NOTTINGHAM TRENT UNIVERSITY

DISCUSSION PAPERS IN ECONOMICS

No. 2019/2 ISSN 1478-9396

POLICE SPENDING AND ECONOMIC STABILIZATION IN A MONETARY ECONOMY WITH CRIME AND DIFFERENTIAL HUMAN CAPITAL

PENGFEI JIA

KING YOONG LIM

JANUARY 2019

DISCUSSION PAPERS IN ECONOMICS

At Nottingham Business School, our Working Papers Series in Economics include a wide variety of approaches reflecting our research interests and academic expertise.

This paper is part of the new series, ***Discussion Papers in Economics***.

Earlier papers can be found at:
https://www.ntu.ac.uk/research/research-at-ntu/academic-schools/research-at-nottingham-business-school/nbs-working-papers

Please contact the Editor (maternity cover) for enquiries concerning any of our Discussion Papers:

King Yoong Lim
Division of Economics
Nottingham Trent University
50 Shakespeare Street
Nottingham NG1 4FQ
UNITED KINGDOM

Email: king.lim@ntu.ac.uk
Tel: + 44 (0)115 848 6071

Police spending and economic stabilization in a monetary economy with crime and differential human capital

Pengfei Jia* and King Yoong Lim**

This Version: December 22, 2018

Abstract

This paper presents a dynamic model with crime, differential human capital, credit market imperfection, and police spending to examine the role of the latter in stabilizing shock arisen from formal educational quality uncertainty. Based on a stylized parameterization, we find formal and illegal human capital accumulation to share a common cyclical property. There is a case for the use of a rule-based approach to police spending as it smoothens out the fluctuations arisen from formal educational uncertainty, while contributing to a "decoupling" of the two types of human capital. This nonetheless comes with a cost of greater propagation of the financial accelerator effect due to credit market imperfection, and therefore necessitates the use of a supplementary monetary smoothing regime to negate these negative effects.

JEL Classification Numbers: H39, H50, K42, E44, E61.
Keywords: Crime, Credit Imperfection, Financial Accelerator, Human Capital Investment, Police Spending.

*Jia: Nanjing University, China; **Lim: Nottingham Business School, Notttingham Trent University.
We would like to thank the helpful comments and feedback from our respective colleagues. All views expressed in the article are our own. Technical appendices can be made available upon request.

1 Introduction

Ever since the contributions of Becker (1968) and Ehrlich (1973), the socio-economic effects of crime have been a subject of both theoretical and empirical investigations by policymakers and economists alike. The macroeconomics literature on crime has examined the economic costs of crime mainly in a growth context, and largely established a negative crime-growth relationship over the long run (see, for instance, Imrohoroglu et al., 2004, 2006; Goulas and Zervoyianni, 2015). These studies also investigate and link crime to the different aspects of agents' decisions and society, which include, non-exhaustively, child-rearing time (Neanidis and Papadopoulou, 2013), job-search and labour market institutions (Engelhardt et al., 2008), inequality (Kelly, 2000; Burdett et al., 2003), and human capital investment choice (Lochner and Moretti, 2004; Mocan et al., 2005). Of note, the latter introduced a framework that differentiates both formal/and crime-specific human capital—albeit not in a general equilibrium framework—bringing to light the intricate link between the two. However, the study stops short at exploring the economy-wide implications of the crime-education nexus, hence neglecting a key aspect associated with human capital investment in most developing economies with low educational attainment and high crime rate: private investment in formal human capital tends to be uncertain, an aspect already implied by various studies dated back to Galor and Zeira (1993).

Indeed, this shortcoming leads us to a general scarcity that remains in the existing analytical literature on macroeconomic analysis of crime: most models developed are independent from monetary and business-cycle considerations, despite studies such as Morrison et al. (2003) and Heinemann and Verner (2006) having documented that crime brings about macroeconomic multiplier effects and therefore, potentially greater economic fluctuations. Indeed, in both country-specific empirical studies (for instance, Detotto and Otranto, 2012; Pinotti, 2012; de Blasio et al., 2016 for Italy) and in the sociological science literature in the tradition of Cantor and Land (1985), strong empirical links between business cycle fluctuations and crime incidence have been established, albeit using mostly atheoretical framework (see, for instance, Arvanites and Defina, 2006; Bressler, 2009; Bushway et al., 2012). To our knowledge, save for a recent multi-equations model by Astarita et al. (2018), a rigorous analytical framework with Keynesian features remains elusive, more so a dynamic stochastic general equilibrium (DSGE) framework of crime with business-cycle properties.

To preview, this paper develops a DSGE model in the broad "*credit market imperfection*" tradition of Bernanke and Gertler (1989) and Bernanke et al. (1999) to examine the effects of human capital investment uncertainty in an economy with crime, police spending (generally, public expenditure on public order and security), credit market imperfections, and monetary policy. The latter duo are common features in "financial accelerator" models, therefore allow for more realistic modeling of the impact of crime on businesses and the wider economy, which in turn facilitate better understanding of the macroeconomic stabilization properties of police spending, and how police spending interacts with the common macroeconomic stabilization tools. Indeed, given that some of the economies with the highest crime rate in Latin America have experienced decades of persistently high organized crime and monetary instability (see, for instance, UNODC, 2012), there is a concrete policy need for such a model. This, together with the well-documented uneven educational quality in the region[1], suggest that the interactions of crime and formal human capital investment have a much significant effect on the effectiveness of macroeconomic stabilization policies in these economies.[2]

[1]See, for instance, Agénor and Lim (p.34, 2018) for a discussion on the issues of overeducation in the region. Despite that, on average, five of the most developed upper-income economies in the region still register a 79.5 percent of non-tertiary workforce, suggesting an overall uncertain environment for the attainment of formal/legal human capital.

[2]According to Heinemann and Verner (2006) and Soares and Naritomi (2010), the non-homicidal and non-domestic crimes in Latin America are predominantly urban crime, and a significant proportion of these criminal activities are of semi-organized nature that have adverse impacts on firms and production activities.

Indeed, the material costs of crime are estimated to add up to about 3.6 percent of GDP for Latin America (Londoño and Guerrero, 2000; Jaitman and Torre, 2017). Crime is said to consistently undermine business activities and therefore disincentivize human capital accumulation (Ayres, 1998). For the latter, Londoño and Guerrero (2000) estimate that the net accumulation of human capital in Latin America is half of what it ought to be due to the prevalence of crime. This, and given that education expansion has been shown empirically to have a crime-reducing effect (Machin et al., 2012), further reinforces the destabilizing impact of crime in the region. Indeed, it has been well-documented that organized criminal activities represent a non-negligible cost of doing business in the region, with the various downside risks resulting from organized crime often contributed to low business confidence, higher credit risk premium, and a greater overall business uncertainty when compared to other regions (Aravena and Solís, 2009; Spillan et al., 2014; Oguzoglu and Ranasinghe, 2017). All these create the needs for the governments to not just spend more on police and crime prevention (Bourguignon, 1999), but to find ways in improving its effectiveness. Indeed, according to Soares and Naritomi (2010), small police force is attributed to be a key factor of the high crime rate in Latin America. The relatively low level of government expenditure on public safety and small number of police personnel are illustrated in Figure 1. With many governments in developed economies, such as the United Kingdom, also currently debating on how best to manage the specific spending on public safety/police, the various issues underlined are well-worth examining.

Specifically, we build on the monetary model of Agénor and Alper (2012) to examine the nexus between crime and macroeconomic stability by exploring the interactions between organized crime and human capital (empirically well-documented in the Italian Mafia literature, but scarce in terms of analytical model). The nominal rigidities and monetary features are therefore included by design, as these are well-documented to be the main drivers of the financial accelerator effect, which in turn affects the real credit cost—the lending risk premium of which depends on crime rate—faced by firms and its propagation mechanism.[3] The rest of the paper is structured as follows. Section 2 presents the model. Section 3 defines and solves for its symmetric and steady-state equilibria. In Section 4, the model solutions are then log-linearized and parameterized to reflect a typical middle-income Latin American economy with high crime rates. Section 5 discusses the policy effects of the structural shocks introduced, especially on the role of public security/police spending in managing the fluctuations associated with formal human capital investment. Policy lessons drawn, together with future research directions, conclude the article in Section 6.

2 The Model

A closed economy populated by a continuum of identical infinitely-lived individuals, indexed by $i \in (0,1)$ is considered. Individuals consume, hold monetary assets, make human and physical capital investments, and allocate their time, normalized to one, among leisure, market works ($N_{it} \in (0,1)$), and criminal activities ($\theta_{it} \in (0,1)$). In market works, individuals supply effective labor hours ($H_{it}^{Y} N_{it}$) to a continuum of monopolistically competitive intermediate goods-producing firms (IG firms), indexed by $q \in (0,1)$, which supply the composite of intermediate goods to a final good-producing firm. In criminal activities, consistent with studies such as Gaviria (2002) and Blackburn et al. (2017), these take a quasi-organized form that has effects similar to imposing a tax (extortion, if interpreted as heavy crime; or swindling of firms' resources, if interpreted as corporate crime) on the production of the intermediate goods (IGs) and therefore can

[3] For readers who are not interested in examining these *credit risk–crime* nexus and instead only want to focus on police spending, these features can be dropped from the model. However, the policy realism of only having only police spending in an economy without monetary policy is minimal, and therefore will not provide much concrete insights.

be treated as a type of marginal cost to the firms.[4] By investing and owning the physical capital stock of the economy, individuals rent it to the IG firms, which in turn use it as collateral for borrowing from a commercial bank. Each IG firm employs effective labor and physical capital, while incurring additional marginal cost due to crime, to produce a perishable good, which is subject to the standard Rotemberg (1982) price adjustment process. Each individual i owns an IG firm and therefore receives all the profits make by that firm. For simplicity, we assume $N_{it}^q = \theta_{it}^q = 0$, which means individuals do not work or commit fraud on own firms. There is full flexibility to wages which adjust to clear the labor market.

Individuals collectively own the commercial bank, which supplies credit at the prevailing loan rate only to the IG firms to finance their working capital needs. The bank also pays interest on individuals' deposits and the liquidity from a Central Bank. The Central Bank supplies liquidity to the bank and purchases government bonds (B_t^C), with the corresponding liabilities being the money supply (M_t^S) and required reserves (Ω_t). Monetary policy is operated by fixing the refinance rate (i_t^R) based on a reactionary Taylor-style (1993) policy rule, as in Liu (2006) and Agénor and Alper (2012). The government purchases the final good (G_t^O) and spend on public order and security (G_t^P). These are financed by taxing the income (both wage and capital income) of individuals at a constant rate, $\tau \in (0, 1)$, and the issuance of riskless one-period bonds, held by individuals and the Central Bank.

Similar to market works, it is the effective hours that count for criminal activities, which is dependent on crime-specific human capital (H_t^C), akin to a form of cultural capital. Unlike formal human capital, individuals do not have the choice to invest in crime-specific human capital, in line with Mocan et al. (2005). Each period, crime-specific

[4] In practice, as described in Case Study-based contributions such as Aravena and Solís (2009) UNODC (2012), the characteristics of organized crime in Latin America can be quite different across the different economies, though a general specification is suffice to capture their impacts on firms in the context of this model.

human capital gains by an exogenous amount Λ, but can be reduced by the government's investment in maintaining public security (G_t^P).[5] The probability of an individual escaping apprehension after committing a crime is given exogenously by $\varkappa \in (0,1)$, in line with most macroeconomic studies on crime.[6] If caught, individuals' ilincome is confiscated.

2.1 Individuals

Individuals $i \in (0,1)$ derive utility from consumption (C_{it}), leisure, and a composite index of real monetary assets (real cash balances, m_{it}, and bank deposits, d_{it}). They solve the intertemporal optimization problem of maximizing

$$V_t^i = E_t \sum_{s=0}^{\infty} \beta^s \frac{(C_{it})^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} + \eta_N \ln(1 - N_{it} - \theta_{it}) + \eta_F \ln(m_{it}^H)^{\upsilon} d_{it}^{1-\upsilon}, \tag{1}$$

where $\beta \in (0,1)$, σ is the constant elasticity of substitution, $\upsilon \in (0,1)$, and $\eta_N, \eta_F > 0$, subject to an end-of-period flow budget constraint of

$$\begin{aligned} \Delta M_{it}^H + \Delta D_{it} + \Delta B_{it}^H \quad = \quad & P_t(r_t K_{it} + w_t H_{it}^Y N_{it}) + P_t[\varkappa H_{it}^C \theta_{it}(r_t K_{it} + w_t H_{it}^Y N_{it})] \\ & - T_{it} + i_{t-1}^D D_{it-1} + i_{t-1}^B B_{it-1}^H + J_{it}^{IG} + \xi_i J_{it}^B - P_t(C_{it} + I_{it} + IH_{it}), \end{aligned} \tag{2}$$

where $r_t K_{it} + w_t H_{it}^Y N_{it}$ is the total factor payments, r_t the real rental price of capital, w_t the economy-wide real wage, $T_{it} = \tau_K r_t K_{it} + \tau_N w_t H_{it}^Y N_{it}$ is the taxes paid to

[5] While the analytical specification is mainly adopted from the differential human capital framework of Mocan et al. (2005), the 'deep-rooted' nature of crime-specific human capital modelled is in consistent with the Italian *Mafia* literature, such as Coniglio et al. (2010) and Caglayan et al. (2017). In addition, for the purposes of this article, police spending and expenditure on public order and security are used interchangeably.

