{k_{jt}} + \alpha_5 \tau_{c_{jt}} \\ &\quad + \alpha_6 DebtGDP_{jt} + \sum_{l=1}^{L} \psi_l X_{l,jt} + \epsilon_j + u_{jt}, \end{aligned} \tag{18}$$

$$\begin{aligned} H_{jt} \quad &= \quad \beta_0 + \beta_1 \theta_{jt} + \beta_2 \pi_{jt} + \beta_3 \pi_{jt}^2 + \beta_4 \tau_{n_{jt}} + \beta_5 \tau_{k_{jt}} + \beta_6 \tau_{c_{jt}} \\ &\quad + \beta_7 DebtGDP_{jt} + \beta_8 EdugGDP_{jt} + \sum_{m=1}^{M} \psi_m W_{m,jt} + \iota_j + \upsilon_{jt}, \end{aligned} \tag{19}$$

where $j(t)$ is the country (time) index, $i(t)$ refers to the individual observation, $EdugGDP_{jt}$ is public spending on education (as shares of GDP), $\{X_{l,jt}\}_{l=1}^{L}$ and $\{W_{m,jt}\}_{m=1}^{M}$ denote the set of control variables commonly used in the literature of crime and human capital. Specifically, $\{X_{l,jt}\}_{l=1}^{L}$ include logarithm of the level of GDP, real GDP growth, urban population share, unemployment rate, and the share of working age population; and $\{W_{m,jt}\}_{m=1}^{M}$include gross secondary enrolment rate, life expectancy, logarithm of total population, and urban population share (Gaviria & Pagés, 2002; Neanidis & Papadopoulou, 2013; Goulas & Zervoyianni, 2015). $DebtGDP_{jt}$ is public debt-to-GDP ratio, introduced as a control variable given the examination of taxation effect. $\epsilon_j$ and $\iota_j$ are the time-invariant country-specific effects, and $u_{jt}$ and $v_{jt}$ are random error terms uncorrelated with the regressors.

In addition to the two key equations, for the extension with an endogenized probability of escaping punishment, a simultaneous equation set-up that prioritizes endogeneity of the key variables becomes important. This is especially so when the impacts of crime and human capital on economic growth are also assessed. We therefore estimate an extended system in which two additional equations are added to (18) and (19). These are:

$$\pi_{jt} = \gamma_0 + \gamma_1 PSGDP_{jt} + \gamma_2 PSGDP_{jt}^2 + \sum_{q=1}^{Q} \psi_q Z_{q,jt} + \xi_j + \varepsilon_{jt}, \tag{20}$$

$$g_{jt} = \delta_0 + \delta_1 H_{jt} + \delta_2 H_{jt}^2 + \delta_3 \theta_{jt} + \sum_{r=1}^{R} \psi_r \Psi_{r,jt} + \varpi_j + \varsigma_{jt}, \tag{21}$$

where (20) estimates the probability, $\pi$, as a function of government expenditure on public order and safety (percentage of GDP), its square term (to account for the threshold in *Proposition 5*), and $\{Z_{q,jt}\}_{q=1}^{Q}$, a set of demographic variables as controls. (21) models GDP growth rate as a function of the crime rate ($\theta_{jt}$), level of human capital ($H_{jt}$) and its square term, and $\{\Psi_{r,jt}\}_{r=1}^{R}$ set of control variables commonly used in growth regressions (investment, trade openness, inflation rate).[11] While not being the main focus, the estimation of the GDP growth equation allows us to verify whether the choice of using a bounded human

[11] Given that (18)-(21) are jointly estimated as a system, the four key policy parameters ($\pi$, $\tau_n$, $\tau_k$, $\tau_c$) are not included as direct regressors in the equation for GDP growth, as their effects on growth are specified to be indirectly through human capital and crime. The inclusion of the square term for human capital is intended to control for any threshold effect.

capital, AK-form specification applied in the theoretical model (for which then, we would expect $\delta_1$ and $\delta_2$ to be insignificant while the coefficient for physical capital investment will be highly significant) is consistent with the empirical evidence.

## 6.2 Data and Estimation

### 6.2.1 Crime data and their limitations

For cross-country examination of crime, there is generally only one data source that is publicly available: the various waves of the UN-CTS, which is the world crime surveys conducted by the *United Nations Office on Drugs and Crime* (UNODC). The main goal of the UN-CTS involves collecting data on the incidence of reported crime and the operations of criminal justice systems worldwide, but the reporting of incidents of victimization is strictly voluntary. This means the data is not only subject to the problems of accuracy of all official crime data, but also asymmetric, uneven reporting by the different national authorities. The first wave of UN-CTS covered the 1970-75 period, but involved only limited number of countries and did not compile any statistics on the criminal justice system (prosecution and conviction data). It was not until the fourth UN-CTS (1986-90) before reasonable reporting of prosecution and conviction statistics were reported; 1986 is therefore selected as the first year of our sample.

As mentioned, an important limitation of the UN-CTS global data is that, responses by the relevant national authorities are strictly voluntary. This means the spread of reported data are significantly uneven and asymmetric data gaps in intermediate years were abundant across the different countries, notably when criminal justice system-related measures are involved (see Burnham & Burnham, 2006). For examples, even among the developed economies, until recently (post-2011), France, Spain, and Switzerland did not report any prosecution statistics, whereas Iceland presents the opposite problem (prosecution data are reported for all years save for 2009-10, but conviction data were only available for 2003 and 2004). Indeed, even Denmark, which is an exceptional nation where at present crime statistics are reported on a monthly basis, has historical data gap in that the number of prosecution cases were not reported for the 1995-2006 periods. Without highlighting all of the individual countries, this inherent limitation of UN-CTS data extends to developing economies too, where uneven, asymmetric data gaps are abundant: Barbados reported data only for the 1998-2000 period, and then 2007 onwards; Kazakhstan reported data only for the periods 1987-97, then 2005-15; Malaysia and Nepal only have data for the two years of 2005 and 2006; Sri Lanka reported only for 2003-04 and 2013-15; Maldives only has 2003-04, 2007-13, and no conviction statistics were reported; Ukraine reported only between the year 2003 and 2010. Our empirical analysis is therefore constrained by the inherent data limitation of UN-CTS.

In addition to the missing observations and uneven data gaps, the UNODC has also implemented a structural change to its reporting requirements after 2005. Specifically, due to poor rate of responses, after the 10th UN-CTS (2005-06), a review had been implemented by the UNODC, which led to the revision of the questionnaires and therefore reduced core questions (UNODC, 2009; UNODC, 2010). After the revision has been back-datedly applied to the 10th wave, this results in a discontinued reporting of the number of prosecution and conviction *by types* of crime. In other words, post-2005, all criminal justice system-related statistics (prosecution and conviction) are only reported at aggregate level. To mitigate this issue, but to stay consistent with the description of crime in the model [the use of both recorded theft and robbery rates (per 100,000 population) as crime measures], we implement our econometric estimation based on two different samples: (i) a sample that consists only of the 9th UN-CTS Survey and those before (1986-2005); and (ii) an integrated sample extending the period of analysis to 2015, with the prosecution and conviction rates for all crime used instead to construction the variable, escape-probability, $\pi$.[12] Specifically, $\pi$ is proxied by one minus the proportion of prosecuted/convicted (of total recorded) cases. In principle, the theft- and robbery-specific prosecution and conviction statistics in (i) are more

[12] Indeed, we choose 2015 as our final observation due to the implementation of another round of review by the UNODC in 2016, and hence the expected revision of the UN-CTS survey methodology.

accurate and representative of the actual punishments, but (ii) enables us to not only enlarge the sample size to support split-sample analysis, but also provides additional robustness check. Given that it is mainly the signs in (18) and (19) that interest us, rather than the precise value of the estimates, we believe that the measurement errors associated with conceptual difference in defining prosecution and conviction between the two sample groups will have minimal effects on the results.

#### 6.2.2 Other variables

For the tax rates variables, the average tax measures are obtained from the tax revenue statistics of the *International Monetary Fund* (IMF). The labor income tax, $\tau_n$, is proxied by personal income tax revenue (percent of GDP), capital income tax, $\tau_k$, by corporate income tax revenue (percent of GDP), and consumption tax, $\tau_c$, by goods and services tax (GST) revenue (percent of GDP). For human capital, we use the human capital index in the Penn World Tables 9.0, which is based on Psacharopoulos (1994) and Barro and Lee (2013). The government spending variables, which include expenditure on education, and expenditure on public order and safety (a commonly used proxy for police spending), are obtained from IMF's *Government Finance Statistics* database. The GDP level and growth rates, and the remaining control variables are obtained from the World Bank *World Development Indicators* and the IMF's *World Economic Outlook* database.

The definition and sources of these variables are further explained in details in Table B1, Appendix B. Based on these annual data, preliminary relationships on the three crime-tax nexus are illustrated in Figures 1-3. It appears that the crime-labor income tax relationship is positive, crime-capital income tax relationship is negative, and the crime-consumption tax relationship has no clear pattern: all three are consistent with our analytical findings.

#### 6.2.3 Estimation strategy

In terms of econometric strategy, a common practice in cross-country regressions is to take the fixed effects (FE) estimator for granted, which does not apply in this instance. Indeed, as seen later, for many of the regressions, the Hausman test indicates that the extra orthogonality conditions imposed by a random-effect (RE) estimator are valid. We suspect this to be largely due to the relatively small sample of observations within some of the panel (economies), once the standard growth regression practice of taking 5-year averages (to filter out business cycle effects) is implemented. In this specific instance, given the asymmetric and uneven reporting that is inherent in the UN-CTS data, the 5-year averaging implementation is not only to reduce cyclical high-frequency autocorrelation and measurement errors, but also to overcome the data constraints. The corresponding summary statistics for the two groups of sample are presented in Table 3. Despite the averaging, the inherent data quality of UN-CTS remains poor, especially in the early years and for criminal justice system-related statistics. As an example, for the sample of '*9th UN-CTS Survey and before*', despite what ought to be a total time periods of $T = 4$ (1986-90, 1991-95, 1996-2000, 2001-05), none of the 77 sample economies have full observations of four years. This results in the actual estimation sample being much smaller than the conceptually speaking full sample of $77 * 4 = 308$. Similar constraint is faced with the integrated sample, which has a conceptually speaking total time periods of $T = 6$ (1986-90, 1991-95, 1996-2000, 2001-05, 2006-10, 2011-15), but much smaller effective sample size used in the econometric estimation. The uneven data gaps also prevent us from examining the dynamics associated with crime. In spite of the data limitation, we make use of all the available information, and report the 'observation per group' statistics for every set of regression results presented in Tables 4-7.

By implication, the small $T$ problem also prevents us from implementing the standard system-GMM estimator. While the issue of endogeneity (over time) is largely overcome by taking 5-year averages and so partly mitigating the aforementioned shortcomings, as a formal check, we implement a panel-data exogeneity test (see Wooldridge, 2010, Section 11.2) and establish individual exogeneity of the four key explanatory variables (escape probability, labor income tax, capital income tax, consumption tax) from the batteries of control variables applied in estimating both the crime and human capital equations in Tables 4-7. After the exogeneity of variables have been established, we apply both the RE- and FE-estimators in estimating (18) and (19). After that, based on the superior estimator identified (a RE-estimator is preferred if the Hausman test gives a P-value above 5 percent; a FE-estimator is preferred if the opposite is true), the implied threshold value is calculated for each regression and a further threshold regression with restricted sample is implemented. As a robustness check, as well as to account for any potential heterogeneity across countries in different stages of development, for both the crime and human capital equation, we also utilize the integrated sample to estimate two additional variations: one based on all crime, and another based on split-sample analysis (developed versus developing economies).

Lastly, to account for the potential endogeneity of escape-probability due to police spending (see Section 5), we also implement a three-stage-least-squares (3SLS) procedure to jointly estimate (18)-(21) using the larger integrated sample, controlling for country-specific effects, high-income dummy, a Latin American and Caribbean (LAC) dummy[13], and a structural break post-2005 dummy (akin to the time-specific effect for the integrated sample).

Overall, in spite of the severe data limitation, the proposed empirical strategy is by design, building in some robustness checks as the estimations are implemented not just by using different econometric methods, but also by using different measures for punishment (prosecution and conviction) and crime (theft and robbery). For the purposes of finding some empirical supports to the core analytical contributions made in Sections 2-5, we believe these would be enough.

[13] If there is any potential heterogeneity to crime across the different economies, the required controls will be on the different income status, as well as for LAC, which is notorious in the literature for the region's persistently high crime incidence (see for instance, Aravena and Solís, 2009; UNODC, 2012; Jaitman and Torre, 2017).

## 6.3 Empirical results

The results of the crime and human capital equations are presented in Tables 4-7. The benchmark results in Table 4 (crime equation) and Table 6 (human capital equation) are estimated based on the sample of '*9th UN-CTS Survey and before*', whereas the results in Table 5 and Table 7 present additional estimates using the larger—albeit imperfectly measured—integrated sample. Specifically, on top of the benchmark results, (18) and (19) are estimated for all crime, as well as for the high-income group (versus non-high income, which is not presented to save space). We evaluate *Propositions 1-3* primarily on the basis of these results.

The 3SLS estimation results for the four-equations, endogenous system (with endogenous probability) are presented in Table 6, which is based on the larger integrated sample. We evaluate *Propositions 4-5* using these results.

### 6.3.1 Crime and Human Capital equations

For the benchmark results, we refer to Tables 4 and 6. Although we have mixed statistical significance in Table 4, *Proposition 2* is largely confirmed by the results. Specifically, there exists a threshold probability, $\pi^*$, above which the equilibrium crime rate, $\tilde{\theta}$, depends positively on the probability of escaping punishment, $\pi$. Most of the estimated regressions imply a U-shape ($\hat{\alpha}_1$ negative and $\hat{\alpha}_2$ positive), with the implied threshold values in the $0.494 - 0.541$ range for theft and $0.246 - 0.515$ for robbery. The statistical significance of the positive relationship above the threshold $\pi^*$ is also well-established, as all-but-one of the estimated coefficients in the restricted-threshold regressions are significant at the 1 percent level. Further, based on the estimated coefficients of $\hat{\beta}_2$ and $\hat{\beta}_3$ in Table 6, for the human capital equation we also observe statistically significant threshold effects of $\pi$ in most of the regressions. This lends further empirical support to *Proposition 2.*

In terms of *Proposition 3*, although the statistical significance remains largely mixed (generally, the robbery-based estimation has a poorer fit than theft-based estimation), the opposite effects between labor and capital income taxes are observed in all but two equations in Tables 4 and 6. Further, in line with the analytical findings, the positive effects of labor income tax on both equilibrium crime rate and human capital level are the consistently observed. Nevertheless, for capital income taxes, despite all the estimated coefficients being negative, there are only two statistically significant estimates in the crime equation estimation.

