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Institutions, Bribes, and Business Cycles

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Abstract: Firms in countries with poor enforcement of property rights are often subject to extortions, which impact the business cycle. Unlike taxes, extortions respond endogenously to exogenous shocks, potentially affecting the volatility of investment, consumption, and GDP. In this study I introduce extortions into a real business cycles framework. The model features an intermediary that demands bribes from firms. In steady state, weak property rights induce higher bribes, lower GDP per capita, and lower investment to GDP ratios. Along the business cycle, they reduce the correlation between investment and output, and amplify the volatility of consumption and investment relative to output. I find this to be in line with the data. My framework accounts for the empirical finding that growth policies are usually more successful in countries with strong enforcement of property rights.

JEL classification: O11; O43
Keywords: Property rights; Extortions; Bribes; Aid and growth; Governance and growth

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1 Introduction

Developing countries typically face weaker property rights than rich ones, allowing mafias or other groups to extract bribes from private firms. Bribes respond endogenously to temporary shocks: they often depend on the ability of a firm to pay, which increases in good times. Thus, a positive shock, which would normally trigger investment and growth, is less bound to do so. This paper studies how bribes affect real business cycles.

To illustrate, consider the *Zhongjian Ren*, an intermediary in China that helps private firms in dealing with the government. They charge an amount that usually depends on the size of the business in question and the quality of their connections, or *guanxi*. The legality of this figure has often been questioned. In fact, this often challenges compliance with the U.S. Foreign Corrupt Practices Act, which prohibits companies issuing stock in the U.S. from bribing foreign officials for government contracts and other business. It has triggered hefty lawsuits for several firms, including IBM, Rockwell, Pfizer and Las Vegas Sands.

These intermediaries also have presence in richer countries. Examples include the "Camorra" in Italy, the "Yakuza" in Japan or the "Bratva" in Russia, to name a few. In fact, one can argue that lobbies in the U.S. are not very different: Grossman and Helpman (1994) would model the *Zhongjian Ren* very similarly to how they model lobbies, that is, agents making contributions to the government in exchange for political favors. It is fair to say that this type of activities, to a different extent, take place in every country in the world. These intermediaries are the focus of this paper.

To study them I develop a micro-founded theory of real business cycles (RBC) with varying degrees of property rights protection. In the model, insecure property rights imply that firms may fail to realize the fruit of their investments[1] because of the existence of intermediaries. Intermediaries endogenously determine a bribe to extract, that depends, among other things, on the value of firms. Exogenous shocks affect this value. The costs of extortions also varies with the business cycle: intermediaries compete with private firms for resources, and costs are usually pro-cyclical. Consequently, a positive shock to total factor productivity (TFP) can in theory both increase or decrease bribery.

My findings can be summarized as follows. Along the steady state, higher bribes behave as higher corporate taxes: they reduce the steady state level of GDP per capita and the ratio of investment to GDP. The first of these facts is in line with Levy-Carciente (2017). The second is in line with Brunetti and Weder (2003), who find a positive correlation between investment and institutional uncertainty. Besley (1995) and Goldstein and Udry (2008) find support for a positive relationship in Ghana, where investment

[1] This is the definition of expropriation risk in Besley and Ghatak (2010), who survey the literature on property rights and development.

is larger in areas that have better enforcement of property rights. Along the business cycle, weak property rights amplify the volatility of consumption and investment relative to GDP, reduce the correlation between investment and GDP, and increase the correlation between consumption and GDP.

I then explore whether the data supports these findings. To do this, I use a measure of property rights developed by the Property Rights Alliance, the International Property Rights Index (IPRI). The higher the score, the stronger the enforcement of property rights. Following Aguiar and Gopinath (2007), I divide the sample into two: high IPRI and low IPRI countries and compare the different moments identified by the model. The data confirms the theoretical implications. Lower IPRI countries have lower GDP per capita, lower investment to output ratios, higher relative volatility of consumption and investment, and lower correlation between investment and GDP. The evidence does not support a higher correlation between consumption and GDP among low IPRI countries.