[6] For examples, see Imrohoroğlu et al. (2004, 2006) and Neanidis and Papadopoulou (2013). An alternative specification is to provide the probability with an underlying distribution, and makes it evolves according to transitional probabilities that are endogenous to G_t^P. We opt to treat G_t^P as a more general expenditure that has effects on crime-specific human capital (also interpretable as a sort of cultural/social capital), hence encompassing more than just spending on police.

the government, $M_{it}^H = P_t m_{it}^H$ the nominal cash holdings, $D_{it} = P_t d_{it}$ the nominal deposits, $B_{it}^H = P_t B_{it}^H$ the nominal holding of government bonds by individuals, $i_{t-1}^D D_{it-1}$ ($i_{t-1}^B B_{it-1}^H$) the interests on deposit (government bonds) hold in previous period, I_{it} the investment in capital stock, IH_{it} the investment in formal human capital, J_{it}^{IG} the end-of-period profits received from IG firms, and J_{it}^B ($\xi_i \in (0,1)$) the claim (fraction of the profits) hold by individual i on the commercial bank. Individuals therefore hold nominal wealth in the form of nominal cash, deposits, government bonds, and real stock of physical capital (K_{it}) in firm $q = i$.

The stock of physical capital at the beginning of period $t+1$ is given by

$$K_{it+1} = (1-\delta^K)K_{it} + I_{it} - \Gamma(K_{it+1}, K_{it}), \tag{3}$$

where δ^K is the depreciation rate of physical capital and $\Gamma(K_{it+1}, K_{it})$ the standard (in the DSGE literature) capital adjustment cost,[7]

$$\Gamma(K_{it+1}, K_{it}) = \frac{\Theta_K}{2}\left[\frac{K_{it+1}}{K_{it}} - 1\right]^2 K_{it}, \;\; \Theta_K > 0. \tag{4}$$

The formal and illegal human capital at period $t+1$ evolves according to

$$\mathbb{E}_t H_{it+1}^Y = \Theta_t^N IH_{it} + (1-\delta^L)H_{it}^Y, \quad \text{and} \tag{5}$$

$$\mathbb{E}_t H_{it+1}^C = \Lambda - \Theta_t^C G_t^P + (1-\delta^C)H_{it}^C, \tag{6}$$

respectively, where $\delta^L, \delta^C \in (0,1)$ is the formal, illegal human capital depreciation rate, Θ_t^N, $\Theta_t^C > 0$ are the respective human capital investment efficiency for private individuals and government common to all individuals, and Λ is a time-invariant additive

[7] This, together with the Rotemberg (1982) pricing introduced later, is incorporated as a generalized feature of a monetary economy. Both can easily be dropped from the model by setting the adjustment parameters to zero.

parameter for crime-specific human capital (that adds to the overall stock in each period as one continues to involve in crime), following Mocan et al. (2005). As novel features that further contribute to their framework, both investment efficiencies are dynamic parameters with both deterministic and stochastic components. Specifically, investment efficiency of formal human capital is given by

$$\Theta_t^N = \Theta_{0t}^N (\frac{H_t^C}{\tilde{H}^C})^{-\varrho_N}, \tag{7}$$

where $\varrho_N \geq 0$, $\Theta_{0t}^N = (\Theta_0^N)^{1-\varsigma_N}(\Theta_{0t-1}^N)^{\varsigma_N}\exp(\epsilon_t^N)$ follows an AR(1) process, in which $\Theta_0^N > 0$, $\varsigma_N \in (0,1)$ is the associated autoregressive coefficient, and ϵ_t^N is normally distributed with zero mean and a constant variance (σ_N^2). The issue of uncertainty in formal human capital investment is explored in various macroeconomic studies in the tradition of Galor and Zeira (1993), mainly in deterministic framework, where human capital investment is endogenized to factors such as credit constraint and unobserved income [see, for instance, Galor and Moav (2004)]. In an economy where crime is a main part of economic activities, it can be argued that formal human capital investment efficiency is adversely affected by the society's receptiveness towards crime, while the stochastic component is similar to Agénor (2016).[8]

To model the link between relative deprivation and crime (Hicks and Hicks, 2014), we utilize a "scale effect" specification for the (cultural) crime-specific human capital investment efficiency,

$$\Theta_t^C = \Theta_{0t}^C (\frac{\theta_t}{\tilde{\theta}})^{-\varrho_C}, \tag{8}$$

where $\varrho_C \geq 0$, $\Theta_{0t}^C = (\Theta_0^C)^{1-\varsigma_C}(\Theta_{0t-1}^C)^{\varsigma_C}\exp(\epsilon_t^C)$, $\Theta_0^C > 0$, $\varsigma_C \in (0,1)$, and $\epsilon_t^C \tilde{} N(0, \sigma_C^2)$.

[8]Alternatively, a partial-equilibrium job-search mechanism in similar vein of Burdett et al. (2003), Engelhardt et al. (2008), Engelhardt (2010) can be introduced that posits human capital investment efficiency as being derived from a job-search process, the cost of which is adversely affected by the stock of crime-specific human capital in the economy. This then leads to a first-order condition that is similar to (**??**, at the cost of increasing the model size with very little gained in terms of what is not already known in the existing literature. We therefore abbreviate this and use a seemingly ad-hoc feature.

As such, while crime-specific human capital accumulation in itself is uncertain, the relativity of the crime rate from a "natural" rate implicitly reflects the state of relative deprivation in the economy, and therefore affecting the effectiveness of government's crime-combatting measures.

Each household i maximizes lifetime utility by choosing C_{it}, N_{it}, θ_{it}, m_{it}^H, b_{it}^H, d_{it}, K_{it+1}, and H_{it+1}^Y, taking prices (and therefore inflation rates, $\pi_{t+1} = (P_{t+1} - P_t)/P_t \; \forall t$), factor returns, tax rate, i_t^D, i_t^B, and the crime-specific human capital levels, $H_{it}^C \; \forall t$ as given. As shown in Appendix A, solving the intertemporal utility maximization problem gives the following first-order conditions for individuals:

$$E_t(\frac{C_{it+1}}{C_{it}})^{1/\sigma} = \beta E_t(\frac{1+i_t^B}{1+\pi_{t+1}}), \tag{9}$$

$$N_{it} - \theta_{it} = \frac{(1-\tau_N)}{\varkappa H_{it}^C} - \frac{r_t K_{it}}{w_t H_{it}^Y}, \tag{10}$$

$$\frac{\eta_N C_{it}^{1/\sigma}}{\varkappa H_{it}^C (r_t K_{it} + w_t H_{it}^Y N_{it})}, = \frac{\eta_N C_{it}^{1/\sigma}}{(1+\varkappa H_{it}^C \theta_{it} - \tau_N) w_t H_{it}^Y}, \tag{11}$$

$$m_{it}^H = \frac{\eta_F \upsilon C_{it}^{1/\sigma}(1+i_t^B)}{i_t^B}, \tag{12}$$

$$d_{it} = \frac{\eta_F (1-\upsilon) C_{it}^{1/\sigma}(1+i_t^B)}{i_t^B - i_t^D}, \tag{13}$$

$$E_t(\frac{1+i_t^B}{1+\pi_{t+1}}) = E_t \left\{ \left[1 + \Theta_K(\frac{K_{it+1}}{K_{it}} - 1) \right]^{-1} \left[\begin{array}{c} (1+\varkappa H_{it+1}^C \theta_{it+1} - \tau_K) r_{t+1} \\ +(1-\delta^K) + \frac{\Theta_K}{2}(\frac{\Delta K_{it+2}^2}{K_{it+1}^2}) \end{array} \right] \right\}, \tag{14}$$

$$E_t(\frac{1+i_t^B}{1+\pi_{t+1}}) = E_t\left[\Theta_t^N (1+\varkappa H_{it+1}^C \theta_{it+1} - \tau_N) w_{t+1} N_{it+1}\right] + (1-\delta^L), \tag{15}$$

$$\begin{aligned} & E_t\left[(1+\varkappa H_{it+1}^C \theta_{it+1})(\Theta_t^N w_{t+1} N_{it+1} - \frac{r_{t+1}}{\Xi_K}) - \tau_N \Theta_t^N w_{t+1} N_{it+1} + \tau_K \frac{r_{t+1}}{\Xi_K}\right] \\ = & \frac{(1-\delta^K)}{\Xi_K} - (1-\delta^L) + E_t[\frac{0.5\Theta_K(\Delta K_{it+2}^2/K_{it+1}^2)}{\Xi_K}], \end{aligned} \tag{16}$$

where $\Xi_K = 1 + \Theta_K(\frac{K_{it+1}}{K_{it}} - 1)$, illegal human capital, H_{it+1}^C, being given by (6), and the transversality conditions, $\lim_{s\to\infty} E_{t+s}\beta^s \lambda_{t+s}(\xi_{ht+s}/P_{t+s}) = 0$, for $\xi = K, m^H$ hold.

Without capital adjustment cost ($\Theta_K = 0$), (14) and (16) can be written as:

$$E_t(\frac{1+i_t^B}{1+\pi_{t+1}}) = E_t[(1+\varkappa H_{it+1}^C \theta_{it+1} - \tau_K) r_{t+1}] + (1-\delta^K), \text{ and} \tag{17}$$

$$E_t\left[\begin{array}{c}(1+\varkappa H_{it+1}^C \theta_{it+1})(\Theta_t^N w_{t+1} N_{it+1} - r_{t+1}) \\ -\tau_N \Theta_t^N w_{t+1} N_{it+1} + \tau_K r_{t+1}\end{array}\right] = (\delta^L - \delta^K). \tag{18}$$

2.2 Final Good sector

The final good, Y_t, is produced by a zero profit-making, perfectly competitive representative firm that assembles a continuum of intermediate goods, Y_{qt}, $q \in (0,1)$, using standard Dixit-Stiglitz (1977) technology. Specifically, the profit maximization problem is given by $Y_{qt} = \arg\max P_t\{\int_0^1 [Y_{qt}]^{(\varsigma-1)/\varsigma} dj\}^{\varsigma/(\varsigma-1)} - \int_0^1 P_{qt} Y_{qt} dj$, where $\varsigma > 1$. For a given IG price P_{qt}, yields the demand function for each intermediate good,

$$Y_{qt} = (\frac{P_{qt}}{P_t})^{-\varsigma} Y_t, \ \forall q \in (0,1), \tag{19}$$

and the corresponding final price, $P_t = \{\int_0^1 [P_{qt}]^{1-\varsigma} dj\}^{1/(1-\varsigma)}$.

2.3 Intermediate Goods sector

Using constant returns-to-scale production technology, each IG firm $q \in (0,1)$ employs physical capital, K_{qt}, and labor (in effective human capital-adjusted terms, $H_{qt}^Y N_{qt}$, supplied by individual i, $q = i$) and faces the production function,

$$Y_{qt} = A_t K_{qt}^\alpha (H_{qt}^Y N_{qt})^{1-\alpha}, \tag{20}$$

where $\alpha \in (0,1)$, and A_t denotes a common economy-wide technology shock following an AR(1) process, $A_t = (A_0)^{1-\varsigma_A}(A_{t-1})^{\varsigma_A} \exp(\epsilon_t^A)$, where ϵ_t^A is normally distributed with zero mean and a constant variance (σ_A^2). Each IG firm q solves a two-stage profit maximization problem: a static unit cost minimization problem, followed by an intertemporal profit maximization problem due to a Rotemberg (1982) style price-adjustment cost.

Following Ravenna and Walsh (2006), IG firm q borrows from the commercial bank to pay wages to effective labor hours in advance. Let L_{qt} be the amount borrowed, the financing constraint is given by

$$l_{qt} = \frac{L_{qt}}{P_t} \geq w_t H^Y_{qt} N_{qt}. \tag{21}$$

At the end of the period, the loan is repaid at a gross nominal loan rate $(1 + i^L_{qt})$. In each period t, each IG firm q therefore incurs a cost of $(1 + i^L_{qt})w_t$ for effective labor hired from a competitive labor market and the rate of returns, r_t for physical capital hired. In addition, consistent with the urban crime described in studies such as Londoño and Guerrero (2000), each IG firm also faces extortions from criminals (the amount of resources extorted depends on the effective hours of crime, $\theta_{qt} H^C_{qt}$, committed by individual j, $q = j$)[9] at a constant probability π_V, hence incurring an additional production cost, $\theta_{qt} H^C_{qt}[w_t H^Y_{qt} N_{qt} + r_t K_{qt}]$. This specification is also consistent with many organized crime described in Latin America-based studies such as Gaviria (2002) and Gomez Soler (2012). For simplicity, we assume $\pi_V = 1$.[10] Each firm q therefore solves the unit cost minimization problem,

$$\min_{N_{qt}, K_{qt}} (1 + i^L_{qt}) w_t H^Y_{qt} N_{qt} + r_t K_{qt} + \theta_{qt} H^C_{qt}[w_t H^Y_{qt} N_{qt} + r_t K_{qt}],$$

subject to $Y_{qt} = 1$, taking wages, rate of returns of capital, and effective of hours of crime as given. The first-order conditions derived in Appendix A. The implied physical

[9] We assume individuals neither work nor extort from the IG firm they own, $N^q_{it} = \theta^q_{it} = 0$. Similarly, we also assume that, while j belongs to the continuum $i \in (0, 1)$, $i \neq j$. In other words, an individual i does not extort from the same firm he is working in.