For consumption tax, $\tau_c$, *Proposition 1* states the independence of the equilibrium crime rate from the effects of consumption tax. The results in Table 4 provides a mixed picture. There are three statistically significant estimates, which do not support *Proposition 1*, but the remaining insignificant estimates of $\hat{\alpha}_5$ have a mixture of positive and negative estimates. Given these, as well as the earlier graphical evidence from Figure 3, it is likely that the actual crime-consumption tax nexus is closer to the positive relationship as predicted in *Proposition 4*, instead of *Proposition 1*.

To evaluate the three analytical propositions further, we examine the additional estimates presented in Tables 5 and 7. When the aggregate crime statistics are examined, the empirical supports for the U-shape pattern proposed in *Proposition 2* remain robust for the crime equation (Table 5), but not the human capital equation (Table 7). In terms of *Proposition 3*, apart from the positive crime-labor income tax relationship, there is no empirical support for the effects of the other two taxes. This suggests a significant heterogeneity across the different types of crime. Unlike theft and robberies, economic opportunism and considerations, dated back to Becker (1968) and Ehrlich (1973), are less likely to explain the incidence of the other criminal activities.

Recognizing the heterogeneity across countries in different income category, we also estimate (18) and (19) based on a developed versus developing economies grouping. The results in Table 5 show that the crime-taxation nexus is the most robust statistically when the incidence of theft are analyzed for the developed economies. Specifically, statistically significant positive effect of labor income tax, negative effect of capital income tax, and the positive effect of consumption taxes on crime incidence are observed. Similarly, the estimated coefficients for the escape probabilities, as in *Proposition 2*, are also most significant when thefts are examined. In contrast, for the robberies-based estimates, there are no empirical supports for any of the crime-taxation nexus (except for *Proposition 1*, which states the independence of crime from consumption tax). Indeed, the results for the non-high income economies group are generally weaker in terms of statistical significance, save for the positive effect associated with labor income tax. For the human capital equation, the split-sample results are similar to the benchmark results in Table 6, in that, taxation variables tend to be inferior to population-based controls, such as life expectancy and urbanization, in explaining the level of human capital. Collectively, these results appear to suggest that our theoretical model is best supported empirically by (and conversely most suitable in explaining) theft crimes in developed economies.

#### 6.3.2 Endogenous probability and growth

For completeness, Table 8 presents the 3SLS-estimated results of the four linearized equations. The findings associated with *Propositions 2-3* largely hold again. We therefore focus on evaluating *Proposition 4* and *5*, which are only applicable when the probability, $\pi$, is endogenous to public spending on police (proxied by expenditure on public order and safety).

First, there is empirical support for one half of the *Proposition 4*. All of the estimated coefficients for consumption tax in Table 8 are positive, indicating an empirically consistent positive association between consumption tax and equilibrium crime rate when the escape probability is treated as endogenous. Nevertheless, the model prediction of a positive human capital-consumption tax nexus does not find good empirical supports, as only one estimated $\hat{\beta}_6$ in Table 8 is statistically significant. The positive (negative) effect of labor income tax on crime (human capital) remains the most significant among the three taxes. For *Proposition 5*, unfortunately we do not find empirical support for the existence of a threshold level of government spending on public order and security, as all the estimated coefficients are statistically insignificant. In other words, although the positive crime-consumption tax association suggests that apprehension probability, $\pi$, is likely to be endogenous (than exogenous) in reality, but its endogeneity may not be due to police spending.

Lastly, the growth regression of (21) is implemented primarily to investigate our theoretical modelling choice of using an AK-framework (instead of Lucas type where output grows at the same constant rate as human capital). Indeed, our choice is supported by empirical data. The estimated coefficients associated with private investment are consistently significant in the growth equation, whereas the effects (both level and threshold) of human capital are neither statistically significant nor consistently positive. As such, our theoretical choice of modelling human capital as a time-bounded productivity factor and using an AK-framework in deriving endogenous growth is supported by empirical evidence.

# 7 Concluding Remarks

We develop a macroeconomic model with crime, human capital, police spending, and three different taxation policies to address the three shortcomings identified in the existing macroeconomic literature on crime. In addition, in an extension, we also endogenize the (escape) apprehension probability—usually treated as exogenous in the literature—to depend on police spending. This is a topical issue given the recent outcry against austerity-induced police spending cut in certain developed economies. We derive 5 theoretical propositions based on analytical and numerical analysis of the model. Of the analytical propositions that find some empirical supports, the labor and capital income tax appears to have opposite relationship with crime. Specifically, of the three crime-tax nexuses, the positive crime-labor income tax relationship appears to be the most statistically robust, hence suggesting a likely negative crime-capital income tax association. Indeed, these relationships are the strongest in developed economies. Although the empirical evidence does not support the endogeneity of apprehension probability (a proxy of the effectiveness of criminal justice system) to police spending, a relatively robust positive association between consumption tax and crime hints at its endogeneity to the fiscal mechanism (recall from the propositions that, the condition for a positive crime-consumption tax nexus depends on the apprehension probability being endogenous). In contrast, the direct effects of the taxes on human capital appears to be poorer.

These findings have some policy significance. First, given the well-documented negative relationship between education and crime, in societies where engagement in opportunistic criminal activities (such as thefts) is non-trivial, the incentive-distortionary effects associated with conventional tax instruments appear to have stronger direct effects on crime than educational decision. In other words, taxes appear to have potentially significant role as supplementary tools to the criminal justice system in the deterrence and prevention of crime. Indeed, the positive crime-labor income tax nexus and to a lesser extent, the positive crime-consumption tax nexus, provide a long-term counterpart to the business-cycle hypothesis in criminology literature: there is an income effect to crime. Although our analysis does not allow for a "recession-induced scarring effect" explanation of crime, as in Bell et al. (2018), when our results are jointly interpreted with theirs, a policy implication can be drawn: dedicated labor income tax incentives for certain segments of population that may be vulnerable to a career in crime may be warranted. On the other hand, our conjecture of the negative crime-capital income tax nexus is along the line of the 'crime and conspicuous consumption' explanation of Mejía and Restrepo (2016). Specifically, if agents "*reduce their consumption of observable goods in the presence of crime not only because criminals may steal these goods, but because it reveals information*" about their wealth, then a regime with consistently high capital income tax would have provided a direct mechanism in enforcing this reduction in observable expensive purchases of assets and capital goods by firms.

Lastly, our empirical results also suggest that, the potential role of tax instruments as supplementary tools in crime deterrence is more applicable to developed than developing economies. The lack of statistical significance in the latter suggests that, the characteristics of criminal activities in developing economies are likely due to underdevelopment (Aravena and Solís, 2009; UNODC, 2012), instead of individuals' opportunism. In such instances, crime will not be responsive to tax incentives (or any associated distortion). Indeed, the criminal activities in developing economies present an avenue for future research. Given the vastly different nature of crime in developing economies, future studies could look into studying crime in the context of economic development and poverty. This is especially relevant when illicit drug trades and organized crime are in question. On the other hand, for future studies in generalizable, theoretical context, including attempts to expand on our analysis, there remains room for much richer policy analysis, notably a direct analysis of the implications of public debt dynamics on crime. Regardless, if the data constraint we faced in this study provides a cautionary tale, it is that future investments in primary collection of crime data remain top priorities, so as to support the demand of rigorous research in the areas of macroeconomics of crime.

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**TABLE 1**

Summary of the Comparative Static Results: Different Initial Values of $\pi$

| $\pi$ | $\partial\tilde{\theta}/\partial\pi$ | $\partial\tilde{\theta}/\partial\tau_c$ | $\partial\tilde{\theta}/\partial\tau_n$ | $\partial\tilde{\theta}/\partial\tau_k$ | $\partial\tilde{H}/\partial\pi$ | $\partial\tilde{H}/\partial\tau_c$ | $\partial\tilde{H}/\partial\tau_n$ | $\partial\tilde{H}/\partial\tau_k$ | $\partial\tilde{H}/\partial\tilde{\theta}$ |
|---|---|---|---|---|---|---|---|---|---|
| 0.10 | -ve | 0 | +ve | -ve | +ve | +ve | +ve | -ve | +ve |
| 0.15 | +ve | 0 | +ve | -ve | +ve | +ve | +ve | -ve | +ve |
| 0.20 | +ve | 0 | +ve | -ve | +ve | +ve | +ve | -ve | +ve |
| 0.25 | +ve | 0 | -ve | +ve | -ve | +ve | -ve | +ve | -ve |
| 0.30 | +ve | 0 | -ve | +ve | -ve | +ve | -ve | +ve | -ve |

**TABLE 2**

Endogenous $\pi$: Summary of the Comparative Static Results

| | $\partial\hat{\theta}/\partial\pi$ | $\partial\hat{\theta}/\partial\tau_c$ | $\partial\hat{\theta}/\partial\tau_n$ | $\partial\hat{\theta}/\partial\tau_k$ | $\partial\hat{H}/\partial\pi$ | $\partial\hat{H}/\partial\tau_c$ | $\partial\hat{H}/\partial\tau_n$ | $\partial\hat{H}/\partial\tau_k$ | $\partial\hat{H}/\partial\hat{\theta}$ |
|---|---|---|---|---|---|---|---|---|---|
| $\tilde{g}^P/Y$ | | | | | | | | | |
| 0.02 | -ve | +ve | +ve | -ve | -ve | +ve | -ve | -ve | -ve |
| 0.04 | -ve | +ve | +ve | -ve | -ve | +ve | -ve | -ve | -ve |
| 0.06 | -ve | +ve | +ve | -ve | -ve | +ve | -ve | -ve | +ve |
| 0.08 | -ve | +ve | +ve | -ve | -ve | +ve | -ve | -ve | +ve |
| $v_P$ | | | | | | | | | |
| 0.05 | -ve | +ve | +ve | -ve | -ve | +ve | -ve | -ve | -ve |
| 0.10 | -ve | +ve | +ve | -ve | -ve | +ve | -ve | -ve | -ve |
| 0.15 | -ve | +ve | +ve | -ve | -ve | +ve | -ve | -ve | -ve |
| 0.20 | -ve | +ve | +ve | -ve | -ve | +ve | -ve | -ve | -ve |

# Table 3
## Summary Statistics, after applying the 5-year averaging

| Variables | *9th UN-CTS Survey and before* Mean | Std Dev. | Min | Max | Obs | *Integrated sample* Mean | Std Dev. | Min | Max | Obs |
|---|---|---|---|---|---|---|---|---|---|---|
| *Crime rate:* | | | | | | | | | | |
| Theft | 1,311.41 | 1,495.03 | 1.08 | 7,731.33 | 258 | 1,180.20 | 1,339.15 | 1.08 | 7,731.33 | 405 |
| Robbery | 97.25 | 180.73 | 0.12 | 1,513.83 | 264 | 104.68 | 196.92 | 0.12 | 1,513.83 | 413 |
| *Punishment probability:* | | | | | | | | | | |
| ***Prosecution**** | | | | | | | | | | |
| Theft | 0.65 | 2.08 | 0.00 | 25.55 | 182 | 0.65 | 1.65 | 0.00 | 25.55 | 298 |
| Robbery | 0.69 | 1.16 | 0.00 | 9.40 | 186 | 0.69 | 0.95 | 0.00 | 9.40 | 304 |
| ***Conviction**** | | | | | | | | | | |
| Theft | 0.34 | 1.31 | 0.00 | 17.39 | 192 | 0.33 | 1.04 | 0.00 | 17.39 | 313 |
| Robbery | 0.34 | 0.41 | 0.01 | 4.78 | 201 | 0.34 | 0.36 | 0.01 | 4.78 | 323 |
| Human Capital | 2.63 | 0.57 | 1.13 | 3.61 | 292 | 2.73 | 0.58 | 1.13 | 3.72 | 438 |
| *Average tax rates:* | | | | | | | | | | |
| Personal income tax | 5.40 | 5.12 | 0.01 | 24.94 | 238 | 5.22 | 4.83 | 0.01 | 25.12 | 384 |
| Corporate income tax | 2.67 | 1.91 | 0.20 | 15.64 | 246 | 2.97 | 2.25 | 0.14 | 21.46 | 397 |
| Goods & services tax | 8.38 | 3.67 | 0.58 | 17.33 | 264 | 8.88 | 3.73 | 0.10 | 17.66 | 416 |
| Gross debt/ GDP | 51.89 | 29.22 | 2.26 | 165.64 | 210 | 50.75 | 30.68 | 0.35 | 237.59 | 362 |
| Spending on public order & safety | 1.45 | 1.51 | 0.09 | 19.01 | 174 | 1.55 | 1.29 | 0.09 | 19.01 | 272 |
| Spending on education | 4.51 | 1.40 | 1.16 | 10.68 | 243 | 4.61 | 1.42 | 1.16 | 10.68 | 391 |
| Gross enrolment rate, secondary | 83.90 | 25.52 | 4.57 | 155.06 | 283 | 87.73 | 24.15 | 4.57 | 155.06 | 428 |
| Logarithm of output | 4.79 | 1.85 | (0.01) | 9.53 | 307 | 4.96 | 1.84 | (0.01) | 9.69 | 461 |
| Urban population | 62.63 | 62.63 | 5.84 | 100.00 | 308 | 63.83 | 20.48 | 5.84 | 100.00 | 462 |
| Unemployment rate | 8.80 | 5.89 | 0.60 | 34.72 | 228 | 8.39 | 5.62 | 0.56 | 34.72 | 380 |
| Working-age population | 63.85 | 5.25 | 47.45 | 72.87 | 308 | 64.79 | 5.14 | 47.45 | 77.20 | 462 |
| Life expectancy | 71.23 | 6.91 | 44.58 | 81.74 | 308 | 72.53 | 6.92 | 44.58 | 83.80 | 462 |
| Logarithm of total population | 2.30 | 1.62 | (1.56) | 7.01 | 308 | 2.34 | 1.62 | (1.56) | 7.15 | 462 |
| Investment | 22.41 | 5.57 | 5.98 | 44.50 | 296 | 22.78 | 5.38 | 5.98 | 44.50 | 448 |
| Trade | 79.86 | 52.18 | 13.94 | 383.80 | 298 | 86.26 | 57.28 | 13.94 | 422.08 | 452 |
| Inflation | 55.18 | 248.58 | (10.10) | 2,342.22 | 286 | 37.47 | 201.76 | (10.10) | 2,342.22 | 440 |

Notes: A detailed description of the variables are presented in Table B1.

* Note that the data of prosecution and conviction rates are calculated differently by UNODC. The former refers to the percentage of booked cases being brought on to prosecution, whereas the latter refers to the percentage of prosecuted cases being found guilty and convicted.