The IPRI aggregates a series of indices that measure different types of property rights enforcement. This makes it unreliable for more thorough statistical analysis.[2] To work around this, I use GDP per capita as a proxy for property rights. Both the model and the data suggest that this is a valid exercise, since Levy-Carciente (2017) finds a correlation of GDP per capita and the IPRI of over 80%. Accordingly, I investigate the correlations between the different moments and GDP per capita both by performing an ordinary least squares regression and using GDP per capita as an instrument for IPRI, via a two step least squares regression, addressing any biases triggered by omitting variables. The empirical results are in line with the model, with the exception of the correlation between consumption and GDP per capita, that tends to be not significant.

The next question is whether property rights can affect the effectiveness of policy. To do this, I reevaluate the findings of several empirical papers in the development literature under the light of my model. These include studies on the effect of foreign aid, on an increase in the price of an exported commodity,[3] and on government investment.

The effect of foreign aid on growth has been thoroughly studied, starting with Burnside and Dollar (2000), who find that aid leads to higher growth in countries that feature low inflation, high degrees of openness, and low fiscal deficits, all characteristics of strong property rights countries. This result has been much debated. Easterly (2003) summarizes the literature in favor and against this finding, highlighting the need for theory. He mentions that the main problem is "*how to choose the appropriate specification without guidance from the theory, which often means there are more plausible right hand side vari-*

[2] Regardless, I performed a least squares regression using the IPRI and the signs of the coefficients are aligned with the model predictions, although usually not significant.

[3] While this price change is not policy, its effects on growth depend on institutions. Understanding this relationship can help shape policy, such as export subsidies.

ables than there are data points in the sample." Following Radelet (2006) and Hansen and Tarp (2000), I model an increase in aid as an increase in TFP. Using data simulated by the model, I confirm Burnside and Dollar (2000)'s findings, providing a theoretical framework that can be used to guide further research.

Next, I use my model in light of the findings in Collier and Goderis (2012): an increase in the price of an exported commodity leads to higher growth when institutions are strong. The authors understand a shock to commodity prices as a quasi-natural experiment of an increase in TFP within countries that export these commodities. To replicate their results, I run a similar regression on data simulated by the model, assuming varying degrees of property rights enforcement. The simulated data is in line with the empirical results.

Finally, I address Isham et al. (1997), who find that government investments perform better in countries with strong levels of civil liberties. Government investments, such as improvements in transportation networks, education, or energy procurement can be understood as increases in TFP, making these findings consistent with my model.

The model features many firms producing a homogeneous good under decreasing returns to scale, using labor and capital as inputs. Intermediaries determine bribes by spending costly resources, that include venal politicians and workers. Politicians must be paid to "look the other way". Workers are needed to maintain the intermediary's network of contacts, and to act as "muscle" to threaten firms into paying.

Weak institutions allow more politicians to accept side payments. Recent events have revealed the extent to which politicians are bought in developing countries. The "Lavajato" in Brazil uncovered almost $10 Billion in side payments to government officials for state contracts granted to Petrobras, a private oil company, in 2014. In 2015, owners of a bank in Chile, Banco Penta, were found guilty of bribery in the form of campaign contributions. In Argentina, a former Vice-president (Amado Boudou) was imprisoned for receiving side payments in 2017 by a private firm acquiring the rights to print money. Countries with weaker property rights allow the existence of more venal politicians, and consequently more extortions. This motivates my measure of property rights enforcement as the number of venal politicians.

The second input of intermediaries is workers. The trade-off faced by workers between the formal and bribery sectors imply that an increase in wages reduce the incentives for criminal activity, as argued by De Soto (1989, 2000). As an example, he proposes that a solution to conflict around the world is economic growth. In fact, he claims growth in Peru is to blame for eliminating the guerrilla group "Sendero Luminoso". But he also makes the case that better opportunities in the formal economy would deter criminals from engaging in mob activities, and reduce extortive practices.

The model works as follows. A positive shock to TFP increases firm value and wages. Larger firm value creates incentives to extort more. But wages also increase, counteracting this effect. In equilibrium, extortions drop on impact, in line with De Soto's conjecture. As the shock fades away, wages decrease, but firm value keeps increasing because investment increases the capital stock. As a result, extortions increase.