[10] Such victimization probability can be referred to Imrohoroğlu et al. (2004, 2006), though they model crime as theft. In this article, we model crime as direct extortions from firms, as in Blackburn et al. (2017). In stationary equilibrium, the victimization probability would then equal economy-wide crime rate, $\tilde{\theta}$. We abstract from this by assuming $\pi_V = 1$.

capital-effective labor ratio of each firm q is given by

$$\frac{K_{qt}}{H_{qt}^{Y}N_{qt}} = \frac{\alpha}{1-\alpha}\frac{(1+i_{qt}^{L}+\theta_{qt}H_{qt}^{C})w_t}{(1+\theta_{qt}H_{qt}^{C})r_t}, \tag{22}$$

where the marginal cost of both labor and physical capital includes the amount lost to crime. Specifically, from Appendix A, the derived unit real marginal cost is given by:

$$mc_{qt} = \frac{[(1+i_{qt}^{L}+\theta_{qt}H_{qt}^{C})w_t]^{1-\alpha}[(1+\theta_{qt}H_{qt}^{C})r_t]^{\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}. \tag{23}$$

In addition to the marginal cost, each firm q also incurs price-adjustment cost due to nominal price stickiness, which takes the form of

$$\frac{\Theta_F}{2}\left(\frac{P_{qt}}{(1+\tilde{\pi})P_{qt-1}}-1\right)^2 Y_t,$$

where $\Theta_F \geq 0$ is the parameter measuring the degree of price stickiness and $\tilde{\pi}$ is the steady-state inflation rate. With this, each IG firm q selects a sequence of prices, $\{P_{qt+s}\}_{s=0}^{\infty}$ so as to maximize the total discounted sum of all the firm's real profits, as in:

$$\max_{\{P_{qt+s}\}_{s=0}^{\infty}} E_t\sum_{s=0}^{\infty}\beta^{s}\lambda_{t+s}\left(\frac{\Pi_{qt+s}}{P_{t+s}}\right), \tag{24}$$

where the discount factor is the same as the individuals (since they own the IG firms) and the nominal profits, Π_{qt}, is given by

$$\Pi_{qt} = P_{qt}Y_{qt} - P_t mc_{qt}Y_{qt} - \frac{\Theta_F}{2}\left(\frac{P_{qt}}{(1+\tilde{\pi})P_{qt-1}}-1\right)^2 P_tY_t. \tag{25}$$

Substitute (19) into (25), the first-order condition can be expressed as

$$(1-\varsigma)\lambda_t(\frac{P_{qt}}{P_t})^{-\varsigma}(\frac{Y_t}{P_t}) + \lambda_t\varsigma(\frac{P_{qt}}{P_t})^{-\varsigma-1}\frac{Y_t mc_{qt}}{P_t} \tag{26}$$
$$-\lambda_t\Theta_F\left\{\begin{array}{c}\left(\frac{P_{qt}}{(1+\tilde{\pi})P_{qt-1}}-1\right)\\ \times\frac{Y_t}{(1+\tilde{\pi})P_{qt-1}}\end{array}\right\} + \beta\Theta_F E_t\left\{\begin{array}{c}\lambda_{t+1}\left(\frac{P_{qt+1}}{(1+\tilde{\pi})P_{qt}}-1\right)\\ \times(\frac{P_{qt+1}}{(1+\tilde{\pi})P_{qt}^2})Y_{t+1}\end{array}\right\} = 0,$$

which, in the absence of price stickiness ($\Theta_F = 0$), is merely a simple mark-up pricing of

$$P_{qt} = \frac{\varsigma}{\varsigma-1}mc_{qt}P_t. \tag{27}$$

2.4 Commercial Bank

The commercial bank receives deposits, $D_t = \int_0^1 D_{it}di$ from individuals and use them to finance the credit to the IG firms. The supply of loans is assumed to be perfectly elastic and collectively, the total loans equal $L_t = \int_0^1 L_{qt}dq = P_t w_t H_t^Y N_t$, where $N_t = \int_0^1 N_{it}di$ and H_t^Y denotes the economy-wide average legal human capital level. The bank also holds required reserves with the central bank, $\Upsilon_t = \mu D_t$, which is a fraction of its deposits, with $\mu \in (0,1)$ denotes the reserve requirement ratio. For a given level of L_t, Υ_t, and D_t, the bank also borrows from the central bank, L_t^B, to cover for any financing shortfall. At the end of each period, it repays the central bank at a nominal refinance rate, i_t^R.

To determine the borrowing from central bank, we use the commercial bank's balance sheet:

$$L_t^B + D_t = \Upsilon_t + L_t, \text{ or equivalently, } L_t^B = L_t - (1-\mu)D_t. \tag{28}$$

The deposit and loan rates are set by the bank, so as to maximize profit, Π_t^B, as in

$$\max_{i_t^D, i_{qt}^L} \Pi_t^B = q i_{qt}^L L_t(i_{qt}^L) + (1-q)(\kappa P_t K_{qt} - \Lambda) - i_t^D D_t - i_t^R[L_t(i_{qt}^L) - (1-\mu)D_t],$$

where q is the repayment probability. Solving this yields the first-order conditions:

$$i_t^D = (1+\frac{1}{\eta_D})^{-1}(1-\mu)i_t^R, \text{ and } i_{qt}^L = (1+\frac{1}{\eta_L})^{-1}\frac{i_t^R}{q}, \tag{29}$$

where $\eta_D = [\partial D_t/\partial i_t^D]\cdot(i_t^D/D_t) > 0$ and $\eta_{L_q} = [\partial L_t/\partial i_{qt}^L]\cdot(i_{qt}^L/L_t) < 0$ are the interest elasticity of deposit supply and the interest elasticity of loan demand respectively. The latter is conceptually speaking different for each IG firm q, but can be assumed to be the same across the firms in the symmetric equilibrium examined later.

Assuming the supply of deposit is perfectly elastic (η_D assumes a large value), the optimal deposit rate, i_t^D, is then:

$$i_t^D = (1-\mu)i_t^R. \tag{30}$$

As argued in Agénor and Montiel (2008), the repayment probability generally increases with the collateral provided, $\kappa P_t K_{qt}$, $\kappa \in (0,1)$, as a percentage of the loan taken out by firms. In addition, in line with the thesis of crime being extortion on firms, we also specify it to depend negatively on a macro-environment factor, in the form of the economy-wide crime rate, θ_t, in consistent with Baumann and Friehe (2017). The repayment probability therefore takes the form of $q = q_0[1+\Psi_{qt}(\kappa P_t K_{qt}/L_{qt};\theta_t)]^{-1}$, which, combined with (29), yields

$$i_{qt}^L = (1+\frac{1}{\eta_{L_q}})^{-1}q_0^{-1}[1+\Psi_{qt}(\kappa P_t K_{qt}/L_{qt};\theta_t)]i_t^R,$$

where $\Psi_{qt} > 0$, $\Psi_{qt}'(\kappa P_t K_{qt}/L_{qt}) < 0$, $\Psi_{qt}'(\theta_t) > 0$ is the risk premium the bank charges on its lending to firms. Specifically, if $\Psi_{qt} = \Psi_0(\kappa P_t K_{qt}/L_{qt})^{-\phi_1}(\theta_t)^{\phi_2}$, $\Psi_0, \phi_1, \phi_2 \geq 0$, we have

$$i_{qt}^L = (1+\frac{1}{\eta_{L_q}})^{-1}q_0^{-1}[1+\Psi_0(\frac{\kappa P_t K_{qt}}{L_{qt}})^{-\phi_1}(\theta_t)^{\phi_2}]i_t^R, \tag{31}$$

At the end of the period, the commercial bank makes a net profit of

$$J_t^B = (1 + i_{qt}^L)L_t - (1 + i_t^D)D_t - (1 + i_t^R)L_t^B, \tag{32}$$

which are paid in equal shares to the individuals.

2.5 Central Bank

The central bank sets the monetary policy. It holds government bonds, B_t^C, and loans to the commercial bank, L_t^B, as assets. Its liabilities consist of the currency, M_t^S, and the required reserves, $\Upsilon_t = \mu D_t$. From the balance sheet of the central bank, the currency in circulation can be determined as:

$$M_t^S = L_t^B + B_t^C - \mu D_t. \tag{33}$$

The net income made on loans to the commercial bank is transferred to the government at the end of each period.

The monetary policy is operated by fixing the refinance rate, i_t^R, assumed to be determined by a Taylor-type (1993) policy rule. The linearized form is given by

$$i_t^R = \epsilon_t (i_{t-1}^R)^{\varpi} [(\tilde{r} + \tilde{\pi})(\frac{1 + \pi_t}{1 + \pi^T})^{\epsilon_1} (\frac{Y_t}{\tilde{Y}})^{\epsilon_2}]^{1-\varpi}, \tag{34}$$

where ϵ_t denotes another structural shock with an AR(1) process, $\epsilon_t = (\epsilon_0)^{1-\varsigma_M}(\epsilon_{t-1})^{\varsigma_M} \exp(\epsilon_t^{\varepsilon})$, where ϵ_t^{ε} is normally distributed with zero mean and a constant variance (σ_M^2) (see Rudebusch (2006)). The specification is in line with the empirical finding of Moura and Carvalho (2010), in that monetary policy-setting in developing economies tend to be reactionary. Likewise, the introduction of a source of random shock to the interest rate-setting is in consistent to the "speed limit" policy approach introduced in Liu (2006) and

Agénor and Alper (2012), and reinforces the reactionary nature of the characteristics of monetary policy in developing economies.

2.6 Government

The government issues nominal riskless one-period bonds to the central bank and individuals. It also taxes both labor and capital income at a constant rate, $T_{it} = \tau_K r_t K_{it} + \tau_N w_t H_{it}^Y N_{it}$. The government also receives the illegal income confiscated from successfully apprehending a criminal, and the net income ($i_t^R L_t$ and $i_{t-1}^B B_{t-1}^C$) transferred from the central bank. These are used to finance the purchases of final good (G_t^O) and an investment expenditure on improving public order and security (G_t^P).[11] The budget constraint is given by

$$\begin{aligned} & P_t[(1-\varkappa)H_{it}^C\theta_{it}(r_t K_{it} + w_t H_{it}^Y N_{it})] + P_t T_{it} + B_t^H + B_t^C \\ = \; & (1+i_{t-1}^B)(B_{t-1}^H + B_{t-1}^C) + P_t(G_t^P + G_t^O) - i_t^R L_t - i_{t-1}^B B_{t-1}^C. \end{aligned} \tag{35}$$

Government purchases are assumed to be a constant fraction of output, hence $G_t^O = \upsilon_O Y_t$, $\upsilon_O \in (0,1)$. The expenditure on public order and security, G_t^P, is the novel feature whose properties is examined in this article. For the benchmark case, we assume G_t^P to be set also at a constant fraction of output, $G_t^P = \upsilon_P Y_t$, where the spending share $\upsilon_P \in (0,1)$ is chosen at the discretion of the government. For comparison, we also consider a case that is rule-based, where $G_t^P = G_0^P(\frac{\theta_t}{\tilde{\theta}})^{\psi_1}$, $\psi_1 \geq 0$, which essentially turns the expenditure on public order and security to a *reaction function* that depends on the relative crime rate, θ_t, from its steady-state value.

[11] It is debatable whether the expenditure on improving public order and security is treated as a consumption or investment expenditure. Given our specification where it contributes to the "de-accumulation" of crime-specific human capital, it is akin to a type of investment expenditure.