## Table 4

### Results for Benchmark Model with Exogenous $\pi$, Crime Equation (9th UN-CTS Survey and before)

(one-way FE and RE models, plus restricted threshold model)

| | Prosecution rate as proxy | | | | | | Conviction rate as proxy | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Theft | | | Robbery | | | Theft | | | Robbery | | |
| | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** |
| Probability of escape, $\pi$ | -2425.4 | -2006.2 | **2638.9*** ** | -100.4 | -45.1 | **152.1*** ** | **-4907.4** ** | 821.2 | **1623.4*** ** | -71.0 | 495.4 | 157.2 |
| | (1815.0) | (4827.3) | (1024.0) | (70.2) | (56.3) | (58.2) | (2255.0) | (3902.8) | (613.1) | (290.4) | (641.6) | (139.3) |
| Escape probability squared, $\pi^2$ | 2626.5 | 1805.3 | | 103.3 | 47.2 | | **4847.1** ** | 1312.6 | | 182.7 | -243.7 | |
| | (1658.6) | (3717.1) | | (65.7) | (57.2) | | (1907.8) | (3204.6) | | (216.5) | (376.9) | |
| Labor income tax, $\pi_n$ | **175.8*** ** | 44.7 | **171.1*** ** | 0.521 | 4.7 | 1.9 | **149.5*** ** | -104.8 | **149.4*** ** | -4.5 | 0.990 | 1.1 |
| | (33.8) | (212.4) | (37.0) | (3.1) | (3.7) | (4.0) | (40.4) | (157.2) | (41.6) | (4.2) | (9.4) | (9.2) |
| Capital income tax, $\pi_k$ | -54.4 | -189.5 | -74.4 | -2.1 | -1.1 | **-11.3*** ** | -8.8 | **-198.9*** | -82.088 | -3.0 | -0.411 | -0.868 |
| | (57.9) | (153.4) | (73.5) | (2.5) | (2.5) | (4.0) | (52.1) | (117.7) | (53.2) | (4.9) | (6.8) | (7.3) |
| Consumption tax, $\pi_c$ | **81.9*** | 114.2 | **96.6*** | -2.6 | -1.8 | -1.7 | 72.6 | **244.8*** | 79.806 | 0.550 | -2.4 | 0.092 |
| | (49.6) | (177.3) | (58.0) | (2.0) | (2.9) | (3.0) | (44.4) | (141.0) | (52.8) | (3.5) | (9.3) | (8.0) |
| Gross debt-to-GDP ratio | 2.1 | 1.8 | 1.6 | -0.227 | -0.109 | **-0.441** ** | 0.312 | -2.2 | 2.897 | -0.473 | 0.952 | 0.883 |
| | (3.9) | (12.8) | (4.9) | (0.163) | (0.169) | (0.199) | (3.8) | (7.8) | (3.4) | (0.357) | (1.1) | (1.0) |
| Logarithm of GDP | **184.2*** | 3017.5 | 179.1 | 1.5 | -44.0 | 2.8 | 134.4 | **3349.5*** | 175.285 | 8.0 | -248.9 | -261.8 |
| | (108.6) | (2788.6) | (136.1) | (8.1) | (36.6) | (10.1) | (101.1) | (1914.0) | (119.1) | (7.9) | (172.1) | (182.0) |
| Real GDP growth | -572.9 | -136.5 | -182.5 | 30.4 | 23.8 | 38.4 | -580.1 | -349.4 | -249.765 | 24.0 | 23.7 | 31.9 |
| | (390.9) | (1261.9) | (580.0) | (24.1) | (25.7) | (24.6) | (464.2) | (717.2) | (474.9) | (58.1) | (46.3) | (41.4) |
| Urban population | 8.4 | 28.1 | 4.5 | **1.5*** | **2.0*** | 0.354 | 7.2 | 17.0 | 12.991 | 1.3 | 2.4 | 3.2 |
| | (8.310) | (102.9) | (11.8) | (0.894) | (0.971) | (1.0) | (8.1) | (72.8) | (9.107) | (1.2) | (4.2) | (4.3) |
| Unemployment rate | -13.9 | 74.9 | 11.2 | 1.3 | 0.326 | 0.782 | -10.1 | 133.3 | -7.455 | 2.0 | -14.9 | -14.6 |
| | (25.7) | (103.8) | (34.5) | (2.5) | (3.2) | (2.9) | (26.1) | (107.0) | (27.4) | (2.5) | (13.1) | (13.0) |
| Working-age population | -33.3 | -125.7 | -23.9 | -2.1 | 0.477 | 4.3 | -13.7 | -110.1 | -13.132 | 0.5 | 21.6 | 22.3 |
| | (38.9) | (199.4) | (57.3) | (2.1) | (3.4) | (3.3) | (35.8) | (143.5) | (36.8) | (3.6) | (17.4) | (18.3) |
| Country Effect | No | Yes | No | No | Yes | No | No | Yes | No | No | Yes | Yes |
| Time Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Countries/Observations | 54/98 | 54/98 | 42/73 | 53/97 | 53/97 | 40/61 | 61/116 | 61/116 | 56/107 | 60/119 | 60/119 | 58/116 |
| Observation per group (min/avg/max) | 1.0/1.8/3.0 | 1.0/1.8/3.0 | 1.0/1.7/3.0 | 1.0/1.8/3.0 | 1.0/1.8/3.0 | 1.0/1.5/3.0 | 1.0/1.9/3.0 | 1.0/1.9/3.0 | 1.0/1.9/3.0 | 1.0/2.0/3.0 | 1.0/2.0/3.0 | 1.0/2.0/3.0 |
| Overall $R^2$ | 0.681 | 0.183 | 0.647 | 0.133 | 0.000 | 0.190 | 0.619 | 0.117 | 0.586 | 0.200 | 0.012 | 0.178 |
| Hausman test (p-value) | 0.701 | | | 0.201 | | | 0.365 | | | 0.033 | | |
| Implied threshold value | 0.541 | | 0.541 | 0.515 | | 0.515 | 0.494 | | 0.494 | | 0.246 | 0.246 |

Parantheses denote values of heteroskedasticity-adjusted robust sandard errors.

Statistically significant estimates at at least the 10% level are bold, with *** for 1% level, ** 5% level, and * 10% level.

The implied threshold value from the RE-estimator is selected if the p-value of Hausman test is above >0.05.

The corresponding threshold regression is then also implemented with RE, vise versa for FE.

All figures with absolute value above 1.0 are rounded to 1 decimal place.

## Table 5

## Robustness, Crime Equation with Exogenous π (integrated sample)

(one-way FE and RE models, plus restricted threshold model)

| | All Crime | | | | | |
|---|---|---|---|---|---|---|
| | Prosecution | | | Conviction | | |
| | RE | FE | Restricted Threshold | RE | FE | Restricted Threshold |
| Probability of escape, π | -1701.6 | **-3207.1*** | **3231.2***** | **-5603.8**** | **-5753.9**** | **7312.1***** |
| | (1374.5) | (1661.3) | (724.0) | (2752.4) | (2545.1) | (2315.3) |
| Escape probability squared, $\pi^2$ | **4993.1**** | **6786.8***** | | **6616.3***** | **6211.3**** | |
| | (1964.8) | (2125.8) | | (2372.5) | (2809.9) | |
| Labor income tax, $\pi_n$ | **361.1***** | 170.4 | **372.3***** | **281.2***** | 63.8 | 202.8 |
| | (72.5) | (185.4) | (73.2) | (79.9) | (173.8) | (199.3) |
| Capital income tax, $\pi_k$ | 36.3 | 54.9 | 26.6 | 83.6 | 263.4 | 69.6 |
| | (39.8) | (49.8) | (43.4) | (163.1) | (208.2) | (181.7) |
| Consumption tax, $\pi_c$ | 75.1 | 53.0 | **83.4*** | 226.6 | 409.2 | 17.4 |
| | (47.4) | (86.1) | (49.4) | (146.9) | (257.9) | (117.3) |
| Gross debt-to-GDP ratio | -0.206 | 9.0 | -0.691 | 10.6 | **23.7***** | **14.6**** |
| | (5.4) | (6.3) | (5.2) | (8.1) | (8.8) | (7.1) |
| Logarithm of GDP | 194.8 | -914.4 | 206.5 | 54.7 | **-1447.4*** | -497.4 |
| | (164.4) | (879.1) | (157.6) | (148.6) | (819.8) | (1019.6) |
| Real GDP growth | 390.3 | 428.1 | 557.2 | -607.1 | -1260.5 | 1316.5 |
| | (840.0) | (895.3) | (768.3) | (1051.2) | (1541.7) | (1003.7) |
| Urban population | 0.209 | -60.3 | -1.6 | -1.1 | -71.3 | -46.1 |
| | (14.2) | (41.4) | (14.5) | (15.0) | (53.1) | (82.5) |
| Unemployment rate | 6.4 | -8.3 | -5.8 | -33.3 | -29.0 | 0.900 |
| | (39.4) | (58.6) | (37.6) | (32.1) | (52.0) | (66.3) |
| Working-age population | 63.3 | **188.7***** | 65.7 | 118.5 | **395.4**** | 84.7 |
| | (43.6) | (62.7) | (44.8) | (72.2) | (194.8) | (96.7) |
| Structural break post-2005 | **-522.7**** | | **-494.9**** | **-696.2***** | -544.4 | -282.0 |
| | (238.5) | | (246.5) | (265.2) | (352.4) | (299.6) |
| Country Effect | No | Yes | No | No | Yes | Yes |
| Countries/Observations | 64/200 | 64/200 | 64/200 | 67/249 | 67/249 | 58/179 |
| Observation per group (min/avg/max) | 1.0/3.1/5.0 | 1.0/3.1/5.0 | 1.0/3.1/5.0 | 1.0/3.7/5.0 | 1.0/3.7/5.0 | 1.0/3.1/5.0 |
| Overall $R^2$ | 0.567 | 0.004 | 0.567 | 0.435 | 0.004 | 0.127 |
| Hausman test (p-value) | 0.105 | | | 0.007 | | |
| Implied threshold value | NA | NA | NA | | 0.540 | 0.540 |

| | High-income, Developed Economies only | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Prosecution, Theft | | | Prosecution, Robbery | | | Conviction, Theft | | | Conviction, Robbery | | |
| | RE | FE | Restricted Threshold | RE | FE | Restricted Threshold | RE | FE | Restricted Threshold | RE | FE | Restricted Threshold |
| Probability of escape, π | **-4131.0***** | **-3754.0**** | **2127.7**** | -24.7 | -106.1 | **91.2***** | **-7484.6***** | **-8373.3**** | 1103.1 | 562.9 | 765.3 | -12.7 |
| | (1433.2) | (1732.5) | (884.3) | (47.1) | (65.0) | (31.4) | (2794.1) | (4036.2) | (823.6) | (513.9) | (745.8) | (121.3) |
| Escape probability squared, $\pi^2$ | **4134.4***** | **3496.9**** | | 61.3 | **100.9*** | | **6765.3***** | **7390.0**** | | -436.2 | -480.8 | |
| | (1337.7) | (1526.1) | | (46.5) | (58.0) | | (2317.0) | (3248.8) | | (375.3) | (471.9) | |
| Labor income tax, $\pi_n$ | **72.1*** | 67.7 | 65.866 | 1.9 | 5.2 | -0.2 | 70.7 | -14.0 | **88.1*** | -0.335 | -6.8 | -0.185 |
| | (41.0) | (151.7) | (50.3) | (2.0) | (4.8) | (1.5) | (48.5) | (108.9) | (48.9) | (4.2) | (11.7) | (4.4) |
| Capital income tax, $\pi_k$ | **-87.6*** | **-127.6***** | -72.981 | 0.485 | 2.6 | 1.3 | **-114.2**** | **-223.0***** | **-125.0**** | -2.2 | 2.3 | -3.0 |
| | (47.4) | (41.6) | (51.3) | (2.4) | (2.8) | (3.1) | (54.4) | (75.5) | (60.0) | (3.6) | (3.6) | (3.3) |
| Consumption tax, $\pi_c$ | **257.3***** | **218.2*** | **270.3***** | -0.427 | 1.7 | 1.6 | **216.9***** | **289.3***** | **194.3***** | 5.8 | 5.0 | 5.7 |
| | (77.6) | (113.5) | (82.6) | (4.5) | (3.5) | (6.0) | (75.7) | (98.9) | (71.1) | (6.4) | (5.6) | (6.3) |
| Gross debt-to-GDP ratio | -4.7 | -4.4 | -6.7 | **-0.229**** | 0.094 | **-0.283**** | **-7.0*** | -8.4 | -6.9 | 0.038 | 0.600 | 0.029 |
| | (4.5) | (8.0) | (5.1) | (0.098) | (0.219) | (0.140) | (4.1) | (6.6) | (4.4) | (0.526) | (0.697) | (0.502) |
| Logarithm of GDP | **391.0***** | 147.3 | **447.6***** | 6.1 | -78.4 | 5.7 | **340.9***** | 595.1 | **426.8***** | 16.0 | -138.7 | 13.2 |
| | (104.6) | (707.4) | (140.3) | (8.9) | (49.1) | (9.6) | (118.1) | (622.0) | (137.9) | (11.3) | (85.0) | (9.9) |
| Real GDP growth | -498.6 | -672.2 | -224.8 | -23.2 | 2.4 | -65.9 | -388.6 | -319.4 | 128.5 | 26.6 | 79.8 | 22.2 |
| | (634.5) | (687.9) | (729.3) | (61.9) | (18.1) | (62.9) | (733.0) | (512.5) | (695.6) | (99.4) | (68.1) | (95.6) |
| Urban population | **36.8**** | -25.0 | **42.2**** | -0.345 | **4.9*** | 0.123 | **22.5*** | -31.4 | 20.0 | 2.9 | 1.7 | 3.0 |
| | (16.2) | (52.9) | (19.2) | (0.5) | (2.8) | (0.547) | (13.3) | (39.5) | (13.1) | (3.2) | (4.5) | (3.3) |
| Unemployment rate | 28.1 | 84.7 | 48.0 | 1.6 | **-3.5*** | 1.2 | 6.9 | 89.2 | 17.8 | **7.0**** | -7.8 | **6.1**** |
| | (49.6) | (80.7) | (63.0) | (1.4) | (1.8) | (1.8) | (44.9) | (56.8) | (54.3) | (3.2) | (5.7) | (2.8) |
| Working-age population | 10.0 | -1.3 | 7.2 | -1.5 | **10.3*** | -1.5 | -11.9 | -62.8 | -30.2 | 0.573 | 11.2 | 1.0 |
| | (57.0) | (100.3) | (69.1) | (2.3) | (5.4) | (3.2) | (46.5) | (61.4) | (53.4) | (5.2) | (7.5) | (5.5) |
| Structural break post-2005 | **-627.2***** | **-444.8***** | **-724.8***** | -6.6 | -3.9 | -10.2 | **-388.4**** | -321.5 | **-612.3***** | -5.0 | 24.4 | -8.3 |
| | (198.9) | (139.1) | (261.7) | (141.4) | (6.8) | (9.6) | (181.4) | (197.1) | (163.2) | (12.1) | (19.1) | (12.5) |
| Country Effect | No | Yes | No | No | Yes | Yes | No | Yes | No | No | Yes | Yes |
| Countries/Observations | 28/102 | 28/102 | 25/80 | 27/105 | 27/105 | 24/73 | 31/128 | 31/128 | 31/113 | 30/129 | 30/129 | 30/127 |
| Observation per group (min/avg/max) | 1.0/3.6/5.0 | 1.0/3.6/5.0 | 1.0/3.2/5.0 | 1.0/3.9/5.0 | 1.0/3.9/5.0 | 1.0/3.0/5.0 | 1.0/4.1/5.0 | 1.0/4.1/5.0 | 1.0/3.6/5.0 | 2.0/4.3/5.0 | 2.0/4.3/5.0 | 2.0/4.2/5.0 |
| Overall $R^2$ | 0.628 | 0.159 | 0.605 | 0.192 | 0.059 | 0.178 | 0.530 | 0.152 | 0.490 | 0.091 | 0.023 | 0.090 |
| Hausman test (p-value) | 0.820 | | | 0.003 | | | 0.113 | | | | | |
| Implied threshold value | 0.500 | | 0.500 | | 0.475 | 0.475 | 0.452 | | 0.452 | | 0.314 | 0.314 |

Parantheses denote values of heteroskedasticity-adjusted robust sandard errors.
Statistically significant estimates at at least the 10% level are bold, with *** for 1% level, ** 5% level, and * 10% level.
The implied threshold value from the RE-estimator is selected if the p-value of Hausman test is above >0.05. The corresponding threshold regression is then also implemented with RE, vise versa for FE.
All figures with absolute value above 1.0 are rounded to 1 decimal place.