The weaker the property rights, the larger the swings in bribery. The consequence is that when property rights are weak, a positive TFP shock is expected to trigger large bribes in the future, reducing the incentives to invest both in capital and in new firms. In this sense, bribes act like financial constraints, explaining the increased correlation between consumption and GDP, and the reduced correlation between investment in GDP. This being said, weak property rights countries are also likely to have higher financial constraints, and improving these property rights would therefore amplify the effects I describe. Besley et al. (2012) argue that improving property rights would loosen financial constraints and allow firms to increase the loans received without increasing the collateral. Garcia-Cicco et al. (2010) show that financial constraints have similar effects to those identified in this paper.

These results complement existing theories to account for some of these observations. Aguiar and Gopinath (2007) explain the differences between developing and developed countries by proposing that long run volatility is more pronounced in developing countries. As a result, consumption and investment become more volatile relative to GDP. Koren and Tenreyro (2007) separate aggregate volatility from sector-specific volatility. They find that development shifts production towards less volatile sectors, and reduces aggregate volatility.

Most studies on institutions focus on long run growth (see Acemoglu et al. 2005 and Acemoglu and Robinson 2012 for a discussion). However, the fact that institutions matter for the business cycles has been highlighted more recently, starting with Acemoglu et al. (2003). Besley and Mueller (2017) show that institutions matter greatly for the high frequency behavior of foreign direct investment, an area not covered by the present paper but that can potentially represent an interesting extension.

Angelopoulos et al. (2011) also study the effects of extortions in a RBC environment. The difference is that extortions are endogenous in my paper, and exogenous in theirs. Modeling this as endogenous is key to understand the effects of TFP shocks on growth and other variables. Mehlum et al. (2006) models this endogenously, with a model where there are "grabbers" and "producers". Grabbers engage in extracting activities, while producers are entrepreneurs with productive activities. When institutions are weak, grabbers are protected, so more individuals become grabbers, and the economy's growth suffers. This is especially so in countries with large endowments of natural resources, where extraction is easier. Empirically, they find that the combination of poor institutions and large resource endowments accounts for lower growth than when institutions are strong. While they study a static model, my model can accommodate a dynamic economy, and therefore capture the effects of temporary shocks.

This study abstracts from expropriations, although the setting of the model could easily reinterpret bribes as expropriated output. Besley and Mueller (2016) argue that this generates important misallocation problems, where workers are assigned to protection rather than production. They find expropriations can generate up to 10% lower output, with two thirds of this loss attributable to workers in protection rather than production. An interesting extension would add a role for this misallocation.

This paper is organized as follows. Section 2 describes the model used to understand the effects of property right enforcement along the business cycle. Section 3 calibrates the model. Section 4 performs the numerical analysis to derive key results. Section 5 studies whether the model predictions hold in the data. Section 6 discusses how the results of the model can account for several empirical regularities that lack formal modeling. Section 7 concludes.

2 The Model

This section introduces the model, which is a fairly standard RBC model with the exception of a continuum of firms with decreasing returns to scale as in Hopenhayn (1992), rather than a representative firm with constant returns to scale, and an intermediary that demands bribes from private firms. The change in the industrial organization follows the need for strictly positive profits in this economy to cover bribes.

The intermediary hires resources to set bribe levels. The more resources, the higher the bribe. Thus, resources are not necessary to visit more firms, but to increase bribe requested. This assumption is more realistic in the sense that intermediaries such as the *Zhongjian Ren* in China can get higher payments when they have better connections, and for this they need resources. More firms will approach them based on connections, and it is fairly costless to add more firms, but costly to add more connections. A similar argument can be made about lobbies and other groups. This being said, the settings are isomorphic to one where the bribe amount is fixed, but the number of firms visited change endogenously.

I assume that bribes are proportional to firm value. Assuming that they are proportional to sales or profits would not change the analysis, given that these measures are strongly correlated.

The key variable in the model is the measure of venal politicians. Countries differ in how many politicians are "open for business" and this is my measure of institutional quality. A country with many venal politicians reduces the price of engaging in bribery, since large supply means that the price paid to each venal politician is low.