3 Symmetric and Steady-state Equilibrium

Definition 1: A *symmetric equilibrium* is where all individuals and all IG firms are identical. This means, for all individuals $i \in (0,1)$, $C_{it} = C_t$, $\theta_{it} = \theta_t$, $N_{it} = N_t$, $K_{it} = K_t$, $I_{it} = I_t$, $IH_{it} = IH_t$, $M_{it}^H = M_t^H$, $B_{it}^H = B_t^H$, $D_{it} = D_t$, $K_{it} = K_t$. For all IG firms $q \in (0,1)$, $P_{qt} = P_t$, $mc_{qt} = mc_t$, $K_{qt} = K_t$, $N_{qt} = N_t$, $\theta_{qt} = \theta_t$. All individual and aggregate behaviors are consistent, which means all individual- and firm-specific human capital equal the economy-wide average level of human capital, that is, $H_{\varphi t}^Y = H_t^Y$, $H_{\varphi t}^C = H_t^C$, where $\varphi = i, q$. All firms produce the same output and prices and marginal costs are the same across firms. By implications, the loan rate, i_{qt}^L, and the interest elasticity of loan demand, η_{L_q}, and the risk premium are the same across firms, $i_{qt}^L = i_t^L$, $\eta_{L_q} = \eta_L$, $\Psi_{qt} = \Psi_t$, $\forall q$. From (25), real profit of a representative IG firm is therefore $(1 - mc_t)Y_t - 0.5\Theta_F[1/(1+\tilde{\pi}) - 1]^2$, with $\tilde{\pi}$ denoting the steady-state inflation rate. These would also allow us to simplify the first-order condition of the intertemporal profit maximization problem of a representative IG firm, (26), to

$$\begin{aligned}&(1-\varsigma) + \varsigma mc_t - \Theta_F\left(\frac{1+\pi_t}{1+\tilde{\pi}} - 1\right)\frac{1+\pi_t}{1+\tilde{\pi}} \\ &+\Theta_F E_t\left\{\frac{1+\pi_{t+1}}{(1+i_t^B)}\left(\frac{1+\pi_{t+1}}{1+\tilde{\pi}} - 1\right)\left(\frac{1+\pi_{t+1}}{1+\tilde{\pi}}\right)\left(\frac{Y_{t+1}}{Y_t}\right)\right\} = 0.\end{aligned} \tag{36}$$

The deposit, credits, currency, government bonds, and goods markets are in equilibrium. The supply of deposits by households and the supply of loans by the commercial bank are perfectly elastic at the prevailing rates, hence the two markets are always clear. For the currency market, the equilibrium condition is $M_t^S = M_t^H + M_t^F$, where $M_t^F = \int_0^1 M_{qt}^F dq$ is firms' total cash-holdings. Assuming that the bank loans to firms are made only in currency form, $L_t = M_t^F$, using (28) and (33), we can eliminate L_t^B to get

$$M_t^H + D_t = B_t^C. \tag{37}$$

Further, by using the aggregate expressions of (12) and (13), we can write an expression for the real value of central bank's holding of government bonds:

$$b_t^C = \frac{B_t^C}{P_t} = \eta_F (C_t)^{1/\sigma}(1+i_t^B)\{\frac{\nu}{i_t^B} + \frac{1-\nu}{i_t^B - i_t^D}\}. \tag{38}$$

Given this, and knowing that $P_t/P_{t-1} = 1+\pi_t$, using the government budget constraint from (35), we solve for the real value of the total stock of government bonds outstanding, b_t:

$$\begin{aligned} b_t &= (\frac{1+i_{t-1}^B}{1+\pi_t})b_{t-1}^H + \frac{b_t^C}{1+\pi_t} + G_t^P + G_t^O - i_t^R l_t \\ &-[(1-\varkappa)H_t^C\theta_t + \tau_K]r_t K_t - [(1-\varkappa)H_t^C\theta_t + \tau_N]w_t H_t^Y N_t), \end{aligned} \tag{39}$$

with the individuals' holding of government bonds determined by $b_t^H = b_t - b_t^C$. Lastly, the goods market equilibrium is given by

$$Y_t = C_t + G_t^P + G_t^O + I_t + \frac{\Theta_F}{2}\left(\frac{1+\pi_t}{1+\tilde{\pi}} - 1\right)^2 Y_t, \tag{40}$$

where $C_t = \int_0^1 C_{it}di$, and $I_t = \int_0^1 I_{it}di$ is given by (3). For the benchmark case where $G_t^P = \upsilon_P Y_t$, the aggregate resource constraint of (40) can be rewritten as

$$\begin{aligned} &\left\{1 - (\upsilon_O + \upsilon_P) - \frac{\Theta_F}{2}\left(\frac{1+\pi_t}{1+\tilde{\pi}} - 1\right)^2\right\} Y_t \\ = &\ C_t + K_{t+1} - (1-\delta^K)K_t + \frac{\Theta_K}{2}\left[\frac{K_{t+1}}{K_t} - 1\right]^2 K_t. \end{aligned} \tag{41}$$

Finally, note that (22), given P_t, can be used to determine both the economy-wide real and nominal wages:

$$w_t = \frac{W_t}{P_t} = \frac{1-\alpha}{\alpha}\frac{(1+\theta_t H_t^C)r_t K_t}{(1+i_t^L+\theta_t H_t^C)H_t^Y N_t}. \tag{42}$$

Definition 2: A *steady-state equilibrium* of this economy is a stationary symmetric equilibrium in which, for a given set of parameters, a probability of escaping apprehension ($\varkappa$), and a set of policy arrangements $\{\mu, \tau, \upsilon_O, \upsilon_P\}$: (i) the endogenous variables ($\tilde{C}$, $\tilde{N}$, $\tilde{\theta}$, $\tilde{M}^H$, $\tilde{B}^H$, $\tilde{D}$, $\tilde{K}$, $\tilde{H}^Y$, $\tilde{H}^C$, $\tilde{B}^C$, $\tilde{Y}$) are constant$\forall t$; (ii) the prices, wages and rates ($\tilde{P}$, $\tilde{r}$, $\tilde{w}$, $\tilde{\imath}^B$, $\tilde{\imath}^D$, $\tilde{\imath}^L$, $\tilde{\imath}^R$) are all constant $\forall t$; and by implications, (iii) the inflation ($\tilde{\pi}$), profits and marginal costs are constant $\forall t$. In addition, in the steady-state, the physical capital and goods' prices fully adjust, which means the relevant adjustment costs equal zero ($\Theta_F = \Theta_K = 0$). The steady-state inflation rate also equals its target value ($\tilde{\pi} = \pi^T$).

We solve for the steady-state equilibrium in Appendix B. Without losing any generality, we solve for a simplified case where the inflation target is zero. As derived in Appendix B, we obtain the standard Fisher relationship, $\tilde{\imath}^R = \tilde{r} + \tilde{\pi}$. When $\tilde{\pi} = \pi^T = 0$, the steady-state refinance rate ($\tilde{\imath}^R$) equals the real interest rate ($\tilde{r}$), which in this monetary economy with credit financing and criminal extortions, is negatively dependent on the steady-state level of effective crime rate ($\tilde{H}^C\tilde{\theta}$):

$$\tilde{r} = \frac{\beta^{-1} - (1 - \delta^K)}{(1 + \varkappa\tilde{H}^C\tilde{\theta} - \tau)}. \tag{43}$$

In turn, the steady-state crime rate, $\tilde{\theta}$, is determined by:

$$\tilde{\theta} = (\varkappa\tilde{H}^C)^{-1}\left[\frac{(\delta^L - \delta^K)}{(\tilde{\Theta}^N\tilde{w}\tilde{N} - \tilde{r})} + \frac{\tilde{\Theta}^N\tau_N\tilde{w}\tilde{N}}{(\tilde{\Theta}^N\tilde{w}\tilde{N} - \tilde{r})} - \frac{\tau_K\tilde{r}}{(\tilde{\Theta}^N\tilde{w}\tilde{N} - \tilde{r})}\right], \tag{44}$$

which depends on the efficiency of investment in legal human capital ($\tilde{\Theta}^N$), the wage rate ($\tilde{w}$), real interest rate ($\tilde{r}$), tax rates (τ_N, τ_K), and the difference between the depreciation rate of human and physical capital ($\delta^L - \delta^K$). If $\tilde{\Theta}^N\tau_N\tilde{w}\tilde{N} = \tau_K\tilde{r}$, then the **assumption** of $\delta^L > \delta^K$ is needed to ensure positive crime rate in the steady state.

In the steady-state, crime-specific human capital ($\tilde{H}^C$) is a function of the steady-state value of government spending on public order and security, and the corresponding spending efficiency in reducing crime-specific (cultural) human capital. Also, when $\tilde{\pi} = 0$, the steady-state gross rate of return for government bonds equals the rate of time preference,$1 + \tilde{\imath}^B = \frac{1}{\beta}$, which then determines the steady-level of real currency- and deposit-holdings of individuals.

For the steady-state solutions to be properly defined, as in when individuals hold $\tilde{d} \geq 0$ of real deposits, given that $\tilde{\imath}^D = (1-\mu)\tilde{r}$, we must have $\tilde{r} < (1-\beta)/(1-\mu)$. Without price-adjustment cost, the marginal cost of IG firms in the steady state, even when there is non-zero cost arisen from criminal extortions, is equal to the standard mark-up condition of monopolistically competitive firms, $\widetilde{mc} = \frac{\varsigma - 1}{\varsigma}$. The equations for other endogenous variables can be referred to in Appendix B. In summary, the simultaneous equations system characterizing the steady-state equilibrium of this model is consisting of 18 endogenous variables in real terms ($\tilde{r}$, $\tilde{\imath}^B$, $\tilde{\imath}^D$, $\tilde{\imath}^L$, $\tilde{w}$, $\tilde{H}^Y$, $\tilde{H}^C$, $\tilde{N}$, $\tilde{\theta}$, $\tilde{m}^H$, $\tilde{d}$, $\tilde{l}$, $\tilde{Y}$, $\tilde{K}$, $\tilde{b}^H$, $\tilde{b}^C$, $\tilde{C}$, $\tilde{G}^P$). Given the presence of the four stochastic shocks, to solve the model, we log-linearize the behavioral equations and the aggregate resource constraints around the non-stochastic, zero-inflation steady state.

4 Illustrative Parameterization

It is well-documented that the quality of crime data is generally poor, even for the well-used dataset of *United Nations Survey of Crime Trends and Operations of Criminal Justice Systems* (UN-CTS). This is especially true for Latin America, where under-reporting of crime remains prevalent (Fajnzylber et al., 1998; Rubio, 2000; Jaitman and Torre, 2017). This, coupled with the non-availability of quarterly data for variables such as human capital and time allocation, means a Bayesian estimation strategy is impractical. Against this backdrop, we calibrate the model with empirical parameterization using available statistics (as much as possible), so as to calibrate illustratively a typical middle-income Latin American economy where crime remains prevalent. Unless specified otherwise, all calibrations are implemented to obtain initial steady-state values for the endogenous variables that match the first moment of the long-term averages of the 21 non-British caribbean, Latin American economies for the period 1991-2016.[12]

The parameter values are summarized in Table 1. Given the annual time frequency and developing country context, the discount factor is set at $\beta = 0.952$, which corresponds to an annual interest rate of 5 percent. With $\tilde{\imath}^B = \frac{1}{\beta} - 1$ in steady state, we have the steady-state bond rate, $\tilde{\imath}^B = 0.05$. The intertemporal elasticity of substitution, σ, and the preference parameter for leisure, η_N, are set at 0.6 and 1.75 respectively, consistent with the values commonly used for the Latin American economies (see Agénor and Montiel, 2015). The preference parameter for composite monetary assets, η_F, is set at a very low value of 0.02 to reflect a low utility derived from holding monetary assets (given that criminal activities provide an alternative outlet to generate income), which coincides with the value used in Agénor et al. (2014). The share parameter in the index of money holdings, υ, is set at 0.2, which is based on the estimated cash-deposit ratio for our sample economies. For convenience, we set both the tax rates to be equal, $\tau_K = \tau_N = 0.2$, in the benchmark case, which is within range of the average marginal income tax rates for our sample economies.

In terms of the initial steady-state values for the time allocation variables, a standard 8 hours of formal market work would give $\tilde{N} = 8/24 = 0.33$. The time allocated to criminal activities ($\tilde{\theta}$) has to be estimated. Based on the methodology of Neanidis and Papadopoulou (2013), we estimate $\tilde{\theta}$ based on average crime incidence for our sample economies using the UN-CTS dataset, which yields approximately 0.167 (per 100,000

[12]These include Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Uruguay, and Venezuela.

inhabitants). We therefore set $\tilde{\theta} = 0.167$. The exogenous probability of escaping apprehension, $\varkappa$, is set at 0.7, which is consistent with the UN-CTS dataset-based estimates of Neanidis and Papadopoulou (2013) and Jia et al. (2018). Using the *IMF Government Financial Statistics*, we can easily calculate the constant parameters for expenditure on public order and security (υ_P) and other government consumption (υ_O). For our sample Latin American economies, we have $\upsilon_P = 0.0157$ and $\upsilon_O = 0.167$.

Next, we consider human capital. Following Mocan et al. (2005), we set the depreciation rate for both types of human capital, $\delta^L = \delta^C = 0.05$. The calibration of the remaining parameter, Λ, as well as the determination of the two time-varying endogenous human capital investment efficiency values ($\tilde{\Theta}^N$ and $\tilde{\Theta}^C$) are as follows. First, to satisfy $\delta^L > \delta^K$, we assume physical capital has a lower depreciation rate than human capital, and set $\delta^K = 0.02$ (a value in line with Agénor et al. (2014)). Given this and other parameter values, from (43), we can determine the value of the composite term, $\varkappa\tilde{H}^C\tilde{\theta} = 1.4$. With $\varkappa = 0.7$ and $\tilde{\theta} = 0.167$, the steady-state level of crime-specific human capital, $\tilde{H}^C = 5.133$. From (44), by normalizing the steady-state wage rate to unity, $\tilde{w} = 1$, the efficiency of investment in legal human capital is then calculated, $\Theta_0^N = 0.215$. For crime-specific human capital, we set the investment efficiency to be twice of Θ_0^N, where $\Theta_0^C = 0.43$. The time-invariant additive parameter of crime-specific human capital, Λ, is therefore 0.258.