**Table 6**

**Results for Benchmark Model with Exogenous π, Human Capital Equation (9th UN-CTS Survey and before)**

(one-way FE and RE models, plus restricted threshold model)

| | **Prosecution rate as proxy** | | | | | | **Conviction rate as proxy** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Theft** | | | **Robbery** | | | **Theft** | | | **Robbery** | | |
| | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** |
| Crime rate, θ | -0.000 | -0.000 | -0.000 | 0.000 | **-0.001*** ** | **-0.001*** | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 | -0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Probability of escape, π | **-0.311*** | -0.287 | -0.056 | 0.113 | 0.168 | -0.010 | -0.111 | **-0.367*** | -0.024 | **0.449**** | **0.453*** | **0.144**** |
| | (0.185) | (0.196) | (0.038) | (0.138) | (0.137) | (0.104) | (0.227) | (0.199) | (0.092) | (0.206) | (0.239) | (0.058) |
| Escape probability squared, $\pi^2$ | 0.206 | 0.197 | | -0.164 | -0.208 | | 0.066 | **0.289*** | | **-0.290*** | -0.280 | |
| | (0.135) | (0.147) | | (0.131) | (0.129) | | (0.170) | (0.154) | | (0.154) | (0.175) | |
| Labor income tax, $\pi_n$ | **0.028***** | **0.029***** | **0.030***** | **0.032***** | **0.029***** | 0.014 | **0.018**** | 0.012 | **0.018**** | **0.019***** | **0.015*** | **0.021***** |
| | (0.007) | (0.010) | (0.008) | (0.008) | (0.009) | (0.009) | (0.008) | (0.008) | (0.008) | (0.007) | (0.009) | (0.007) |
| Capital income tax, $\pi_k$ | -0.008 | **-0.010*** | -0.006 | -0.005 | -0.006 | -0.003 | -0.008 | -0.007 | -0.007 | -0.008 | -0.009 | -0.008 |
| | (0.005) | (0.006) | (0.005) | (0.005) | (0.005) | (0.008) | (0.006) | (0.006) | (0.006) | (0.006) | (0.005) | (0.009) |
| Consumption tax, $\pi_c$ | 0.007 | -0.001 | 0.010 | 0.008 | 0.000 | 0.000 | 0.008 | 0.007 | 0.008 | 0.004 | -0.002 | 0.009 |
| | (0.007) | (0.009) | (0.007) | (0.008) | (0.009) | (0.017) | (0.008) | (0.011) | (0.008) | (0.008) | (0.011) | (0.010) |
| Gross debt-to-GDP ratio | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | **0.002**** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) |
| Education expenditure | -0.008 | 0.003 | -0.014 | -0.016 | -0.010 | -0.022 | **-0.021*** | -0.010 | **-0.022*** | **-0.026**** | -0.012 | **-0.031***** |
| | (0.011) | (0.012) | (0.013) | (0.010) | (0.009) | (0.013) | (0.012) | (0.009) | (0.012) | (0.012) | (0.012) | (0.012) |
| Gross enrolment ratio, secondary | -0.001 | -0.002 | -0.001 | -0.001 | **-0.003***** | 0.000 | 0.001 | 0.000 | 0.001 | 0.002 | 0.001 | 0.002 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Urban population | **0.006**** | 0.005 | 0.004 | **0.008***** | 0.006 | 0.001 | **0.008***** | **0.011*** | **0.008**** | **0.009***** | 0.010 | **0.009***** |
| | (0.003) | (0.005) | (0.003) | (0.003) | (0.005) | (0.005) | (0.003) | (0.006) | (0.003) | (0.003) | (0.006) | (0.003) |
| Life expectancy | **0.034***** | **0.029***** | **0.040***** | **0.032***** | **0.029**** | -0.006 | **0.028***** | 0.023 | **0.028***** | **0.022**** | 0.012 | **0.021**** |
| | (0.008) | (0.010) | (0.008) | (0.010) | (0.014) | (0.044) | (0.010) | (0.017) | (0.010) | (0.009) | (0.015) | (0.010) |
| Logarithm of total population | 0.036 | -0.072 | 0.042 | 0.036 | -0.062 | **-0.336*** | 0.000 | **-0.640**** | 0.001 | -0.003 | -0.456 | -0.004 |
| | (0.038) | (0.304) | (0.040) | (0.039) | (0.244) | (0.191) | (0.039) | (0.274) | (0.039) | (0.039) | (0.293) | (0.041) |
| Country Effect | No | Yes | No | No | Yes | Yes | No | Yes | No | No | Yes | No |
| Time Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Countries/Observations | 49/96 | 49/96 | 46/89 | 48/98 | 48/98 | 32/54 | 56/120 | 56/120 | 55/118 | 55/122 | 55/122 | 53/109 |
| Observation per group (min/avg/max) | 1.0/2.0/4.0 | 1.0/2.0/4.0 | 1.0/1.9/4.0 | 1.0/2.0/4.0 | 1.0/2.0/4.0 | 1.0/1.7/4.0 | 1.0/2.1/4.0 | 1.0/2.1/4.0 | 1.0/2.1/4.0 | 1.0/2.2/4.0 | 1.0/2.2/4.0 | 1.0/2.1/4.0 |
| Overall $R^2$ | 0.441 | 0.310 | 0.445 | 0.412 | 0.248 | 0.003 | 0.394 | 0.069 | 0.391 | 0.449 | 0.088 | 0.479 |
| Hausman test (p-value) | 0.301 | | | 0.020 | | | 0.057 | | | 0.080 | | |
| Implied threshold value | 0.331 | | 0.331 | | 0.620 | 0.620 | 0.296 | | 0.296 | 0.324 | | 0.324 |

Parantheses denote values of heteroskedasticity-adjusted robust sandard errors.
Statistically significant estimates at at least the 10% level are bold, with *** for 1% level, ** 5% level, and * 10% level.
The implied threshold value from the RE-estimator is selected if the p-value of Hausman test is above >0.05. The corresponding threshold regression is then also implemented with RE, vise versa for FE.
All figures with absolute value above 1.0 are rounded to 1 decimal place.

## Table 7
## Robustness, Human Capital Equation with Exogenous π (integrated sample)
(one-way FE and RE models, plus restricted threshold model)

| | All Crime | | | | | | High-income, Developed Economies only | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Prosecution | | | Conviction | | | Prosecution, Theft | | | Prosecution, Robbery | | | Conviction, Theft | | | Conviction, Robbery | | |
| | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** | **RE** | **FE** | **Restricted Threshold** |
| Crime rate, θ | **-0.000*** ** | **-0.000*** ** | **-0.000*** ** | **-0.000*** ** | **-0.000*** ** | 0.000 | -0.000 | -0.000 | -0.000 | **-0.000*** | **-0.001*** ** | **-0.001*** ** | -0.000 | **-0.000*** | -0.000 | **-0.000*** ** | **-0.000*** ** | **-0.000** ** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Probability of escape, π | -0.017 | -0.021 | **-0.097** ** | 0.424 | 0.342 | -0.131 | -0.129 | -0.112 | -0.059 | 0.115 | 0.159 | 0.053 | -0.392 | **-0.636** ** | -0.072 | -0.251 | -0.291 | 0.044 |
| | (0.180) | (0.188) | (0.041) | (0.260) | (0.238) | | (0.256) | (0.255) | (0.046) | (0.164) | (0.163) | (0.105) | (0.316) | (0.284) | (0.107) | (0.270) | (0.273) | (0.075) |
| Escape probability squared, $\pi^2$ | -0.063 | -0.046 | | **-0.458** ** | **-0.389*** | | 0.081 | 0.072 | | -0.048 | -0.088 | | 0.235 | **0.432** ** | | 0.296 | 0.323 | |
| | (0.164) | (0.168) | | (0.210) | (0.198) | | (0.190) | (0.195) | | (0.168) | (0.175) | | (0.240) | (0.205) | | (0.200) | (0.214) | |
| Labor income tax, $\pi_n$ | 0.001 | -0.002 | 0.001 | 0.005 | 0.003 | -0.003 | -0.006 | -0.008 | -0.003 | 0.015 | 0.012 | 0.019 | 0.005 | 0.005 | 0.005 | 0.009 | 0.010 | **-0.014*** |
| | (0.007) | (0.009) | (0.007) | (0.007) | (0.010) | (0.010) | (0.008) | (0.009) | (0.009) | (0.015) | (0.014) | (0.015) | (0.012) | (0.012) | (0.012) | (0.014) | (0.014) | (0.008) |
| Capital income tax, $\pi_k$ | -0.006 | -0.003 | -0.005 | 0.003 | 0.007 | **0.015*** | -0.007 | -0.008 | -0.001 | -0.006 | -0.003 | 0.005 | -0.001 | 0.004 | 0.005 | -0.004 | 0.001 | 0.007 |
| | (0.007) | (0.008) | (0.007) | (0.009) | (0.010) | (0.008) | (0.008) | (0.008) | (0.005) | (0.009) | (0.009) | (0.008) | (0.011) | (0.012) | (0.012) | (0.010) | (0.011) | (0.010) |
| Consumption tax, $\pi_c$ | -0.010 | -0.011 | -0.012 | -0.006 | -0.006 | -0.001 | -0.019 | **-0.022*** | -0.010 | -0.009 | -0.017 | 0.001 | 0.007 | 0.014 | 0.010 | 0.005 | 0.009 | 0.009 |
| | (0.008) | (0.008) | (0.007) | (0.006) | (0.007) | (0.007) | (0.012) | (0.012) | (0.009) | (0.013) | (0.014) | (0.014) | (0.013) | (0.014) | (0.015) | (0.015) | (0.017) | (0.014) |
| Gross debt-to-GDP ratio | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Education expenditure | 0.003 | 0.005 | 0.003 | -0.016 | -0.017 | -0.010 | 0.003 | 0.003 | -0.005 | -0.033 | **-0.029*** | **-0.033** ** | -0.020 | -0.017 | -0.018 | -0.035 | -0.033 | 0.010 |
| | (0.013) | (0.013) | (0.013) | (0.014) | (0.014) | (0.014) | (0.011) | (0.012) | (0.012) | (0.019) | (0.016) | (0.016) | (0.017) | (0.015) | (0.015) | (0.022) | (0.019) | (0.013) |
| Gross enrolment ratio, secondary | 0.001 | 0.000 | 0.000 | 0.002 | 0.001 | 0.001 | 0.002 | 0.002 | 0.001 | 0.000 | 0.000 | -0.001 | 0.001 | 0.001 | 0.001 | **0.003*** | 0.002 | **0.003** ** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Urban population | **0.003*** | 0.003 | **0.003*** | **0.007*** ** | **0.009** ** | **0.007** ** | 0.003 | 0.003 | 0.001 | 0.002 | 0.003 | 0.003 | 0.003 | **0.006*** | 0.004 | 0.001 | 0.003 | 0.000 |
| | (0.002) | (0.002) | (0.002) | (0.003) | (0.004) | (0.004) | (0.003) | (0.003) | (0.002) | (0.003) | (0.003) | (0.004) | (0.003) | (0.003) | (0.004) | (0.003) | (0.004) | (0.004) |
| Life expectancy | **0.053*** ** | **0.056*** ** | **0.055*** ** | **0.041*** ** | **0.044*** ** | **0.047*** ** | **0.058*** ** | **0.061*** ** | **0.064*** ** | **0.064*** ** | **0.071*** ** | **0.074*** ** | **0.055*** ** | **0.061*** ** | **0.061*** ** | **0.055*** ** | **0.059*** ** | **0.064*** ** |
| | (0.005) | (0.005) | (0.004) | (0.009) | (0.010) | (0.012) | (0.006) | (0.005) | (0.004) | (0.005) | (0.005) | (0.007) | (0.007) | (0.006) | (0.007) | (0.005) | (0.005) | (0.011) |
| Logarithm of total population | -0.003 | -0.071 | -0.003 | 0.002 | -0.024 | -0.107 | 0.042 | 0.095 | 0.195 | 0.014 | -0.401 | -0.252 | 0.030 | -0.334 | -0.263 | 0.001 | -0.278 | -0.319 |
| | (0.032) | (0.143) | (0.032) | (0.030) | (0.157) | (0.178) | (0.048) | (0.176) | (0.185) | (0.053) | (0.288) | (0.280) | (0.052) | (0.234) | (0.269) | (0.060) | (0.241) | (0.274) |
| Structural break post-2005 | **0.047*** ** | **0.044*** ** | **0.040*** ** | **0.057*** ** | **0.047** ** | 0.033 | 0.017 | 0.004 | -0.010 | 0.034 | 0.026 | 0.014 | 0.010 | 0.005 | 0.002 | **0.044** ** | **0.040** ** | **0.028** ** |
| | (0.016) | (0.016) | (0.015) | (0.022) | (0.023) | (0.026) | (0.018) | (0.017) | (0.016) | (0.024) | (0.020) | (0.016) | (0.024) | (0.019) | (0.020) | (0.019) | (0.019) | (0.013) |
| Country Effect | No | Yes | No | No | Yes | Yes | No | Yes | No | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes |
| Countries/Observations | 59/192 | 59/192 | 59/192 | 63/242 | 63/242 | 56/181 | 27/107 | 27/107 | 26/98 | 26/111 | 26/111 | 24/95 | 31/138 | 31/138 | 31/135 | 30/140 | 30/140 | 25/93 |
| Observation per group (min/avg/max) | 1.0/3.3/6.0 | 1.0/3.3/6.0 | 1.0/3.3/6.0 | 1.0/3.8/6.0 | 1.0/3.8/6.0 | 1.0/3.2/6.0 | 1.0/4.0/6.0 | 1.0/4.0/6.0 | 1.0/3.8/6.0 | 1.0/4.3/6.0 | 1.0/4.3/6.0 | 1.0/4.0/6.0 | 1.0/4.5/6.0 | 1.0/4.5/6.0 | 1.0/4.4/6.0 | 2.0/4.7/6.0 | 2.0/4.7/6.0 | 1.0/3.7/6.0 |
| Overall $R^2$ | 0.392 | 0.342 | 0.392 | 0.419 | 0.406 | 0.362 | 0.166 | 0.158 | 0.175 | 0.115 | 0.029 | 0.019 | 0.070 | 0.010 | 0.007 | 0.080 | 0.001 | 0.024 |
| Hausman test (p-value) | 0.053 | | | 0.032 | | | 0.036 | | | 0.017 | | | 0.012 | | | 0.043 | | |
| Implied threshold value | NA | NA | NA | | 0.568 | 0.568 | | 0.323 | 0.323 | | 0.277 | 0.277 | | 0.339 | 0.339 | | 0.556 | 0.556 |

Parantheses denote values of heteroskedasticity-adjusted robust sandard errors.
Statistically significant estimates at at least the 10% level are bold, with *** for 1% level, ** 5% level, and * 10% level.
The implied threshold value from the RE-estimator is selected if the p-value of Hausman test is above >0.05. The corresponding threshold regression is then also implemented with RE, vise versa for FE.
All figures with absolute value above 1.0 are rounded to 1 decimal place.