Next, we consider the production side. The parameters in the production function, (20), is parameterized in the standard manner, in that, the share of physical capital, $\alpha = 0.35$, and share of effective labor, $1 - \alpha = 0.65$, are based on the production shares of the respective input. The average productivity parameter, A, is normalized to one, as in Tayler and Zilberman (2016). From *IMF Capital Stock Database*, the average final output-to-physical capital ratio of our sample economies is 0.451. From Appendix B, we know that $\tilde{r} = \frac{\alpha\tilde{Y}}{(1+\tilde{\theta}\tilde{H}^C)\tilde{K}}(\frac{\varsigma-1}{\varsigma})$, which then allows us to calculate the elasticity of demand for intermediate goods, $\varsigma = 2.43$, implying a high mark-up rate of 70 percent. This is relatively high but does illustrate a case where firms would need a higher mark-up in the presence of additional cost associated with illegal extortions.

In terms of the parameters characterizing commercial banks' lending, following Agénor and Alper (2012), we set the effective collateral-loan ratio, $\kappa = 0.2$, and the elasticity of the risk premium with respect to collateral, $\phi_1 = 0.05$. We also set the elasticity of the risk premium with respect to the economy-wide crime rate to be the same, $\phi_2 = 0.05$. For the other parameters, first, from the *World Bank World Development Indicators*, note that the average lending interest rate for our 21 sample economies during the period 1991-2016 is 22 percent, while the average risk premium on lending is 17.2 percent. Using the steady-state relationship, $\tilde{\imath}^L = (1 + \frac{1}{\eta_{L_q}})^{-1} q_0^{-1}[1 + \Psi_0(\frac{\kappa \tilde{K}}{\tilde{l}})^{-\phi_1}(\tilde{\theta})^{\phi_2}]\tilde{r}$, assuming $\eta_{L_q} = 1$, base repayment probability, q_0, of 0.2, and given the initial values of the endogenous variables, the risk premium parameter, Ψ_0, is calculated to be 0.815.

For the central bank, we follow Agénor and Alper (2012) and Agénor et al. (2014) by setting initial reserve requirement ratio, μ, to a relatively low rate of 10 percent. Given this, and that $\tilde{\imath}^D = (1 - \mu)\tilde{r}$, we have the steady-state deposit rate, $\tilde{\imath}^D = 0.045$. For the monetary policy, the smoothing parameter is set at $\varpi = 0$. We also set $\epsilon_1 = 1.5$ and $\epsilon_2 = 0.2$, which is consistent with Liu (2006) and Moura and Carvalho (2010). The latter, ε_2, in particular, is consistent with evidence reported for several countries in Latin America. For the rule-based specification for public expenditure on public order and safety, (**??**), the parameter, ψ_1, which models the responsiveness of the spending with respect to a deviation in crime rate from its steady state, is set at 0.1. Finally, for the stochastic shocks, we specify all four as first-order autoregressive processes with a common degree of persistence, $\varsigma_A = \varsigma_M = \varsigma_C = \varsigma_N = 0.8$.

5 Policy Experiments

As alluded, our main objective involves examining how the approach to macroeconomic stabilization would differ in an economy with crime and formal educational quality uncertainty.[13] Given the intricate relationship between the two, we also explore for any potential role of police spending in stabilization. First, we consider a temporary shock to formal human capital investment, or specifically, a 10 percent standard deviation shock to ϵ_t^N. From (7), this reflects a quality uncertainty to households' investment in formal human capital, albeit an upside shock. The impulse responses are presented in Figure 2, which in addition to the benchmark, also illustrates scenarios of (i) an economy with less crime (household spend 5 percent less of their time in criminal activities, $\tilde{\theta} = 0.117$), (ii) higher (quadruple) base efficiency level of formal human capital investment, Θ_0^N, and (iii) a higher (double) initial share of spending on public order and safety, υ_P.

As expected, we see that formal market works and formal human capital level respond positively, which in turn leads to higher production and consumption. With the temporary uptick in investment efficiency, individuals reduce their asset-holdings, including government bonds, and invest more in human capital. The expansionary effects on production also result in greater opportunities for extortions, which translate to a general equilibrium effect of a higher level of crime-specific human capital. In comparison to an economy with lower steady-state crime rate, we see that the procyclicality effect on formal human capital, market works, and output is lower. In other words, the initial *level* of crime reduces the procyclicality effect of formal human capital investment, with slightly higher degree of persistence in the response of output and inflation. In fact, a positive shock to formal human capital investment efficiency also raises the level of

[13] Indeed, a quick deterministic analysis of a steady-state increase in the share of police spending, υ_P, will lead to higher levels of formal human capital, final output, consumption, and lower level of crime-specific human capital in the new steady state. These therefore reaffirms the long-run positive effects of police spending commonly documented in the literature. The results of this analysis is not presented to save space.

illegal human capital, and this co-movement appears to be independent of the initial level of police spending. This co-movement appears to partly explain the experience in some Latin American economies over the past decades: In spite of increasing policy efforts in promoting formal education, crime rate appears to persist.

Next, we explore the role of police spending further. Suppose for the same temporary ϵ_t^N shock, we undertake a standard "rule versus discretion" exercise by comparing the impulse responses of the benchmark model (discretionary approach to police spending by setting υ_P) and the model with reactionary rule. These, together with selected sensitivity analysis scenarios, are presented in Figure 3. While Figure 2 initially suggests that the initial level of police spending is immaterial in curbing the accumulation of crime-specific human capital, we notice in Figure 3 that the use of a *spending rule* significantly increases its policy effectiveness. Indeed, when compared to a discretionary allocation tied to the output level, the presence of a reactionary rule reduces the cyclical effects associated with the fluctuation in educational quality, while gaining more in formal human capital investment, formal works, output and consumption over a longer period. These, coupled with the "de-coupling" of the shock's influence on illegal human capital, suggest a potentially useful rule-based approach to police spending allocation, especially in an economy with significant organized crime and educational quality uncertainty.

Next, we examine the model properties by stimulating a temporary 10 percent structural shock in increasing the effectiveness of expenditure on police spending, ϵ_t^C. The impulse responses for both the benchmark and rule-based specification, along with the sensitivity analysis scenario of a higher base efficiency (Θ_0^C), are presented in Figure 4. Unlike the marked difference observed for the ϵ_t^N shock in Figure 3, the policy effects for this specific shock are numerically insiginificant. This is likely due to the unit of measurement of crime rate being small, $\theta_t \in (0, 1)$, which as a ratio to its steady state, means any relative deviation will be small. In the absence of a very large ψ_1 elasticity value, the responses of other variables are therefore small. Nevertheless, within this context, we still find consistency to previous results, in that, the efficiency and the level of the expenditure have very small effect in curbing accumulation of illegal human capital, though the greater stabilization properties of a rule-based approach can negate this to an extent.

Based on the two structural shocks considered, while the difference appears to be trivial if we only concern about fluctuations in the efficiency of the specific spending, a policy rule to police spending allocation can have a stabilization role if the policymaker is concerned about smoothing the effects of shocks arisen from formal educational uncertainty, while simultaneously achieving a "de-coupling" of the shock's positive influence on illegal human capital accumulation.

To examine further the properties of the rule-based approach to police spending, we study the remaining two shocks (monetary and productivity), with the impulse responses illustrated in Figure 5 and Figure 6. In Figure 5, we observe the well-documented "financial accelerator" effect, where credit imperfection in the model causes the impact of monetary shocks on prices to magnify. While a rule-based approach to police spending remains effective in de-coupling the illegal human capital accumulation process from the procyclical formal human capital, it appears to exacerbate the financial accelerator effect, in that the response of prices to the monetary shock is greater beyond the initial 10 periods, with the propagation process appears to have a greater degree of inertia.

Lastly, in Figure 6, when experimenting with a positive productivity shock, we observe similar patterns in the impulse responses. While a rule-based approach has better output stabilization property in the short-term horizon (first 20 periods) than even some instances of conventional interest-rate smoothing regime, such a regime also imparts greater degree of inertia to the adjustment process. In the medium-term, it underperforms conventional monetary smoothing. This suggests that, while a rule-based police spending might be effective in supporting formal human capital investment (by smoothing out the fluctuation associated with educational quality uncertainty), as well as decoupling the cyclical properties of formal and illegal human capital accumulation, it comes at a cost of imparting greater inertia to the adjustment process. As such, instead of replacing the role of conventional monetary policy, the use of a more systematic reaction rule to police spending allocation in stabilizing shocks to formal human capital investment would necessarily require a supplementary monetary smoothing to reduce the adverse financial accelarator effect brought about by such a regime.

6 Concluding Remarks

We develop a DSGE model to examine the effects of quality uncertainty in human capital investment in an economy with crime, differential human capital, police spending (generally, public expenditure on public order and security), credit market imperfection, and monetary policy. The latter duo are common features in "financial accelerator" models, therefore allow for more realistic modeling of the impact of crime on businesses and the wider economy, which in turn facilitate better understanding of the macroeconomic stabilization properties of a policy such as the police spending. The model is parameterized illustratively for a stylized middle-income Latin American economy where criminal activities are a significant part of society. The main innovation of our study is that we explicitly consider the different potential role of public spending on public order and safety, beyond its generally assumed function of crime reduction.

Based on our analysis, in a model economy with organized crime, the accumulation processes of formal and illegal human capital tend to share the same cyclical properties, hence contributing to the persistency in crime rate. In order for formal education to achieve its desired role in reducing crime [as suggested in Pressman (2008) and Machin et al. (2012)], there appears to be a need for the adoption of a rule-based approach to police spending allocation. Such a policy regime not only smoothens out the fluctuations arisen from formal educational uncertainty, but also contributes to a "decoupling" of the common cyclical properties of the two types of human capital. This suggests that, in an economy with persistently high crime rate, a more systematic fiscal allocation to expenditure on public security/police may be warranted. Nevertheless, the use of a rule-based approach does come with the cost of it imparting a greater degree of inertia onto more conventional business-cycle shocks, and potentially worsening the financial accelerator effect arisen from credit market imperfections. This means the use of a more systematic reaction rule to police spending allocation in stabilizing shocks to formal human capital investment would necessarily require a supplementary interest-rate smoothing regime to negate these negative effects.

For future research direction, we acknowledge the limitations of our analysis due to the uneven quality of crime data. With longer time series, the heterogeneous nature of the different Latin American economies can be accounted for by either Bayesian-estimating our theoretical model, or evaluating the properties of the model solutions in a DSGE-vector autoregression (DSGE-VAR) examination. In terms of theoretical modeling, it is also worth pointing out that neither the issue of income inequality nor other demographic factors known to cause violent crime are explored (see, for example, Fajnzylber et al., 2002). These are issues worth-exploring in further theoretical studies, perhaps in a model without the credit and monetary features introduced in this study.

References

Agénor, Pierre-Richard (2016). Aid volatility, human capital, and growth. Centre for Growth and Business Cycle Research Discussion Paper Series 219, Economics, The University of Manchester.

Agénor, Pierre-Richard, and Koray Alper (2012). Monetary shocks and central bank liquidity with credit market imperfections. *Oxford Economic Papers* 64(3), 563-91.

Agénor, Pierre-Richard, Alper Koray, and Luiz Pereira da Silva (2014). Sudden floods, macroprudential regulation and stability in an open economy. *Journal of International Money and Finance* 48, 68-100.

Agénor, Pierre-Richard, Bratsiotis, George, and Damjan Pfaifer (2014). Credit frictions, collateral and the cyclical behaviour of the finance premium. *Macroeconomic Dynamics* 18(5), 985-97.

Agénor, Pierre-Richard, and King Yoong Lim (2018). Unemployment, growth and welfare effects of labor market reforms. *Journal of Macroeconomics* 58(4), 19-38.

Agénor, Pierre-Richard, and Peter J. Montiel (2008). Monetary policy analysis in a small open credit-based economy. *Open Economies Review* 19(4), 423-55.

Agénor, Pierre-Richard, and Peter J. Montiel (2015). *Development Macroeconomics*, 4th edition, Princeton University Press, New Jersey.

Aravena, Francisco R., and Luis Guillermo Solís (2009). *Organized Crime in Latin America and the Caribbean*. San Jose, Costa Rica: FLACSO.

Arvanites, Thomas M., and Robert H. Defina (2006). Business cycles and street crime. *Criminology* 44(1), 139-64.

Astarita, Caterina, Capuano, Carlo, and Franceso Purificato (2018). The macroeconomic impact of organised crime: A post-Keynesian analysis. *Economic Modelling* 68, 514-28.

Ayres, Robert L. (1998). *Crime and Violence as Development Issues in Latin America and the Caribbean*, February, World Bank, Washington, DC.

Baumann, Florian, and Tim Friehe (2017). Imperfect credit markets and crime. *Review of Law & Economics* 13(2), 1555-5879.

Becker, Gary S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy* 78, 169-217.

Bernanke, Ben S., and Mark Gertler (1989). Agency costs, net worth and business fluctuations. *American Economic Review* 79(1), 14-31.

Bernanke, Ben S., Gertler, Mark, and Simon Gilchrist (1999). The financial accelerator in a quantitative business cycle framework. In: John B. Taylor and Michael Woodford (eds), *Handbook of Macroeconomics*, Vol. 1C, 1341-93, Amsterdam.

Blackburn, Keith, Neanidis, Kyriakos, and Maria Paola Rana (2017). A theory of organized crime, corruption and economic growth. *Economic Theory Bulletin* 5(2), 227-45.

Bourguignon, François (1999). Crime, violence, and inequitable development. In *Annual World Bank Conference on Development Economics 1999/2000*, Pleskovic, Boris and Stiglitz, Joseph E. (eds.), World Bank Publication, 199-220.

Bressler, Martin S. (2009). The impact of crime on business: A model for prevention, detection & remedy. J*ournal of Management and Marketing Research* 2(1), 12-20.

Burdett, Kenneth, Lagos, Ricardo, and Randall Wright (2003). Crime, inequality, and unemployment, *American Economic Review* 93, 1764-77.

Bushway, Shawn, Cook, Philip J., and Matthew Phillips (2012). The overall effect of the business cycle on crime. *German Economic Review* 13(4), 436.46.

Caglayan, Mustafa, Flamini, Alessandro, and Babak Jahanshahi (2017). Organized crime and human capital. DEM Working Papers Series 143. University of Pavia, Department of Economics and Management.

Cantor, David, and Kenneth C. Land (1985). Unemployment and crime rates in the Post-World War II United States: A theoretical and empirical analysis. *American Sociological Review* 50(3), 317-32.

Coniglio, Nicola D., Celi, Giuseppe, and Cosimo Scagliusi (2010). Organized crime, migration and human capital formation: Evidence from the south of Italy. SERIES 0028, Dipartimento di Economia e Finanza - Università degli Studi di Bari.

de Blasio, Guido, Maggio, Giuseppe, and Carlo Menon (2016). Down and out in Italian towns: Measuring the impact of economic downturns on crime. *Economics Letters* 146, 99-102.

Detotto, Claudio, and Edoardo Otranto (2012). Cycles in crime and economy: Leading, lagging and coincident behaviors. *Journal of Quantitative Criminology* 28(2), 295-317.

Dixit, Avinash K., and Joseph E. Stiglitz (1977). Monopolistic competition and optimum product diversity. *American Economic Review* 67(3), 297-308.

Ehrlich, Isaac (1973). Participation in illegitimate activities: A theoretical and empirical investigation. *Journal of Political Economy* 81(3), 521-65.

Engelhardt, Bryan (2010). The effect of employment frictions on crime. *Journal of Labor Economics* 28(3), 677-718.

Engelhardt, Bryan, Rocheteau, Guillaume, and Rupert Peter (2008). Crime and the labor market: A search model with optimal contracts. *Journal of Public Economics* 92(10-11), 1876-91.

Fajnzylber, Pablo, Lederman, Daniel, and Norman Loayza (1998). *Determinants of Crime Rates in Latin America and the World: An Empirical Assessment.* World Bank Latin American and Caribbean Studies, November, Washington, DC.

Fajnzylber, Pablo, Lederman, Daniel, and Norman Loayza (2002). What causes violent crime? *European Economic Review* 46(7), 1323-57.

Galor, Oded, and Omer Moav (2004). From physical to human capital accumulation: Inequality and the process of development. *Review of Economic Studies* 71, 1001-26.

Galor, Oded, and Joseph Zeira (1993). Income distribution and macroeconomics. *Review of Economic Studies* 60, 35-52.

Gaviria, Alejandro (2002). Assessing the effects of corruption and crime on firm performance: evidence from Latin America. *Emerging Markets Review* 3(3), 245-268.

Gaviria, Alejandro, and Carmen Pagés (2002). Patterns of crime victimization in Latin American cities. *Journal of Development Economics* 67(1), 181-203.

Gomez Soler, Silvia C. (2012). Organized crime, foreign investment and economic growth. *Revista Economia & Region*, Universidad Technologica de Bolivar 6, 5-32.

Heinemann, Alessandra, and Dorte Verner (2006). Crime and violence in development: A literature review of Latin America and the Caribbean. Policy Research Working Paper 4041, October, World Bank, Washington, DC.

Hicks, Daniel, and Joan Hicks (2014). Jealous of the Joneses: conspicuous consumption, inequality, and crime. *Oxford Economic Papers* 66, 1090-120.

Imrohoroğlu, Ayse, Merlo, Antonio, and Rupert Peter (2004). What accounts for the decline in crime? *International Economic Review* 45(3), 707-29.

Imrohoroğlu, Ayse, Merlo, Antonio, and Rupert Peter (2006). Understanding the determinants of crime. *Journal of Economics and Finance* 30(2), 270-84.

Jaitman, Laura, and Iván Torre (2017). A systematic approach to measuring the costs of crime in 17 Latin American and Caribbean countries. In: Laura Jaitman (eds), *The Costs of Crime and Violence*, Inter-American Development Bank, Washington DC, 19-29.

Jia, Pengfei, King Yoong, Lim, and Ali Raza (2018). Crime, human capital, and the impact of different taxation. Economics Working Paper 2018/001, Lancaster University Management School.

Kelly, Morgan (2000). Inequality and crime, *Review of Economics and Statistics* 82(4), 530-9.

Liu, Philip (2006). A small new Keynesian model of the New Zealand economy. Reserve Bank of New Zealand Discussion Paper Series, 2006/03, Reserve Bank of New Zealand.

Lochner, Lance, and Enrico Moretti (2004). The effect of education on crime: Evidence from prison inmates, arrests, and self-reports. *American Economic Review* 94(1), 155-89.

Londoño, Juan Luis, and Rodrigo Guerrero (2000). Violencia en América Latina: Epidemología y Costos. In *Asalto al desarrollo*, Londoño, Juan Luis, Gaviria, Alejandro, and Rodrigo Guerrero (eds.), Inter-American Development Bank, Washington, DC.

Machin, Stephen, Marie, Olivier, and Sunčica Vujić (2012). Youth crime and education expansion. *German Economic Review* 13(4), 366-84.

Mocan, H. Naci, Billups Stephen, and Jody Overland (2005). A dynamic model of differential human capital and criminal activity. *Economica* 72(288), 655-81.

Morrison, Andrew, Buvinic, Mayra, and Michael Shifter (2003). The violent Americas: Risk factors, consequences, and policy implications of social and domestic violence. In *Crime and Violence in Latin America*, Frühling, Hugo, Tulchin, Joseph S., and Heather Golding (eds.), Woodrow Wilson Center Press, Washington, DC.

Moura, Marcelo L., and Alexandre de Carvalho (2010). What can Taylor rules say about monetary policy in Latin America? *Journal of Macroeconomics* 32(1), 392-404.

Neanidis, Kyriakos, and Vea Papadopoulou (2013). Crime, fertility, and economic growth: Theory and evidence. *Journal of Economic Behavior & Organization* 91, 101-21.

Ogaki, Masao, Ostry, Jonathan, and Carmen M. Reinhart (1996). Saving behavior in low- and middle-income developing countries: A comparison. *IMF Staff Papers* 43, 38-71.

Oguzoglu, Umut, and Ashantha Ranasinghe (2017). Crime and establishment size: Evidence from South America. *B.E. Journal of Economic Analysis & Policy* 17(4), 1-17.

Pinotti, Paolo (2012). The economic costs of organized crime: Evidence from Southern Italy. Working Papers 054. Carlo F. Dondena Centre for Research on Social Dynamics, Università Commerciale Luigi Bocconi.

Pressman, Steven (2008). Expanding the boundaries of the economics of crime. *International Journal of Political Economy* 37(1), 78-100.

Ravenna, Federico, and Carl E. Walsh (2006). Optimal monetary policy with the cost channel. *Journal of Monetary Economics* 53(2), 199-216.

Rotemberg, Julio J. (1982). Monopolistic price adjustment and aggregate output. *Review of Economic Studies* 49, 517-31.

Rudebusch, Glen (2006). Monetary policy inertia: Fact or fiction. *International Journal of Central Banking* 2, 85-135.

Rubio, Mauricio (2000). El desabordamiento de la violencia en Colombia. In *Asalto al desarrollo*, Londoño, Juan Luis, Gaviria, Alejandro, and Rodrigo Guerrero (eds.), Inter-American Development Bank, Washington, DC.

Soares, Rodrigo R., and Joana Naritomi (2010). Understanding high crime rates in Latin America: The role of social and policy factors. In *The Economics of Crime: Lessons for and from Latin America*, Di Tella Rafael, Edwards, Sebastian, and Ernesto Schargrodsky (eds.), National Bureau of Economic Research, 19-55.

Spillan, John E., Virzi, Nicholas, and Mauricio Garita (2014). *Doing Business In Latin America: Challenges and Opportunities.* New York, NY: Routledge.

Tayler, William, and Roy Zilberman (2016). Macroprudential regulation, credit spreads and the role of monetary policy. *Journal of Financial Stability* 26(C), 144-58.

Taylor, John B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy* 39, 195-214.

United Nations Office on Drugs and Crime (UNODC) (2012). *Transnational Organized Crime in Central America and the Caribbean: A Threat Assessment.* Vienna, Austria: UNODC.

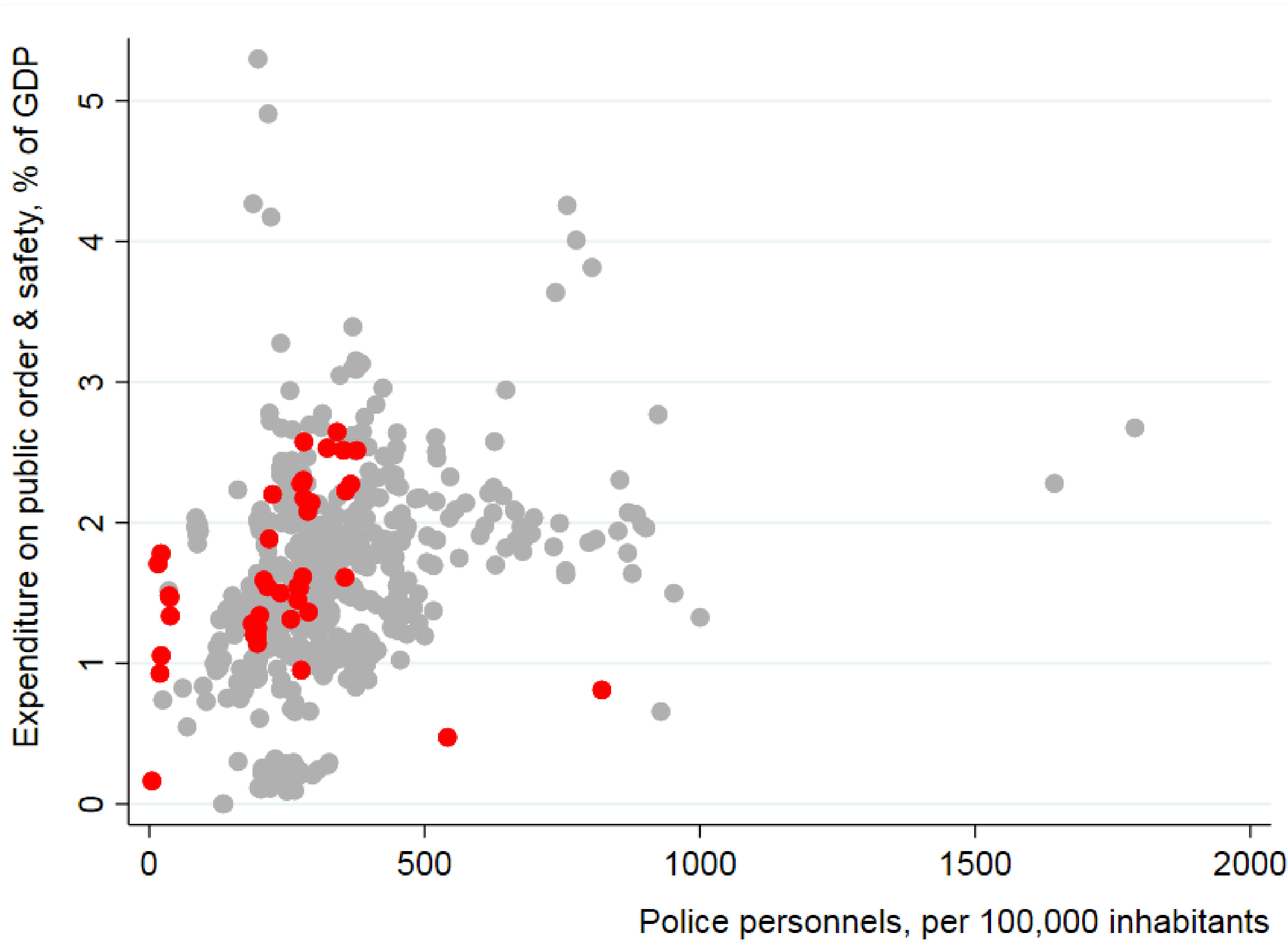
Table 1

Benchmark: Key Parameter Values

Parameter	Value	Description
		Preferences
β	0.952	Discount factor
σ	0.6	Elasticity of intertemporal substitution
η_N	1.75	Preference parameter for leisure
η_F	0.02	Preference parameter for monetary assets
υ	0.2	Share parameter in index of money holdings
		Human Capital and Crime
δ^L, δ^C	0.05	Depreciation rate, both types of human capital
$\varkappa$	0.7	Probability, escaping apprehension
Λ	0.258	Time-invariant, crime-specific human capital
Θ_0^N	0.215	Base inv. efficiency, formal human capital
Θ_0^C	0.430	Base inv. efficiency, crime-specific h.capital
		Production
ς	2.43	Elasticity of demand for intermediate goods
α	0.35	Share of physical capital, intermediate goods
δ^K	0.02	Depreciation rate, physical capital
		Commercial Banks and Loans
κ	0.2	Effective collateral-loan ratio
ϕ_1	0.05	Elasticity of repayment prob, collateral
ϕ_1	0.05	Elasticity of repayment prob, crime rate
η_{L_q}	1.0	Interest elasticity of loan demand
q_0	0.2	Base repayment probability
Ψ_0	0.815	Parameter, risk premium for loan
		Central bank
μ	0.1	Reserve requirement ratio
ϖ	0.0	Degree of interest rate smoothing
ϵ_1	1.5	Response of policy rate to inflation deviations
ϵ_2	0.2	Response of policy rate to cyclical output
		Government
τ_K	0.2	Tax rate, physical capital income
τ_N	0.2	Tax rate, labor income
υ_O	0.167	Gov. consumption parameter, % of GDP
υ_P	0.0157	Spending on public order & safety, % of GDP
ψ_1	0.1	Parameter, responsiveness to crime rate
		Adjustment Cost Parameters
Θ_F	10	Price-setting
Θ_K	10	Physical capital investment

Figure 1

Government Expenditure on Public Order & Safety, and Number of Police Personnel, 1990-2014



Note: Red dots denote observations for Latin American economies.