**Table 8**
**Three-stage-least squares (3SLS) estimation results for the system of 4 equations, with endogenous π (integrated sample)**

| | Prosecution rate as proxy | | | | | | | | Conviction rate as proxy | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Theft | | | | Robbery | | | | Theft | | | | Robbery | | | |
| | Crime | Human Capital | Probability | Growth | Crime | Human Capital | Probability | Growth | Crime | Human Capital | Probability | Growth | Crime | Human Capital | Probability | Growth |
| Crime rate, θ | | 0.000** | | 0.000*** | | 0.000** | | -0.001*** | | 0.000*** | | 0.000* | | -0.003*** | | 0.000 |
| | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.001) | | (0.000) |
| Probability of escape, π | -9236.1** | 1.3** | | | -639.3* | 1.3*** | | | 4708.4 | 6.1*** | | | -1141.5** | 5.8*** | | |
| | (3766.2) | (0.512) | | | (328.7) | (0.446) | | | (3674.8) | (1.5) | | | (525.0) | (1.7) | | |
| Escape probability squared, $\pi^2$ | 8109.2** | -0.928** | | | 678.4** | -1.1** | | | -2149.8 | -4.9*** | | | 875.4** | -4.4*** | | |
| | (3198.7) | (0.449) | | | (318.6) | (0.438) | | | (2972.6) | (1.2) | | | (445.5) | (1.4) | | |
| Labor income tax, $\pi_n$ | 178.0*** | -0.044*** | | | 19.1*** | -0.050*** | | | 189.1*** | -0.088*** | | | -5.8 | -0.024 | | |
| | (53.5) | (0.011) | | | (6.8) | (0.010) | | | (60.6) | (0.025) | | | (7..2) | (0.025) | | |
| Capital income tax, $\pi_k$ | 112.2 | -0.035** | | | 9.4 | -0.035*** | | | 4.1 | 0.050 | | | -7.9 | 0.084** | | |
| | (91.6) | (0.015) | | | (9.8) | (0.013) | | | (82.3) | (0.030) | | | (9.4) | (0.033) | | |
| Consumption tax, $\pi_c$ | 237.4*** | 0.004 | | | 6.5 | 0.003 | | | 157.7*** | 0.075*** | | | 7.7 | 0.002 | | |
| | (64.3) | (0.013) | | | (8.7) | (0.012) | | | (44.3) | (0.016) | | | (4.7) | (0.016) | | |
| Human capital | | | | -0.207 | | | | 2.6** | | | | 0.805 | | | | 1.4* |
| | | | | (0.762) | | | | (1.0) | | | | (0.551) | | | | (0.836) |
| Human capital, squared | | | | 0.031 | | | | -0.454*** | | | | -0.145 | | | | -0.238* |
| | | | | (0.132) | | | | (0.167) | | | | (0.093) | | | | (0.143) |
| Expenditure on public order & security | | | -0.095 | | | | 0.056 | | | | -0.077 | | | | 0.000 | |
| | | | (0.144) | | | | (0.147) | | | | (0.066) | | | | (0.067) | |
| POS expenditure, squared | | | 0.021 | | | | -0.026 | | | | 0.015 | | | | -0.010 | |
| | | | (0.035) | | | | (0.036) | | | | (0.019) | | | | (0.020) | |
| Gross debt-to-GDP ratio | 6.7 | -0.003 | | | -0.669 | -0.001 | | | -4.7 | 0.001 | | | | 0.000 | | |
| | (5.3) | (0.001) | | | (0.546) | (0.001) | | | (4.9) | (0.001) | | | | (0.001) | | |
| Education expenditure | | -0.002 | | | | 0.019 | | | | 0.031 | | | | 0.011 | | |
| | | (0.019) | | | | (0.020) | | | | (0.043) | | | | (0.043) | | |
| Gross enrolment ratio, secondary | | 0.004** | | | | 0.004** | | | | 0.008*** | | | | -0.002 | | |
| | | (0.002) | | | | (0.002) | | | | (0.003) | | | | (0.003) | | |
| Logarithm of GDP | 463.2*** | | | -0.001 | 15.5 | | | 0.043*** | 228.9** | | | 0.020 | 28.7** | | | 0.033 |
| | (129.1) | | | (0.015) | (16.1) | | | (0.015) | (110.5) | | | (0.013) | (14.6) | | | (0.020) |
| Real GDP growth | 1122.4 | | | | -635.1*** | | | | -2812.9** | | | | 33.7 | | | |
| | (1275.8) | | | | (149.4) | | | | (1227.2) | | | | (135.5) | | | |
| Unemployment rate | 51.4 | | | | 6.2* | | | | -66.3*** | | | | 9.5*** | | | |
| | (38.9) | | | | (3.6) | | | | (23.4) | | | | (2.8) | | | |
| Working-age population | -40.3 | | | | 17.7** | | | | 70.9 | | | | 11.9** | | | |
| | (71.2) | | | | (7.5) | | | | (44.5) | | | | (5.3) | | | |
| Urban population | 15.2 | 0.015*** | 0.006** | | -0.758 | 0.010*** | 0.007** | | 4.9 | -0.007 | 0.007*** | | 5.4*** | 0.003 | 0.010*** | |
| | (15.2) | (0.002) | (0.002) | | (1.9) | (0.002) | (0.003) | | (14.4) | (0.005) | (0.002) | | (1.8) | (0.006) | (0.002) | |
| Life expectancy | | 0.016 | 0.025** | | | -0.015* | 0.036*** | | | -0.001 | -0.001 | | | 0.046*** | -0.006 | |
| | | (0.012) | (0.012) | | | (0.009) | (0.012) | | | (0.012) | (0.006) | | | (0.017) | (0.006) | |
| Logarithm of total population | | 0.048* | 0.053* | | | 0.050** | 0.076*** | | | -0.039 | 0.008 | | | 0.173*** | -0.008 | |
| | | (0.025) | (0.027) | | | (0.023) | (0.029) | | | (0.044) | (0.017) | | | (0.066) | (0.017) | |
| Investment | | | | 0.023*** | | | | 0.011*** | | | | 0.018*** | | | | 0.017*** |
| | | | | (0.004) | | | | (0.004) | | | | (0.003) | | | | (0.003) |
| Trade | | | | 0.000 | | | | 0.000 | | | | 0.000 | | | | 0.000 |
| | | | | (0.000) | | | | (0.001) | | | | (0.000) | | | | (0.000) |
| Inflation | | | | 0.000 | | | | 0.000 | | | | 0.000 | | | | -0.001 |
| | | | | (0.000) | | | | (0.000) | | | | (0.000) | | | | (0.000) |
| High-income dummy | 497.7* | 0.641*** | 0.062 | -0.094 | -56.0 | 0.733*** | -0.056 | 0.153*** | 486.2 | 0.252** | 0.140*** | -0.021 | 49.8 | 0.460*** | 0.142*** | -0.003 |
| | (298.9) | (0.063) | (0.085) | (0.070) | (42.3) | (0.071) | (0.087) | (0.055) | (300.5) | (0.119) | (0.053) | (0.037) | (33.3) | (0.123) | (0.055) | (0.046) |
| Latin American & Caribbean dummy | 808.7 | -0.736*** | 0.087 | 0.102** | 767.9*** | -0.092 | -0.053 | 0.549*** | 285.2 | 0.077 | 0.283*** | 0.122*** | 400.2*** | 1.0*** | 0.252*** | 0.233** |
| | (643.0) | (0.143) | (0.109) | (0.047) | (86.3) | (0.158) | (0.111) | (0.549) | (741.7) | (0.252) | (0.066) | (0.045) | (105.5) | (0.424) | (0.068) | (0.115) |
| Structural break post-2005 | -682.6*** | 0.104** | -0.229*** | -0.017 | -32.9 | 0.152*** | -0.210*** | -0.035 | -382.9** | 0.231*** | -0.120*** | -0.040* | -34.3* | -0.017 | -0.086*** | -0.060*** |
| | (198.1) | (0.046) | (0.046) | (0.024) | (24.5) | | (0.046) | (0.028) | (177.2) | (0.067) | (0.030) | (0.021) | (20.7) | (0.077) | (0.032) | (0.022) |
| Country Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 118 | 118 | 118 | 118 | 121 | 121 | 121 | 121 | 144 | 144 | 144 | 144 | 147 | 147 | 147 | 147 |
| Adjusted $R^2$ | 0.767 | 0.920 | 0.618 | 0.595 | 0.681 | 0.929 | 0.590 | 0.362 | 0.720 | 0.503 | 0.664 | 0.481 | 0.614 | 0.485 | 0.594 | 0.455 |
| Implied threshold values | 0.439 | 0.366 | 0.112 | | 0.531 | 0.423 | 0.232 | | 0.228 | 0.401 | 0.099 | | 0.383 | 0.380 | NA | |

Parantheses denote values of heteroskedasticity-adjusted robust sandard errors.
Statistically significant estimates at at least the 10% level are bold, with *** for 1% level, ** 5% level, and * 10% level.
All figures with absolute value above 1.0 are rounded to 1 decimal place.

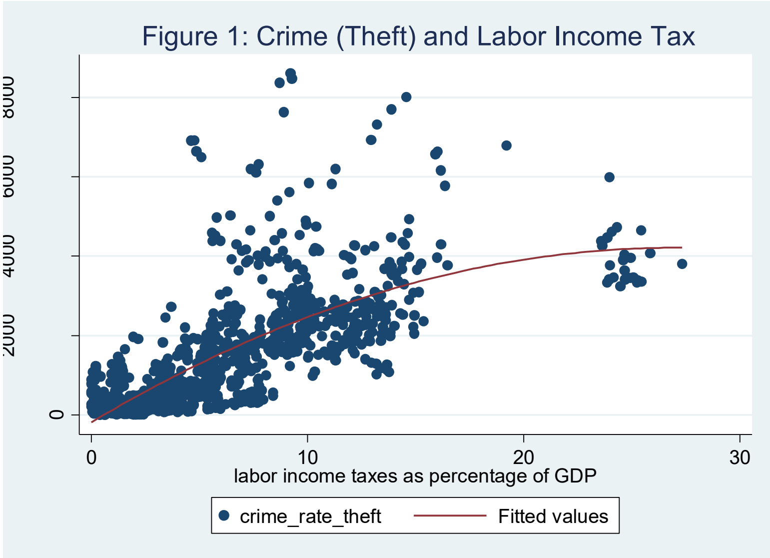
Figure 1: Crime (Theft) and Labor Income Tax
0
2000
4000
6000
8000
0
10
20
30
labor income taxes as percentage of GDP
crime_rate_theft
Fitted values

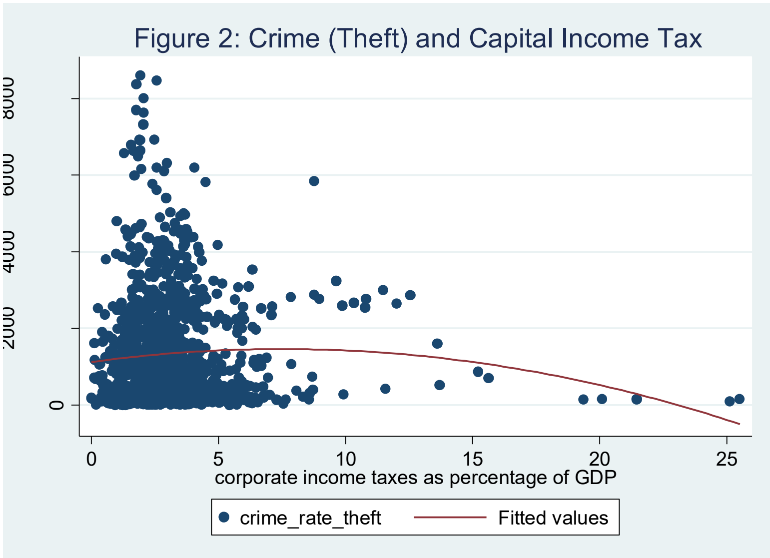
Figure 2: Crime (Theft) and Capital Income Tax
0
2000
4000
6000
8000
0
5
10
15
20
25
corporate income taxes as percentage of GDP
crime_rate_theft
Fitted values

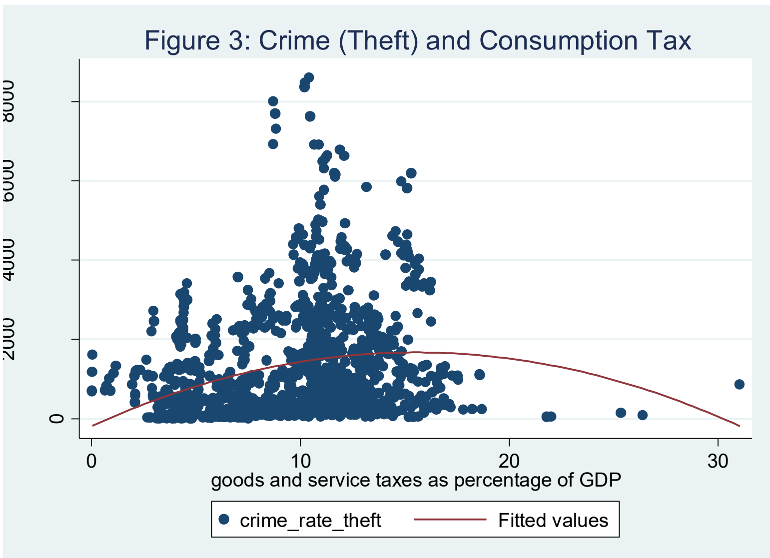
Figure 3: Crime (Theft) and Consumption Tax
0
2000
4000
6000
8000
0
10
20
30
goods and service taxes as percentage of GDP
crime_rate_theft
Fitted values

# APPENDIX

The individuals' intertemporal utility maximization problem in maximizing (1) by choosing $c_t$, $n_t$, $z_t$, $\theta_t$, and $k_t$, subject to the budget constraint of (3), can be solved by setting up a dynamic Lagrangian problem, as in

$$\begin{aligned} L &= E_t \sum_{t=0}^{\infty} \beta^t u(c_t, l_t, h_{t+1}) + \lambda_t \{(1-\pi_v)(1-\tau_n)h_t n_t w_t + \pi x_t \\ &\quad +(r_t^k - \delta)(1-\tau_k)k_{t-1} + k_{t-1} - (1+\tau_c)c_t - k_t - z_t, \}, \end{aligned} \tag{A1}$$

where $x_t = \theta_t(1-\tau)h_t n_t w_t$ and $l_t = \Gamma - h_t n_t - \theta_t - \varepsilon$.