Sources: IMF Government Finance Statistics;
United Nations Survey of Crime Trends and Operations of Criminal Justice Systems (UN-CTS)

Figure 2
Temporary shock in formal human capital investment efficiency, Benchmark

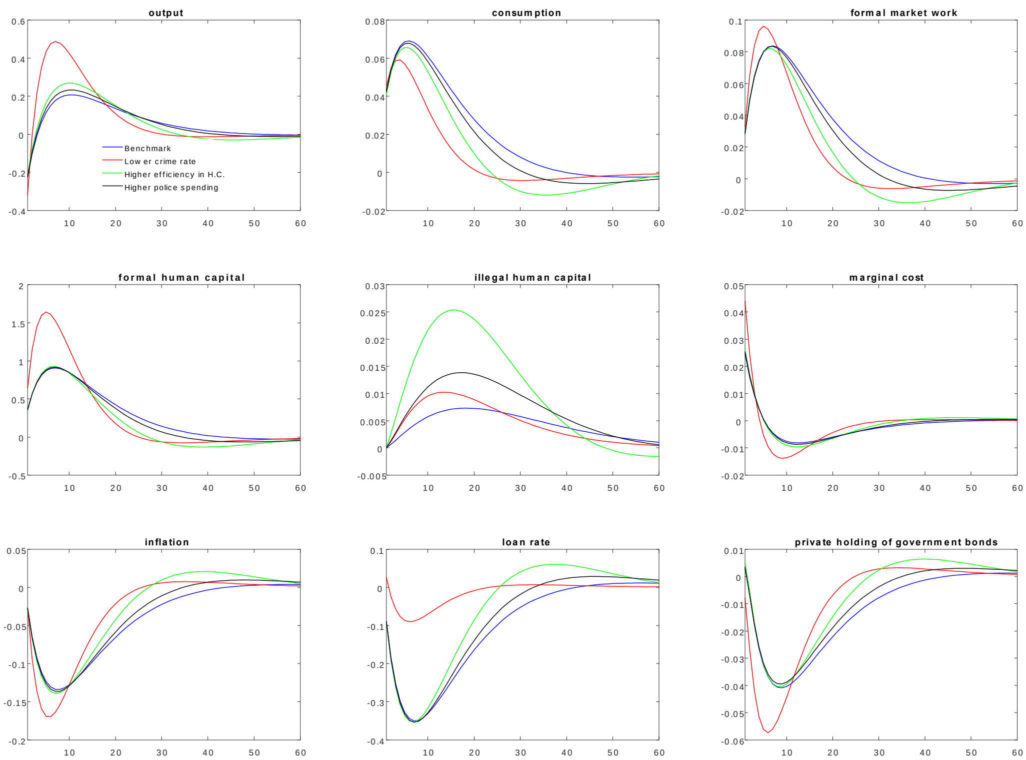


Figure 3
Temporary shock in formal human capital investment efficiency, Rule versus Discretion

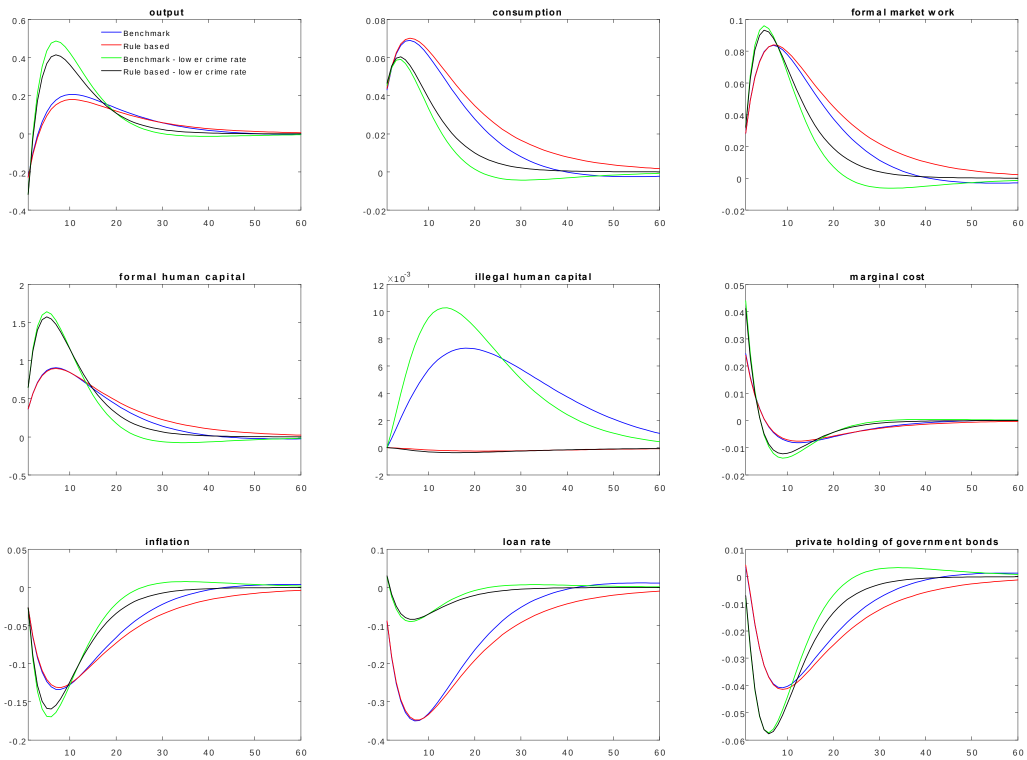


Figure 4
Temporary shock in crime-specific human capital investment efficiency

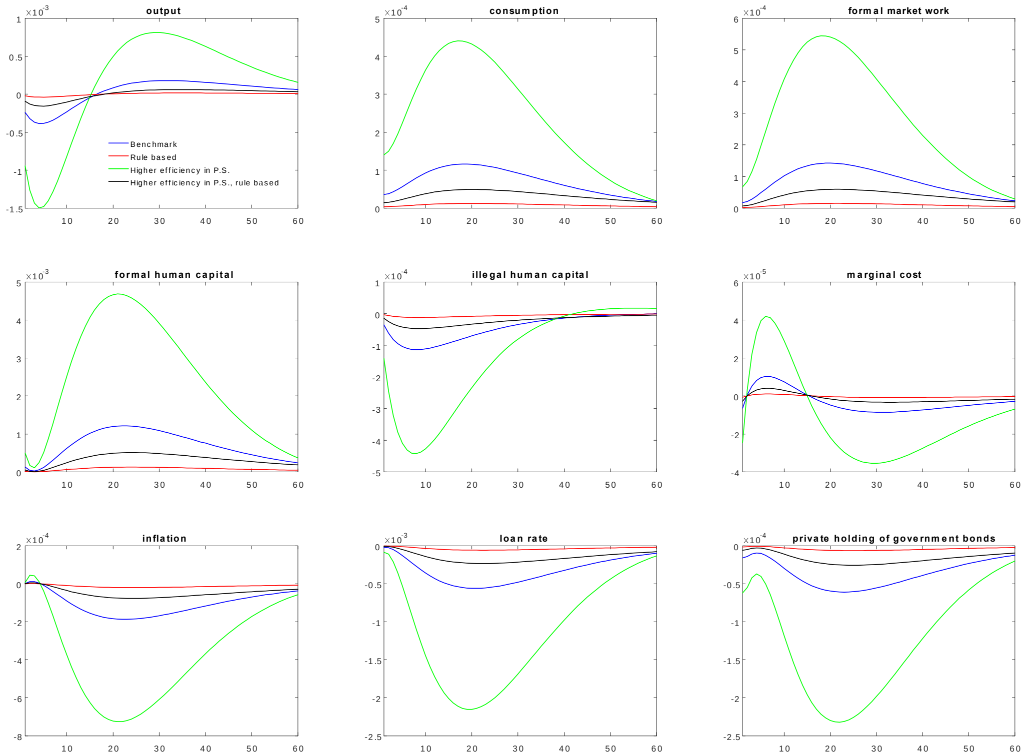


Figure 5
Temporary shock in monetary policy rate-setting

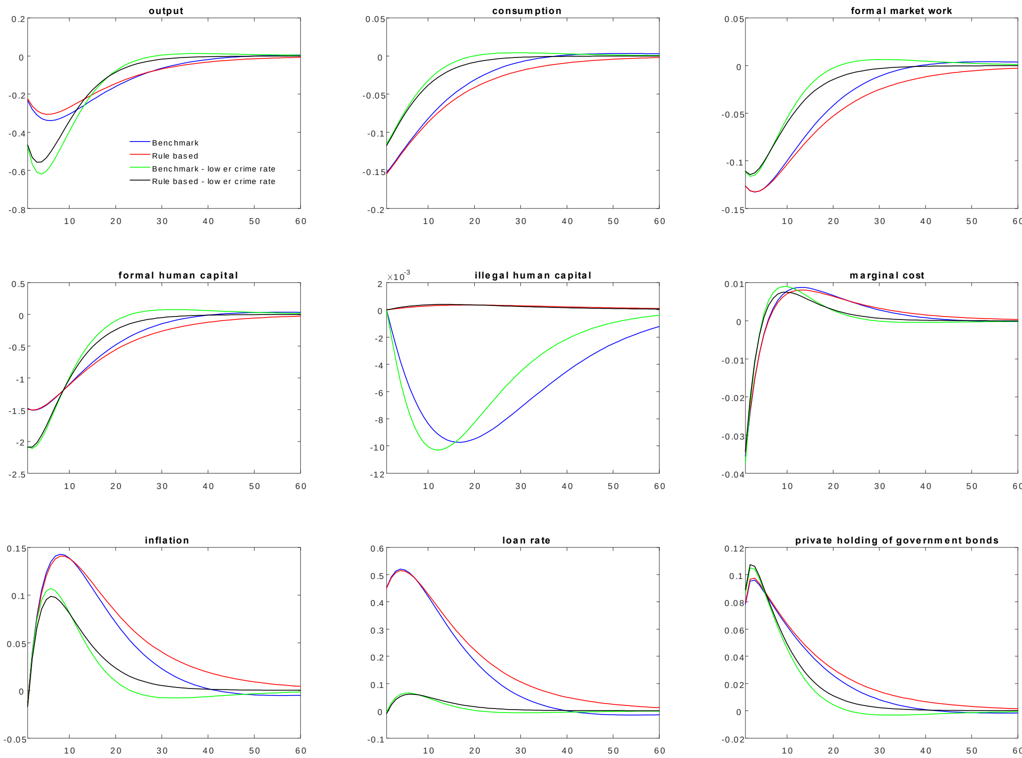
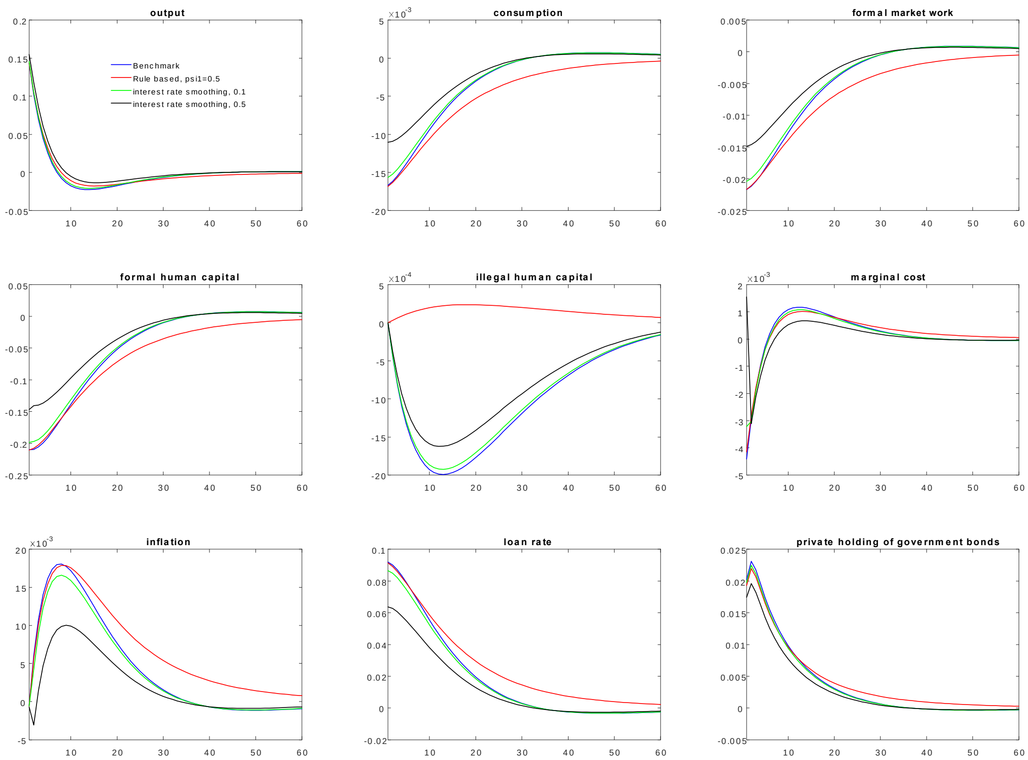


Figure 6
Temporary shock in productivity



DISCUSSION PAPERS IN ECONOMICS

2019/2 Pengfei Jia and King Yoong Lim, Police Spending and Economic Stabilization in a Monetary Economy with Crime and Differential Human Capital.