Solving the problem yields the first-order conditions of

$$\beta^t u_{c,t} - \lambda_t(1+\tau_c) = 0, \tag{A2}$$

$$-\beta^t u_{n,t} + \lambda_t \left[(1-\pi_v+\pi\theta_t)(1-\tau_n)\right] h_t w_t = 0, \tag{A3}$$

$$E_t[\lambda_{t+1}(1+r_t^B)] - \lambda_t = 0, \tag{A4}$$

$$\beta^t u_{h,t} h_{z,t} - \lambda_t = 0, \tag{A5}$$

$$E_t[\lambda_{t+1}(1+(r_t^k-\delta)(1-\tau_k))] - \lambda_t = 0, \tag{A6}$$

$$-\beta^t u_{\theta,t} + \lambda_t \pi(1-\tau_n)h_t n_t w_t = 0. \tag{A7}$$

Equating the $c_t$ and $c_{t+1}$ version of (A2), and then substituting out $\lambda_{t+1}/\lambda_t$ using (A6), yield the Euler equation:

$$\beta^{-1}\frac{u_{c,t}}{u_{c,t+1}} = 1 + (r_t^k - \delta)(1-\tau_k). \tag{A8}$$

Equating (A2) and (A5) yields

$$\frac{u_{c,t}}{(1+\tau_c)} = u_{h,t}h_{z,t}, \tag{A9}$$

while equating (A3) and (A7) yields

$$\frac{u_{n,t}}{u_{\theta,t}} = \frac{(1-\pi_v+\pi\theta_t)(1-\tau_n)}{\pi(1-\tau_n)n_t}. \tag{A10}$$

Finally, equating (A4) and (A6) allows us to derive the following relationship between returns on government bonds and the real rate of returns on physical capital:

$$r_t^B = (r_t^k - \delta)(1-\tau_k). \tag{A11}$$

Suppose $u(c_t, l_t, h_{t+1}) = \eta_C \ln c_t + \eta_H \ln h_{t+1} + \psi \ln(\Gamma - h_t n_t - \theta_t - \varepsilon)$, the Euler equation in (A8) becomes

$$\beta^{-1}\frac{c_{t+1}}{c_t} = 1 + (r_t^k - \delta)(1-\tau_k). \tag{A12}$$

Meanwhile, (A9) can be rearranged and written as an expression of $z_t$ that depends on $c_t$, as in

$$z_t = \frac{\nu_2 \eta_H}{\eta_C}(1+\tau_c)c_t. \tag{A13}$$

For (A10), a bit of algebraic manipulation would yield

$$h_t n_t = \frac{(1-\pi_v)+\pi\theta_t}{\pi}. \tag{A14}$$

With log-utility, we know that (A5) would give $\lambda_t = \beta^t(\nu_2\eta_H)/z_t$, which when substituted into (A7), would give

$$\frac{\psi z_t}{\Gamma - h_t n_t - \theta_t - \varepsilon} = \nu_2 \eta_H \pi (1-\tau_n) h_t n_t w_t.$$

Knowing that $H_t n_t = h_t n_t$, we then substitute the first-order condition (10) for $w_t$, as well as (A13) and (A14) into the expression, yielding

$$\frac{\psi \frac{\nu_2\eta_H}{\eta_C}(1+\tau_c)c_t}{\Gamma - \frac{(1-\pi_v)}{\pi} - 2\theta_t - \varepsilon} = \nu_2\eta_H\pi(1-\tau_n)h_t n_t (1-\alpha)\frac{Y_t}{h_t n_t},$$

which after further algebraic manipulations, allows us to derive an expression for the consumption-to-final output ratio, $c_t/Y_t$, as in

$$\frac{c_t}{Y_t} = (\Phi_1)^{-1}\left[\Gamma - \frac{(1-\pi_v)}{\pi} - 2\theta_t - \varepsilon\right], \tag{A15}$$

where $\Phi_1 = \psi(1+\tau_c)[\eta_C \pi(1-\tau_n)(1-\alpha)]^{-1}$. Equivalently, (A15) can also be written as an expression for $\theta_t$, where

$$\theta_t = \frac{\Gamma}{2} - \frac{(1-\pi_v)}{2\pi} - \frac{\Phi_1}{2}\frac{c_t}{Y_t} - \frac{\varepsilon}{2}. \tag{A16}$$

From (12) in the final output sector, we have

$$\frac{Y_t}{k_t} = (H_t n_t)^{1-\alpha},$$

which given (A14) and that $H_t = h_t$, yields

$$\frac{Y_t}{k_t} = (\frac{(1-\pi_v)+\pi\theta_t}{\pi})^{1-\alpha}. \tag{A17}$$

In the government sector, dividing (14) by $Y_t$, we can derive an expression for the public spending on education (as a share of final output):

$$\frac{g_t^E}{Y_t} = v_E[\tau_c \frac{c_t}{Y_t} + \tau_n w_t \frac{H_t n_t}{Y_t} + \tau_k (r_t^k - \delta) \frac{k_{t-1}}{k_t} \frac{k_t}{Y_t} + (1-\pi)\theta_t (1-\tau_n) \frac{h_t n_t}{Y_t} w_t]. \tag{A18}$$

Using (10) and (A15) to substitute out $w_t$, $r_t^k$, and $c_t/ Y_t$, and subsequently (A17) for $Y_t/k_t$, (A18) can be rearranged and simplified to

$$\frac{g_t^E}{Y_t} = v_E \left\{ \begin{array}{c} \frac{\tau_c}{\Phi_1}\left[\Gamma - \frac{1}{\pi} + \frac{\pi_v}{\pi} - \varepsilon\right] + (1-\alpha)\tau_n + \left(\Phi_2 - 2\frac{\tau_c}{\Phi_1}\right)\theta_t \\ + \left[\alpha\tau_k - \tau_k \delta \left(\frac{1-\pi_v}{\pi} + \theta_t\right)^{\alpha-1}\right] \frac{k_{t-1}}{k_t} \end{array} \right\}. \tag{A19}$$

Next, the economy-wide aggregate resource constraint is divided by $Y_t$ and rewritten below as:

$$1 = (1+\tau_c)\frac{c_t}{Y_t} + [\tau_n + (1-\pi)\theta_t(1-\tau_n)]\frac{w_t H_t n_t}{Y_t} + \left(\frac{Y_t}{k_t}\right)^{-1} - [(1-\delta) - \tau_k(r_t^k - \delta)]\frac{k_{t-1}}{Y_t}. \tag{A20}$$

Using (A15) to substitute out $c_t/Y_t$, and (10) to substitute out $w_t$ and $r_t^k$, we can rewrite (A20) as

$$\begin{aligned} 1 = {} & (1+\tau_c)(\Phi_1)^{-1}[\Gamma - \frac{(1-\pi_v)}{\pi} - 2\theta_t - \varepsilon] + (1-\alpha)\tau_n \\ & +[(1-\pi)(1-\alpha)(1-\tau_n)]\theta_t \\ & + \left(\frac{Y_t}{k_t}\right)^{-1} + \left([\delta(1-\tau_k) - 1]\left(\frac{Y_t}{k_t}\right)^{-1}\right)\frac{k_{t-1}}{k_t} + \alpha\tau_k \frac{k_{t-1}}{k_t}, \end{aligned} \tag{A21}$$

which after further rearrangement of terms, as well as the substitution of (12) for $Y_t/k_t$, allows us to derive an expression for $k_t/k_{t-1}$, as in

$$\frac{k_t}{k_{t-1}} = \left\{[1-\delta(1-\tau_k)]\left[\frac{(1-\pi_v)}{\pi} + \theta_t\right]^{\alpha-1} - \alpha\tau_k\right\} \times \left\{ \begin{array}{c} (1+\tau_c)(\Phi_1)^{-1}[\Gamma - \frac{(1-\pi_v)}{\pi} - 2\theta_t - \varepsilon] \\ +(1-\alpha)\tau_n - 1 + \left[\frac{(1-\pi_v)}{\pi} + \theta_t\right]^{\alpha-1} + \Phi_2\theta_t \end{array} \right\}^{-1}, \tag{A22}$$

where $\Phi_2 = (1-\pi)(1-\alpha)(1-\tau_n)$.

**Model Solutions:**

Gathering all the equations, we can summarize the model solutions that characterize the dynamics of the system as follows:

$$\beta^{-1}\frac{c_{t+1}}{c_t} = 1+(\alpha\frac{Y_t}{k_t}-\delta)(1-\tau_k),$$

$$\frac{Y_t}{k_t} = (\frac{(1-\pi_v)+\pi\theta_t}{\pi})^{1-\alpha},$$

$$\theta_t = \frac{\Gamma}{2}-\frac{(1-\pi_v)}{2\pi}-\frac{\Phi_1}{2}\frac{c_t}{Y_t}-\frac{\varepsilon}{2},$$

$$\frac{g_t^E}{Y_t} = v_E\left\{\begin{array}{c} \frac{\tau_c}{\Phi_1}\left[\Gamma-\frac{1}{\pi}+\frac{\pi_v}{\pi}-\varepsilon\right]+(1-\alpha)\tau_n+\left(\Phi_2-2\frac{\tau_c}{\Phi_1}\right)\theta_t \\ +\left[\alpha\tau_k-\tau_k\delta\left(\frac{1-\pi_v}{\pi}+\theta_t\right)^{\alpha-1}\right]\frac{k_{t-1}}{k_t} \end{array}\right\},$$

$$\begin{aligned} \frac{k_t}{k_{t-1}} &= \left\{[1-\delta(1-\tau_k)]\left[\frac{(1-\pi_v)}{\pi}+\theta_t\right]^{\alpha-1}-\alpha\tau_k\right\}\times \\ &\left\{\begin{array}{c} (1+\tau_c)(\Phi_1)^{-1}[\Gamma-\frac{(1-\pi_v)}{\pi}-2\theta_t-\varepsilon] \\ +(1-\alpha)\tau_n-1+\left[\frac{(1-\pi_v)}{\pi}+\theta_t\right]^{\alpha-1}+\Phi_2\theta_t \end{array}\right\}^{-1}, \end{aligned}$$

where $\Phi_1 = \psi(1+\tau_c)[\eta_C\pi(1-\tau_n)(1-\alpha)]^{-1}$, $\Phi_2 = (1-\pi)(1-\alpha)(1-\tau_n)$, $\Phi_E = (\chi_E)^{\nu_1}(\frac{\nu_2\eta_H}{\eta_C}(1+\tau_c))^{\nu_2}$.

To determine the growth rate, in equilibrium, we know that $\pi_v = \frac{\theta_t}{\Gamma}$, and that knowing that physical capital stock grows at the same rate as final output, (A22) can be rewritten as an expression of transitory growth rate that depends on the expectation of crime rate, $\theta_{t+1}$, and the economy's public debt-to-final output ratio, $\frac{d_{t+1}}{Y_{t+1}}$. Specifically,

$$\begin{aligned} 1+\gamma_t &= \frac{k_{t+1}}{k_t} = \left\{[1-\delta(1-\tau_k)]\left[\pi^{-1}+[1-(\Gamma\pi)^{-1}]\theta_{t+1}\right]^{\alpha-1}-\alpha\tau_k\right\}\times \\ &\left\{\begin{array}{c} (1+\tau_c)(\Phi_1)^{-1}[(\Gamma-\pi^{-1}-\varepsilon)+((\Gamma\pi)^{-1}-2)\theta_{t+1}] \\ +(1-\alpha)\tau_n-1+[\pi^{-1}+(1-(\Gamma\pi)^{-1})\theta_{t+1}]^{\alpha-1}+\Phi_2\theta_{t+1} \end{array}\right\}^{-1}. \end{aligned} \tag{A23}$$

Equivalently, dividing (7) by $h_t$, and knowing that $H_{t+1}/H_t = h_{t+1}/h_t$, we have

$$1+\gamma_t = \frac{H_{t+1}}{H_t} = \frac{(\chi_E\frac{g_t^E}{Y_t})^{\nu_1}}{(H_t)^{\nu_1+\nu_2}}\left\{\frac{\nu_2\eta_H}{\eta_C\Phi_1}(1+\tau_c)\left[\begin{array}{c}\Gamma-\frac{1}{\pi}-\varepsilon \\ +\theta_t[(\Gamma\pi)^{-1}-2]\end{array}\right]\right\}^{\nu_2}, \tag{A24}$$

where $g_t^E/Y_t$ is given by (A19).

In the stationary equilibrium, we know that $\theta_t = \theta_{t+1} = \tilde{\theta}$, $k_t = k_{t+1} = k_{t-1} = \tilde{k}$. These allow us to rearrange the steady-state version of (A22) to yield a function of the crime incidence, $f(\tilde{\theta}) = 0$, as follow:

$$\begin{aligned} f(\tilde{\theta}) &= (1-\alpha)\tau_n - 1 + \alpha\tau_k + (1+\tau_c)(\Phi_1)^{-1}[(\Gamma - \pi^{-1} - \varepsilon) \\ &\quad + \left[\Phi_2 + (1+\tau_c)(\Phi_1)^{-1}((\Gamma\pi)^{-1} - 2)\right]\tilde{\theta} + \delta(1-\tau_k)\left[\pi^{-1} + (1-(\Gamma\pi)^{-1})\tilde{\theta}\right]^{\alpha-1} \\ &= 0, \end{aligned} \tag{A25}$$

which would enable the application of implicit function theorem to examine the steady-state relationship between the crime incidence, $\tilde{\theta}$, and the set of policy arrangements, $\tau_c$, $\tau_k$, $\tau_n$, and $\pi$, in the economy.