2019/1 King Yoong Lim and Diego Morris, Modeling the Drugs and Guns Trade in a Two-Country Model with Endogenous Growth.

2018/3 Pengfei Jia and King Yoong Lim, Tax Policy and Toxic Housing Bubbles in China.

2018/2 Yousef Makhlouf, Trends in Income Inequality.

2018/1 Dimitrios Bakas and Athanasios Triantafyllou, The Impact of Uncertainty Shocks on the Volatility of Commodity Prices.

2017/9 Eghosa Igudia, Rob Ackrill and Simeon Coleman, *Entrepreneurial Responses to Austerity: The Role of the Informal Sector*.

2017/8 Rahmi Cetin and Robert Ackrill, *Openness and Growth in Challenging Times: Analysing the Trade-Growth Nexus in Slovakia*.

2017/7 Dimitrios Bakas and Yousef Makhlouf, *Can the Insider-Outsider Theory explain Unemployment Hysteresis in the OECD Countries?*

2017/6 Dimitrios Bakas, Georgios Chortareas and Georgios Magkonis, *Volatility and Growth: A not so Straightforward Relationship.*

2017/5 Will Rossiter, *Prospects and Challenges for City Region Devolution in Nottingham and the East Midlands.*

2017/4 Chunping Liu and Zhirong Ou, *What determines China's housing price dynamics? New evidence from a DSGE-VAR.*

2017/3 Morakinyo O. Adetutu and Thomas G. Weyman-Jones, *Fuel subsidies versus market power: is there a countervailing second best welfare optimum?*

2017/2 Robert Mullings, *Do Institutions moderate Globalization's effect on Growth?*

2017/1 Anthony J Glass, Karligash Kenjegalieva, Victor Ajayi, Morakinyou Adetutu, Robin C. Sickles, *Relative Winners and Losers from Efficiency Spillovers in Africa with Policy Implications for Regional Integration*.

2016/4 Sara Ornati, *International Environmental Agreements and Domestic Politics*.

2016/3 Yanhui Zhu, Jingwen Fan and Jon Tucker, *The impact of UK monetary policy on gold price dynamics*.

2016/2 John Ebireri and Alberto Paloni, *Bank Development and a Lower Degree of Sophistication and Diversification of Developing Countries' Exports*.

2016/1 Robert Mullings and Aruneema Mahabir, *Growth by Destination: The Role of*

Trade in Africa's Recent Growth Episode.

2015/1 Andrew Atherton, João R. Faria, Dongxu Wu and Zhongmin Wu, *Human Capital, Entrepreneurial Entry and Survival*.

2014/5 Leighton Vaughan Williams, *The US Supreme Court and the 'Affordable Care Act': An Exercise in Closed-Door Forecasting*.

2014/4 Juan Carlos Cuestas and Barry Harrison, *Unemployment Persistence in the EU15*.

2014/3 Francesco Marchionne and Sunny Parekh, *Growth, Debt, and Inequality*.

2014/2 Bo Jiang, Zhongmin Wu, Bruce Philp and Simeon Coleman, *Macro Stress Testing in the Banking System of China*.

2014/1 Eghosa Igudia, Rob Ackrill, Simeon Coleman and Carlyn Dobson, *Austerity Measures or Entrepreneurial Development? The case of the Nigerian Informal Economy*.

2013/5 Barry Harrison and Theodorus Wisnu Widjaja, *Did the Financial Crisis impact on the Capital Structure of Firms?*

2013/4 Geetha Ravishankar and Marie Stack, *The Gravity Model and Trade Efficiency: A Stochastic Frontier Analysis of Potential Trade*.

2013/3 Chunping Liu and Patrick Minford, *How Important is the Credit Channel? An Empirical Study of the US Banking Crisis.*

2013/2 Chunping Liu and Patrick Minford, *Comparing Behavioural and Rational Expectations for the US Post-War Economy.*

2013/1 Dan Wheatley, *Is it good to share? Debating patterns in availability and use of job share*.

2012/3 Simeon Coleman and Vitor Leone, *Time-Series Characteristics Of UK Commercial Property Returns: Testing For Multiple Changes In Persistence*.

2012/2 Otavio Ribeiro de Medeiros and Vitor Leone, *Multiple Changes in Persistence vs. Explosive Behaviour: The Dotcom Bubble*.

2012/1 Rob Ackrill and Simeon Coleman, *Inflation Dynamics In Central And Eastern European Countries*.

2011/4 Simeon Coleman, *Inflation Dynamics and Poverty Rates: Regional and Sectoral Evidence for Ghana.*

2011/3 Dan Wheatley and Zhongmin Wu, *Work, Inequality, And The Dual Career Household*.

2011/2 Simeon Coleman and Kavita Sirichand, *Fractional Integration and the Volatility Of UK Interest Rates*.

2011/1 Simeon Coleman, *Investigating Business Cycle Synchronization In West Africa*.

2010/11 Marie Stack and Eric Pentecost, *A Gravity Model Approach To Estimating Prospective Trade Gains in The EU Accession And Associated Countries*.

2010/10 Vitor Leone And Bruce Philp, *Surplus-Value And Aggregate Concentration In The UK Economy, 1987-2009*.

2010/9 Robert Ackrill and Adrian Kay, *WTO Regulations and Bioenergy Sustainability Certification – Synergies and Possible Conflicts.*

2010/8 Paul Alagidede, Simeon Coleman and Juan Carlos Cuestas, *Persistence Of Inflationary Shocks: Implications For West African Monetary Union Membership.*

2010/6 Bruce Philp and Dan Wheatley, *The time scarcity and the dual career household: competing perspectives*

2010/5 Juan Carlos Cuestas, Sebastián Freille and Patricio O'Gorman, *The media and public agendas: testing for media effects in Argentina Turing the Kirchner administration*

2010/4 Vitor Leone, *From property companies to real estate investment trusts: the impact of economic and property factors in the UK commercial property returns*

2010/3 Juan Carlos Cuestas and Paulo José Regis, *Purchasing power parity in OECD countries: nonlinear unit root tests revisited*

2010/2 Juan Carlos Cuestas and Bruce Philp, *Exploitation and the class struggle*

2010/1 Barry Harrison and Winston Moore, *Nonlinearities in Stock Returns for Some Recent Entrants to the EU*

2009/7 Joao R. Faria, Le Wang and Zhongmin Wu, *Debts on debts*

2009/6 Juan Carlos Cuestas and Luis A. Gil-Alana, *Unemployment hysteresis, structural changes,non-linearities and fractional integration in Central and Eastern Europe*

2009/5 Juan Carlos Cuestas and Javier Ordóñez, *Unemployment and common smooth transition trends in Central and Eastern European Countries*

2009/4 Stephen Dobson and Carlyn Ramlogan, *Is there a trade-off between income inequality and corruption? Evidence from Latin America*

2009/3 Juan Carlos Cuestas and Luís Alberiko Gil-Alana, *Further evidence on the PPP analysis of the Australian dollar: non-linearities, structural changes and fractional integration*

2009/2 Estefanía Mourelle and Juan Carlos Cuestas, *Inflation persistence and asymmetries: Evidence for African countries*

2009/1 Juan Carlos Cuestas and Barry Harrison, *Further evidence on the real interest rate parity hypothesis in Central and Eastern European Countries: unit roots and nonlinearities*

2008/16 Simeon Coleman, *Inflation persistence in the Franc Zone: evidence from disaggregated prices*

2008/15 Juan Carlos Cuestas and Paulo Regis, *Nonlinearities and the order of integration of order prices*

2008/14 Peter Dawson and Stephen Dobson, *The influence of social pressure and nationality on individual decisions: evidence from the behaviour of referees*

2008/13 Juan Carlos Cuestas and Barry Harrison, *Testing for stationarity of inflation in Central and Eastern European Countries*

2008/12 Juan Carlos Cuestas and Dean Garratt, *Is real GDP per capita a stationary process? Smooth transitions, nonlinear trends and unit root testing*

2008/11 Antonio Rodriguez Andres and Carlyn Ramlogan-Dobson, *Corruption, privatisation and the distribution of income in Latin America*

2008/10 Stephen Dobson and Carlyn Ramlogan, *Is there an openness Kuznets curve? Evidence from Latin America*

2008/9 Stephen Dobson, John Goddard and Frank Stähler, *Effort levels in contests: an empirical application of the Tullock model*

2008/8 Juan Carlos Cuestas and Estefania Mourelle, *Nonlinearities in real exchange rate determination: Do African exchange rates follow a random walk?*

2008/7 Stephen Dobson and John Goddard, *Strategic behaviour and risk taking in football*

2008/6 Joao Ricardo Faria, Juan Carlos Cuestas and Estefania Mourelle, *Entrepreneurship and unemployment: A nonlinear bidirectional causality?*

2008/5 Dan Wheatley, Irene Hardill and Bruce Philp, *"Managing" reductions in working hours: A study of work-time and leisure preferences in the UK industry*

2008/4 Adrian Kay and Robert Ackrill, *Institutional change in the international governance of agriculture: a revised account*

2008/3 Juan Carlos Cuestas and Paulo José Regis, *Testing for PPP in Australia: Evidence from unit root test against nonlinear trend stationarity alternatives*

2008/2 João Ricardo Faria, Juan Carlos Cuestas and Luis Gil-Alana, *Unemployment and entrepreneurship: A Cyclical Relation*

2008/1 Zhongmin Wu, Mark Baimbridge and Yu Zhu, *Multiple Job Holding in the United Kingdom: Evidence from the British Household Panel Survey*

DISCUSSION PAPERS IN POLITICAL ECONOMY

2006/3 Ioana Negru, *On Homogeneity and Pluralism within Economics Schools of Thought*

2006/2 David Harvie and Bruce Philp, *Learning and Assessment in a Reading Group Format or Reading Capital… For Marks*

2006/1 David Harvie, Bruce Philp and Gary Slater, *Regional Well-Being and 'Social Productivity' in Great Britain'*

2004/2 Massimo De Angelis and David Harvie, *Globalisation? No Question: Foreign Direct Investment and Labour Commanded*

2004/1 David Harvie, *Value-Production and Struggle in the Classroom, or, Educators Within, Against and Beyond Capital*

DISCUSSION PAPERS IN APPLIED ECONOMICS AND POLICY

2007/2 Juan Carlos Cuestas, *Purchasing Power Parity in Central and Eastern European Countries: An Analysis of Unit Roots and Non-linearities*

2007/1 Juan Carlos Cuestas and Javier Ordóñez, *Testing for Price Convergence among Mercosur Countries*

2006/2 Rahmi Cetin and Robert Ackrill, *Foreign Investment and the Export of Foreign and Local Firms: An Analysis of Turkish Manufacturing*

2006/1 Robert Ackrill and Adrian Kay, *The EU Financial Perspective 2007-2013 and the Forces that Shaped the Final Agreement*

2004/5 Michael A. Smith, David Paton and Leighton Vaughan-Williams, *Costs, Biases and Betting markets: New evidence*

2004/4 Chris Forde and Gary Slater, *Agency Working in Britain: Character, Consequences and Regulation*

2004/3 Barry Harrison and David Paton, *Do 'Fat Tails' Matter in GARCH Estimation? Stock market efficiency in Romania and the Czech Republic*

2004/2 Dean Garratt and Rebecca Taylor, *Issue-based Teaching in Economics*

2004/1 Michael McCann, *Motives for Acquisitions in the UK*

2003/6 Chris Forde and Gary Slater, *The Nature and Experience of Agency Working in Britain*

2003/5 Eugen Mihaita, *Generating Hypothetical Rates of Return for the Romanian Fully Funded Pension Funds*

2003/4 Eugen Mihaita, *The Romanian Pension Reform*

2003/3 Joshy Easaw and Dean Garratt, *Impact of the UK General Election on Total Government Expenditure Cycles: Theory and Evidence*

2003/2 Dean Garratt, *Rates of Return to Owner-Occupation in the UK Housing Market*

2003/1 Barry Harrison and David Paton, *The Evolution of Stock Market Efficiency in a Transition Economy: Evidence from Romania.*