Before doing so, we also define the equilibrium level of human capital, $\tilde{H}$. Given that $\tilde{H} = \tilde{h}$, $k_t = \tilde{k}$ $\forall t$, and $\pi_v = \tilde{\theta}$ in the stationary equilibrium, (7) can be manipulated to give

$$\tilde{H}^{\nu_1+\nu_2} = \Phi_E(\Phi_1)^{-\nu_2}(\frac{\tilde{g}^E}{\tilde{Y}})^{\nu_1}\left[\Gamma - \frac{1}{\pi} - \varepsilon + \tilde{\theta}[(\Gamma\pi)^{-1} - 2]\right]^{\nu_2}, \tag{A26}$$

or

$$\tilde{H} = (\Phi_E)^{\frac{1}{\nu_1+\nu_2}}(\Phi_1)^{-\frac{\nu_2}{\nu_1+\nu_2}}(\frac{\tilde{g}^E}{\tilde{Y}})^{\frac{\nu_1}{\nu_1+\nu_2}}\left[\Gamma - \frac{1}{\pi} - \varepsilon + \tilde{\theta}[(\Gamma\pi)^{-1} - 2]\right]^{\frac{\nu_2}{\nu_1+\nu_2}}, \tag{A27}$$

where $\Phi_E = (\chi_E)^{\nu_1}(\frac{\nu_2\eta_H}{\eta_C}(1+\tau_c))^{\nu_2}$, and $\tilde{g}^E/\tilde{Y}$ is given by

$$\frac{\tilde{g}^E}{\tilde{Y}} = v_E\left\{\begin{array}{c} \frac{\tau_c}{\Phi_1}(\Gamma - \varepsilon - \frac{1}{\pi}) + \frac{\tilde{\theta}}{\Gamma\pi}\frac{\tau_c}{\Phi_1} + (1-\alpha)\tau_n + (\Phi_2 - 2\frac{\tau_c}{\Phi_1})\tilde{\theta} \\ + \left[\alpha\tau_k - \tau_k\delta\left[\frac{1}{\pi} + \tilde{\theta}(1-(\Gamma\pi)^{-1})\right]^{\alpha-1}\right]. \end{array}\right\}, \tag{A28}$$

**Comparative Statics and Analytical Derivations of Propositions**

For the purposes of this paper, (A25) and (A27) are the two key equations of interest, as we examine the comparative statics of the different policy arrangements in affecting the crime incidence ($\tilde{\theta}$) and the human capital level ($\tilde{H}$) in this equilibrium. The comparative statics of the equilibrium $\tilde{\theta}$ and $\tilde{H}$ with respect to $\pi$, $\tau_c$, $\tau_k$, $\tau_n$ are derived. For the crime incidence ($\tilde{\theta}$), the implicit function theorem is applied as follows:

$$\frac{\partial\tilde{\theta}}{\partial\pi} = -\frac{f_\pi}{f_\theta},\ \frac{\partial\tilde{\theta}}{\partial\tau_c} = -\frac{f_{\tau_c}}{f_\theta},\ \frac{\partial\tilde{\theta}}{\partial\tau_n} = -\frac{f_{\tau_n}}{f_\theta},\ \frac{\partial\tilde{\theta}}{\partial\tau_k} = -\frac{f_{\tau_k}}{f_\theta},\ \text{where} \tag{A29}$$

the respective partial derivatives and composite parameters are derived and evaluated below.

First, to simplify matters, we derive partial derivatives for the composite parameters, $\Phi_1$, $\Phi_2$, and $\Phi_E$. The partial derivatives with respect to $\pi$, $\tau_c$, $\tau_n$, $\tau_k$ are easily derived, which give the followings:

$$\Phi_{1\pi} = -\frac{\Phi_1}{\pi} < 0;\ \Phi_{2\pi} = -1 < 0;\ \Phi_{E\pi} = 0; \tag{A30}$$

$$\Phi_{1\tau_c} = \frac{\Phi_1}{1+\tau_c} > 0;\ \Phi_{2\tau_c} = 0;\ \Phi_{E\tau_c} = \frac{\nu_2\tilde{H}}{1+\tau_c} > 0; \tag{A31}$$

$$\Phi_{1\tau_n} = \frac{\Phi_1}{1-\tau_n} > 0;\ \Phi_{2\tau_n} = -1 < 0;\ \Phi_{E\tau_n} = 0; \tag{A32}$$

$$\Phi_{1\tau_k} = 0;\ \Phi_{2\tau_k} = 0;\ \Phi_{E\tau_k} = 0; \tag{A33}$$

Applying the implicit function theorem, we first calculate $f_\theta$ from (A25), which yields

$$\begin{aligned} f_\theta &= \left[\Phi_2 + (1+\tau_c)(\Phi_1)^{-1}((\Gamma\pi)^{-1} - 2)\right] \\ &\quad +(\alpha-1)\delta(1-\tau_k)[1-(\Gamma\pi)^{-1}][\pi^{-1} + (1-(\Gamma\pi)^{-1})\tilde{\theta}]^{\alpha-2}. \end{aligned} \tag{A34}$$

Given that $1-(\Gamma\pi)^{-1} > 0$ (due to $\Gamma\pi > 1$), the second and third terms are clearly negative. The first term is ambiguous and its sign depends on $(\Gamma\pi)^{-1} - 2$. However, for $\Gamma > 1$, and most reasonable combinations of $\Gamma\pi$, the first term will be negative too. As such, $f_\theta < 0$.

Second, we calculate $f_\pi$ from (A25), which gives

$$\begin{aligned} f_\pi &= (1+\tau_c)\left\{\frac{1}{\Phi_1\pi^2} - (\Gamma - \varepsilon - \frac{1}{\pi})\frac{\Phi_{1\pi}}{(\Phi_1)^2}\right\} - \tilde{\theta} \\ &\quad -\tilde{\theta}(1+\tau_c)\left\{\frac{\Phi_{1\pi}}{(\Phi_1)^2}[(\Gamma\pi)^{-1} - 2] + \frac{1}{\Gamma\Phi_1\pi^2}\right\} \\ &\quad +\delta(1-\tau_k)(\alpha-1)(\tilde{H}\tilde{n})^{\alpha-2}\left[\pi^{-2}(\frac{\tilde{\theta}}{\Gamma} - 1)\right] \\ &\quad +\alpha(\alpha-1)(1-\tau_k)(\tilde{H}\tilde{n})^{-\alpha}\left[\pi^{-2}(\frac{\tilde{\theta}}{\Gamma} - 1)\right]. \end{aligned} \tag{A35}$$

Given that $(\alpha - 1) < 0$ and $(\frac{\tilde{\theta}}{\Gamma} - 1) < 0$, the third and fourth terms are unambiguously positive. With $\Phi_{1\pi} < 0$, the first two terms are technically ambiguous. However, numerically, the first term is positive, and the second term is positive as well if $(\Gamma\pi)^{-1} - 2 < 0$ (which gives an overall negative term due to the minus sign in the front).

Third, differentiating (A25) with respect to $\tau_c$, we get

$$\begin{aligned} f_{\tau_c} &= (\Gamma - \varepsilon - \frac{1}{\pi})\left[\frac{1}{\Phi_1} - \frac{(1+\tau_c)\Phi_{1\tau_c}}{(\Phi_1)^2}\right] + \tilde{\theta}[(\Gamma\pi)^{-1} - 2]\left[\frac{1}{\Phi_1} - \frac{(1+\tau_c)\Phi_{1\tau_c}}{(\Phi_1)^2}\right] \\ &= 0, \end{aligned} \tag{A36}$$

due to the fact that $(\Phi_1)^{-1} = (1+\tau_c)\Phi_{1\tau_c}(\Phi_1)^{-2}$.

Fourth, we calculate $f_{\tau_n}$ by differentiating (A25) with respect to $\tau_n$, which yields

$$\begin{aligned} f_{\tau_n} &= (1-\alpha) - (1+\tau_c)(\Gamma - \varepsilon - \frac{1}{\pi})\frac{\Phi_{1\tau_n}}{(\Phi_1)^2} - \tilde{\theta} \\ &\quad -(1+\tau_c)\tilde{\theta}[(\Gamma\pi)^{-1} - 2]\frac{\Phi_{1\tau_n}}{(\Phi_1)^2}. \end{aligned} \tag{A37}$$

The sign of $f_{\tau_n}$is generally ambiguous. The second term, $(1+\tau_c)(\Gamma - \varepsilon - \frac{1}{\pi})\Phi_{1\tau_n}(\Phi_1)^{-2}$ is definitely positive, but the sign of the last term depends on the sign of $(\Gamma\pi)^{-1} - 2$.

Finally, we calculate $f_{\tau_k}$ from (A25) and obtain

$$f_{\tau_k} = \alpha - \delta[\pi^{-1} + (1 - (\Gamma\pi)^{-1})\tilde{\theta}]^{\alpha-1}, \tag{A38}$$

which again, has ambiguous sign.

Applying the implicit function theorem, we have

$$\frac{\partial\tilde{\theta}}{\partial\pi} = -\frac{f_\pi}{f_\theta}, \frac{\partial\tilde{\theta}}{\partial\tau_c} = -\frac{f_{\tau_c}}{f_\theta}, \frac{\partial\tilde{\theta}}{\partial\tau_n} = -\frac{f_{\tau_n}}{f_\theta}, \frac{\partial\tilde{\theta}}{\partial\tau_k} = -\frac{f_{\tau_k}}{f_\theta}. \tag{A39}$$

Analytically, it is clear that $\partial\tilde{\theta}/\partial\tau_c = 0$ (**Proposition 1).**

For the remainders, we know that $1 - (\Gamma\pi)^{-1} > 0$ (since $\Gamma\pi > 1$), and for most combinations of $\Gamma\pi$, $(\Gamma\pi)^{-1} - 2 < 0$ can be established. This means $f_\theta < 0$. Similarly, for $f_{\tau_k} > 0$, for a reasonably small value of $\delta$, it is straightforward to establish that $f_{\tau_k} > 0$, which means $\partial\tilde{\theta}/\partial\tau_k > 0$. However, as seen from the derived expressions, the signs of $f_\pi$ and $f_{\tau_n}$ are generally ambiguous, which therefore require numerical evaluations.

For the expression of the stationary level of human capital, (A27) is rewritten below for convenience:

$$\tilde{H} = (\Phi_E)^{\frac{1}{\nu_1+\nu_2}}(\Phi_1)^{-\frac{\nu_2}{\nu_1+\nu_2}}(\frac{\tilde{g}^E}{\tilde{Y}})^{\frac{\nu_1}{\nu_1+\nu_2}}\left[\Gamma - \frac{1}{\pi} - \varepsilon + \tilde{\theta}[(\Gamma\pi)^{-1} - 2]\right]^{\frac{\nu_2}{\nu_1+\nu_2}}. \tag{A40}$$

First, we calculate $\partial\tilde{H}/\partial\pi$, which yields

$$\begin{aligned}\frac{\partial\tilde{H}}{\partial\pi} &= \frac{\tilde{H}\nu_2}{(\nu_1+\nu_2)}\left\{[\pi^{-2}(1-\frac{\tilde{\theta}}{\Gamma})]\left[\Gamma - \frac{1}{\pi} - \varepsilon + \tilde{\theta}[(\Gamma\pi)^{-1} - 2]\right]^{-1} - \frac{\Phi_{1\pi}}{\Phi_1}\right\} \\ &\quad + \frac{\tilde{H}\nu_1 v_E}{(\nu_1+\nu_2)}(\frac{\tilde{g}^E}{\tilde{Y}})^{-1}\left\{\begin{array}{c} \frac{\tau_c}{\Phi_1}[\pi^{-2}(1-\frac{\tilde{\theta}}{\Gamma})] - \frac{\tau_c}{\Phi_1}\frac{\Phi_{1\pi}}{\Phi_1}(\Gamma - \frac{1}{\pi} - \varepsilon + \frac{\tilde{\theta}}{\Gamma\pi}) + \left[2\frac{\tau_c\Phi_{1\pi}}{(\Phi_1)^2} - 1\right]\tilde{\theta} \\ +\delta\tau_k(1-\alpha)[\pi^{-2}(\frac{\tilde{\theta}}{\Gamma} - 1)] \end{array}\right\},\end{aligned} \tag{A41}$$

which needs to be evaluated numerically.

Second, we evaluate $\partial\tilde{H}/\partial\tau_c$ by differentiating (A40) with respect to $\tau_c$, yielding

$$\begin{aligned}\frac{\partial\tilde{H}}{\partial\tau_c} &= \frac{\tilde{H}\nu_2}{(\nu_1+\nu_2)}\left[\frac{1}{(1+\tau_c)} - \frac{\Phi_{1\tau_c}}{\Phi_1}\right] \\ &\quad + \frac{\tilde{H}\nu_1 v_E}{(\nu_1+\nu_2)}(\frac{\tilde{g}^E}{\tilde{Y}})^{-1}\left[\begin{array}{c}\Gamma - \frac{1}{\pi} - \varepsilon \\ +\tilde{\theta}[(\Gamma\pi)^{-1} - 2]\end{array}\right]\left[(\Phi_1)^{-1}(1+\tau_c)^{-1}\right].\end{aligned} \tag{A42}$$

Again, given that $(1+\tau_c)^{-1} = (\Phi_{1\tau_c}/\Phi_1)$, the first term is zero, while the second term is clearly positive. This means $\partial\tilde{H}/\partial\tau_c > 0$.

Third, we evaluate $\partial\tilde{H}/\partial\tau_n$ by differentiating (A40) with respect to $\tau_n$. This gives

$$\begin{aligned}\frac{\partial\tilde{H}}{\partial\tau_n} &= \frac{-\tilde{H}\nu_2}{(\nu_1+\nu_2)}\frac{\Phi_{1\tau_n}}{\Phi_1} \\ &\quad+\frac{\tilde{H}\nu_1 v_E}{(\nu_1+\nu_2)}(\frac{\tilde{g}^E}{\tilde{Y}})^{-1}\left\{(1-\alpha)-\tau_c\left[\begin{array}{c}\Gamma-\frac{1}{\pi}-\varepsilon\\ +\tilde{\theta}[(\Gamma\pi)^{-1}-2]\end{array}\right]\right\},\end{aligned} \tag{A43}$$

which is a clear negative because $\Phi_{1\tau_n}>0$ and $\tau_c\tilde{l}>1$ (the part inside the bracket in the second terms is just equal to steady-state leisure).

Next, we also evaluate $\partial\tilde{H}/\partial\tau_k$ by differentiating (A40) with respect to $\tau_k$, which delivers

$$\frac{\partial\tilde{H}}{\partial\tau_k}=\frac{\tilde{H}\nu_1 v_E}{(\nu_1+\nu_2)}(\frac{\tilde{g}^E}{\tilde{Y}})^{-1}\left\langle\left\{\alpha-\delta[\pi^{-1}+(1-(\Gamma\pi)^{-1})\tilde{\theta}]^{\alpha-1}\right\}\right\rangle. \tag{A44}$$

Lastly, the partial derivative of $\partial\tilde{H}/\partial\tilde{\theta}$ is also derived, which gives

$$\begin{aligned}\frac{\partial\tilde{H}}{\partial\tilde{\theta}} &= \frac{\tilde{H}\nu_2[(\Gamma\pi)^{-1}-2]}{(\nu_1+\nu_2)}\left[\Gamma-\frac{1}{\pi}-\varepsilon+\tilde{\theta}[(\Gamma\pi)^{-1}-2]\right]^{-1} \\ &\quad+\frac{\tilde{H}\nu_1 v_E}{(\nu_1+\nu_2)}(\frac{\tilde{g}^E}{\tilde{Y}})^{-1}\left\{\begin{array}{c}\frac{\tau_c}{\Phi_1}[(\Gamma\pi)^{-1}-2]+\Phi_2\\ +\tau_k\delta(1-\alpha)[1-(\Gamma\pi)^{-1}][\pi^{-1}+(1-(\Gamma\pi)^{-1})\tilde{\theta}]^{\alpha-2}\end{array}\right\}.\end{aligned} \tag{A45}$$

Since $(\Gamma\pi)^{-1}-2<0$, it can be shown numerically that the first term is negative, whereas the second term is positive. We therefore have two conflicting effects that necessitates numerical evaluation.

**Extensions with endogenous apprehension probability:**

To re-derive the partial derivatives for the case where $\pi$ is endogenized to $\tilde{g}^P/Y$, first, we note that the expression for $\tilde{g}^P/Y$ is given by

$$\frac{\tilde{g}^P}{\tilde{Y}}=v_P\left\{\begin{array}{c}\frac{\tau_c}{\Phi_1}(\Gamma-\varepsilon-\frac{1}{\pi})+\frac{\tilde{\theta}}{\Gamma\pi}\frac{\tau_c}{\Phi_1}+(1-\alpha)\tau_n+(\Phi_2-2\frac{\tau_c}{\Phi_1})\tilde{\theta}\\ +\left[\alpha\tau_k-\tau_k\delta\left[\frac{1}{\pi}+\tilde{\theta}(1-(\Gamma\pi)^{-1})\right]^{\alpha-1}\right]\end{array}\right\}, \tag{A46}$$

and the terms inside the bracket would now also have to be accounted for when deriving the partial derivatives. For the comparative statics of the equilibrium crime incidence, the implicit function theorem was used in the benchmark case. We therefore re-derive the relevant terms (denoted by an upper-case hat). These are:

$$\begin{aligned}\hat{f}_\theta &= f_\theta-\kappa\pi_0\pi\left(\frac{\tilde{g}^P}{Y}\right)^{-1}v_P\left\{\begin{array}{c}\frac{\tau_c}{\Phi_1}[(\Gamma\pi)^{-1}-2]+\Phi_2\\ +\tau_k\delta(1-\alpha)[1-(\Gamma\pi)^{-1}][\pi^{-1}+(1-(\Gamma\pi)^{-1})\tilde{\theta}]^{\alpha-2}\end{array}\right\} \\ &\quad\times\left\{\begin{array}{c}(1+\tau_c)\left[\frac{\pi^{-2}}{\Phi_1}-\frac{\Phi_{1\pi}}{(\Phi_1)^2}(\Gamma-\pi^{-1}-\varepsilon)\right]+\Phi_{2\pi}\tilde{\theta}-\tilde{\theta}(1+\tau_c)\left(\frac{\Phi_{1\pi}}{(\Phi_1)^2}[(\Gamma\pi)^{-1}-2]+\frac{\Phi_1^{-1}}{\Gamma\pi^2}\right)\\ +\frac{(1-\tau_k)(\alpha-1)}{[\pi^{-1}+(1-(\Gamma\pi)^{-1})\tilde{\theta}]}[\frac{1}{\pi^2}(\frac{\tilde{\theta}}{\Gamma}-1)]\delta\end{array}\right\},\end{aligned} \tag{A47}$$

$$\hat{f}_\pi = -f_\pi \kappa \pi_0 \pi \left(\frac{\tilde{g}^P}{Y}\right)^{-1} v_P \left\{ \begin{array}{c} \frac{\tau_c}{\Phi_1}[\pi^{-2}(1-\frac{\tilde{\theta}}{\Gamma})] - \frac{\tau_c}{\Phi_1}\frac{\Phi_{1\pi}}{\Phi_1}(\Gamma - \frac{1}{\pi} - \varepsilon + \frac{\tilde{\theta}}{\Gamma\pi}) + \left[2\frac{\tau_c \Phi_{1\pi}}{(\Phi_1)^2} - 1\right]\tilde{\theta} \\ +\delta\tau_k(1-\alpha)[\pi^{-2}(\frac{\tilde{\theta}}{\Gamma} - 1)] \end{array} \right\}, \tag{A48}$$

$$\begin{aligned} \hat{f}_{\tau_c} &= f_{\tau_c} - \kappa\pi_0\pi \left(\frac{\tilde{g}^P}{Y}\right)^{-1} v_P \left[ \begin{array}{c} \Gamma - \frac{1}{\pi} - \varepsilon \\ +\tilde{\theta}[(\Gamma\pi)^{-1} - 2] \end{array} \right] [(\Phi_1)(1+\tau_c)]^{-1} \\ &\times \left\{ \begin{array}{c} (1+\tau_c)\left[\frac{\pi^{-2}}{\Phi_1} - \frac{\Phi_{1\pi}}{(\Phi_1)^2}(\Gamma - \pi^{-1} - \varepsilon)\right] + \Phi_{2\pi}\tilde{\theta} - \tilde{\theta}(1+\tau_c)\left(\frac{\Phi_{1\pi}}{(\Phi_1)^2}[(\Gamma\pi)^{-1} - 2] + \frac{\Phi_1^{-1}}{\Gamma\pi^2}\right) \\ + \frac{(1-\tau_k)(\alpha-1)}{[\pi^{-1} + (1-(\Gamma\pi)^{-1})\tilde{\theta}]}[\frac{1}{\pi^2}(\frac{\tilde{\theta}}{\Gamma} - 1)]\delta \end{array} \right\}, \end{aligned} \tag{A49}$$

$$\begin{aligned} \hat{f}_{\tau_n} &= f_{\tau_n} - \kappa\pi_0\pi \left(\frac{\tilde{g}^P}{Y}\right)^{-1} v_P \left\{ (1-\alpha) - \tau_c \left[ \begin{array}{c} \Gamma - \frac{1}{\pi} - \varepsilon \\ +\tilde{\theta}[(\Gamma\pi)^{-1} - 2] \end{array} \right] \right\} \\ &\times \left\{ \begin{array}{c} (1+\tau_c)\left[\frac{\pi^{-2}}{\Phi_1} - \frac{\Phi_{1\pi}}{(\Phi_1)^2}(\Gamma - \pi^{-1} - \varepsilon)\right] + \Phi_{2\pi}\tilde{\theta} - \tilde{\theta}(1+\tau_c)\left(\frac{\Phi_{1\pi}}{(\Phi_1)^2}[(\Gamma\pi)^{-1} - 2] + \frac{\Phi_1^{-1}}{\Gamma\pi^2}\right) \\ + \frac{(1-\tau_k)(\alpha-1)}{[\pi^{-1} + (1-(\Gamma\pi)^{-1})\tilde{\theta}]}[\frac{1}{\pi^2}(\frac{\tilde{\theta}}{\Gamma} - 1)]\delta \end{array} \right\}, \end{aligned} \tag{A50}$$

$$\begin{aligned} \hat{f}_{\tau_k} &= f_{\tau_k} - \kappa\pi_0\pi \left(\frac{\tilde{g}^P}{Y}\right)^{-1} v_P \left\{ \alpha - \delta[\pi^{-1} + (1-(\Gamma\pi)^{-1})\tilde{\theta}]^{\alpha-1} \right\} \\ &\times \left\{ \begin{array}{c} (1+\tau_c)\left[\frac{\pi^{-2}}{\Phi_1} - \frac{\Phi_{1\pi}}{(\Phi_1)^2}(\Gamma - \pi^{-1} - \varepsilon)\right] + \Phi_{2\pi}\tilde{\theta} - \tilde{\theta}(1+\tau_c)\left(\frac{\Phi_{1\pi}}{(\Phi_1)^2}[(\Gamma\pi)^{-1} - 2] + \frac{\Phi_1^{-1}}{\Gamma\pi^2}\right) \\ + \frac{(1-\tau_k)(\alpha-1)}{[\pi^{-1} + (1-(\Gamma\pi)^{-1})\tilde{\theta}]}[\frac{1}{\pi^2}(\frac{\tilde{\theta}}{\Gamma} - 1)]\delta \end{array} \right\}. \end{aligned} \tag{A51}$$

For the comparative statics of the equilibrium level of human capital when there is endogenous $\pi$, let the partial derivatives with respect to $\hat{H}$ denote the 'new' ones, we can then express $\partial\hat{H}/\partial\pi$ as

$$\frac{\partial\hat{H}}{\partial\pi} = -\frac{\partial\tilde{H}}{\partial\pi}\kappa\pi_0\pi\left(\frac{\tilde{g}^P}{Y}\right)^{-1} v_P \left\{ \begin{array}{c} \frac{\tau_c}{\Phi_1}[\pi^{-2}(1-\frac{\tilde{\theta}}{\Gamma})] - \frac{\tau_c}{\Phi_1}\frac{\Phi_{1\pi}}{\Phi_1}(\Gamma - \frac{1}{\pi} - \varepsilon + \frac{\tilde{\theta}}{\Gamma\pi}) \\ + \left[2\frac{\tau_c\Phi_{1\pi}}{(\Phi_1)^2} - 1\right]\tilde{\theta} + \delta\tau_k(1-\alpha)[\pi^{-2}(\frac{\tilde{\theta}}{\Gamma} - 1)] \end{array} \right\}, \tag{A52}$$

where $\partial\tilde{H}/\partial\pi$ is from (A41). For the other comparative statics, they are given by

$$\frac{\partial\hat{H}}{\partial\tau_c} = \frac{\partial\tilde{H}}{\partial\tau_c} + \frac{\partial\hat{H}}{\partial\pi}\left[ \begin{array}{c} \Gamma - \frac{1}{\pi} - \varepsilon \\ +\tilde{\theta}[(\Gamma\pi)^{-1} - 2] \end{array} \right][(\Phi_1)(1+\tau_c)]^{-1}, \tag{A53}$$

$$\frac{\partial\hat{H}}{\partial\tau_n} = \frac{\partial\tilde{H}}{\partial\tau_n} + \frac{\partial\hat{H}}{\partial\pi}\left\{ (1-\alpha) - \tau_c \left[ \begin{array}{c} \Gamma - \frac{1}{\pi} - \varepsilon \\ +\tilde{\theta}[(\Gamma\pi)^{-1} - 2] \end{array} \right] \right\}, \tag{A54}$$

$$\frac{\partial\hat{H}}{\partial\tau_k} = \frac{\partial\tilde{H}}{\partial\tau_k} + \frac{\partial\hat{H}}{\partial\pi}\left\{ \alpha - \delta[\pi^{-1} + (1-(\Gamma\pi)^{-1})\tilde{\theta}]^{\alpha-1} \right\}, \tag{A55}$$

$$\frac{\partial \hat{H}}{\partial \hat{\theta}} = \frac{\partial \tilde{H}}{\partial \tilde{\theta}} + \frac{\partial \hat{H}}{\partial \pi} \left\{ \begin{array}{c} \frac{\tau_c}{\Phi_1}[(\Gamma\pi)^{-1} - 2] + \Phi_2 \\ +\tau_k \delta(1-\alpha)[1-(\Gamma\pi)^{-1}][\pi^{-1} + (1-(\Gamma\pi)^{-1})\tilde{\theta}]^{\alpha-2} \end{array} \right\}. \tag{A56}$$

Online supplementary appendix;
Not for print publication consideration.

# Appendix B

## Variables, Data, and Sample

**Sample Countries (77 economies) - Unbalanced panel with uneven data gaps, averaged into a 5-interval interval from 1986 to 2015**

Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Barbados, Belarus, Belgium, Bolivia, Botswana, Bulgaria, Burundi, Canada, Chile, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, El Salvador, Estonia, Finland, France, Georgia, Germany, Guatemala, Hong Kong, Hungary, Iceland, India, Israel, Italy, Japan, Republic of Korea, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Malaysia, Maldives, Malta, Mauritius, Mexico, Moldova, Mongolia, Nepal, Netherlands, New Zealand, Norway, Panama, Peru, Philippines, Poland, Portugal, Romania, Russian Federation, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Turkey, USA, Uganda, Ukraine, United Kingdom (England & Wales).

**Table B1: Variables, sources, and definitions**

| Variables | Source | Definition |
|---|---|---|
| *Crime measures:* | | |
| Crime rate | UN-CTS | Total recorded crimes (for all penal code) per 100,000 inhabitants |
| Crime_rate_theft | UN-CTS | Total recorded thefts per 100,000 inhabitants |
| Crime_rate_robbery | UN-CTS | Total recorded robberies per 100,000 inhabitants |
| *Criminal justice system-related measures:* | | |
| Probability of escaping prosecution_all crime | UN-CTS | 1 minus the probability of being prosecuted, all crime |
| Probability of escaping conviction_all crime | UN-CTS | 1 minus the probability of being convicted, all crime |
| Probability of escaping prosecution_theft | UN-CTS | 1 minus the probability of being prosecuted for theft |
| Probability of escaping prosecution_robbery | UN-CTS | 1 minus the probability of being prosecuted for robbery |
| Probability of escaping conviction_theft | UN-CTS | 1 minus the probability of being convicted for theft |
| Probability of escaping conviction_robbery | UN-CTS | 1 minus the probability of being convicted for robbery |
| Human Capital | Penn World Tables 9.0 | Human capital index constructed based on average schooling years measure of Barro and Lee (2013) and the estimated rates of return by Psacharopoulos (1994) |
| *Tax rate measures:* | | |
| Average personal income tax | IMF GFS | Personal income tax revenue as a percentage of GDP |
| Average corporate income tax | IMF GFS | Corporate income tax revenue as a percentage of GDP |
| Average goods & services tax | IMF GFS | Goods and services tax revenue as a percentage of GDP |
| *Others:* | | |
| Gross debt/ GDP | IMF WEO | Gross general government debt (percent of GDP) |
| Spending on public order & safety | IMF GFS | Public expenditure on public order & safety (percent of GDP) |
| Spending on education | IMF GFS | Public expenditure on education, total (percent of GDP) |
| Gross enrolment rate, secondary | World Bank WDI | Gross secondary enrolment rate |
| Logarithm of output | World Bank WDI | Logarithm of GDP in constant 2005 USD prices |
| Urban population | World Bank WDI | Urban population (percentage of total) |
| Unemployment rate | World Bank WDI | Total unemployment as a percentage of total workforce |
| Working-age population | World Bank WDI | Population aged 15-64 (percentage of total) |
| Life expectancy | World Bank WDI | Life expectancy at birth, total (years) |
| Logarithm of total population | World Bank WDI | Logarithm of total population |
| Investment | World Bank WDI | Gross fixed capital formation (percent of GDP) |
| Trade | World Bank WDI | Trade (percent of GDP) |
| Inflation | World Bank WDI | Consumer Price Index, inflation rate (in percent) |
| Dummy - Structural break post-2005 | Author-defined | Equal one if year is after 2005; to capture the structural change in reporting structure of criminal & justice system-related variables made by the United Nations in the UN-CTS survey questionnaires |
| Dummy - High-income | Author-defined | Equal one if a country is high-income, as defined by the World Bank |
| Dummy - Latin America & Caribbean | Author-defined | Equal one if a country is classified in the Latin America & Caribbean region, as defined by the World Bank |