2.1 Setup

Consumers. There is a continuum of identical consumers with mass 1 and preferences given by:

$$U = \mathbb{E}\sum_{t=0}^{\infty} \beta^t \ln(C_t), \quad \beta \in (0,1) \tag{1}$$

where β is the discount factor, $C_t \geq 0$ is consumption at time t, and $\mathbb{E}$ is the expectations operator. The consumer can save by accumulating capital which then sells to firms. Notice that consumers sell their capital to firms, and do not rent it out. This makes the setting more realistic: capital increases the value of firms, which matter for extortions.[4]

Capital accumulates according to the law of motion

$$K_{t+1} = (1-\delta_k)K_t + I_t$$

where K_t is capital in period t, I_t is investment in period t and $\delta_k \in (0,1)$ is the depreciation rate of capital. I_t is units of the consumption good.

Firms. Firms are located evenly within a continuum of locations with measure 1. These are owned by the representative agent, and operate under perfect competition to produce the final output good. They are identical and their technology is

$$f(z,k,h) = e^z \left(k^\alpha h_p^{1-\alpha}\right)^\gamma, \quad \alpha,\gamma \in (0,1)$$

where z is a random shock common to all firms, h_p is labor in production, and k is capital. The shock z follows the following autoregressive process:

$$z_{t+1} = \rho z_t + \varepsilon_t, \rho \in (0,1), \varepsilon_t \sim N(0,\sigma^2)$$

Firms own their stock of capital. Each period, they hire labor services and may change their capital by purchasing or selling units.

M_t denotes the measure of incumbent firms. These die at an exogenous rate $\delta_f \in (0,1)$. When a firm dies, it sells its remaining capital. If N_t firms are created in period t, the mass of firms evolves as

$$M_{t+1} = (1-\delta_f)M_t + N_t$$

There is a continuum of potential entrants that can start new firms by spending κ units of labor. If this cost is incurred in period t, a firm starts producing in period $t+1$ with probability $1-\delta_f$ and 0 units of capital.

[4] Alternatively, one could assume that firms accumulate the stock of capital. The alternative I choose is more tractable since it allows for a algebraic mapping between the value of incumbent firms and entrants, as Corollary **??** shows.

Intermediaries. Intermediaries are the new element of the model. There is a measure 1 of identical intermediaries, that hire workers and venal politicians to extract bribes from firms. Each intermediary targets all firms within an assigned location and extracts the same bribe from each firm.

Locations are randomly assigned, no two intermediaries get the same location, and the location assigned in period t is independent of the location in period $t-1$. This setting prevents firms from behaving strategically, keeping their values low to minimize bribes. The fact that bribes depend on the value of all firms within a location implies that firms have no incentives to hide under low values. Random location assignment deals with the potential concern that intermediaries may behave strategically, allowing firms within their location to grow before extracting bribes.

Intermediaries compete with private firms for workers, that are compensated at the going rate. This generates a trade-off between productive and delinquent activities. The representative consumer conforms the political body, and a share $\Gamma \in [0,1]$ of these are venal. The price paid to each venal politician is v, endogenously determined in equilibrium. Countries with more venal politicians (larger Γ) are countries with weaker enforcement of property rights.

The extortion technology is as follows:

$$s(h, P) = h_e^{\mu} P^{1-\mu}, \;\; 0 \leq \mu \leq 1$$

where $s \in [0,1]$ is the share of the value of firms demanded as bribes, $h_e \geq 0$ is workers in extortions, and $P \geq 0$ is politicians.

Notice that it is not costly to visit more firms, but it is costly to request higher payments. For example, one *Zhongjian Ren* can costlessly work for several firms at the same time, but it would ask for higher payments if able to show proper connections, which is achieved by having many politicians and workers in the payroll. A similar argument also applies to lobbies. This being said, the environment is isomorphic to one in which the level of the bribe is fixed, but the measure of firms visited changes endogenously.

Feasibility. To close the model, four markets clear: the final output market, the labor market, the politician market, and the capital market:

$$C_t + K_{t+1} - (1-\delta_k)K_t = M_t e^{z_t}(k_t^{\alpha} h_t^{1-\alpha})^{\gamma} \tag{2}$$

$$1 = M_t h_{p,t} + N_t/\kappa + h_{e,t} \tag{3}$$

$$\Gamma = P_t \tag{4}$$

$$K_t = M_t k_t \tag{5}$$

Equation (2) is the goods' market clearing equation. Equation (3) is the labor market clearing condition. Equation (4) says that total politicians available must equal politicians demanded. Equation (5) is the capital market clearing condition.

2.2 Equilibrium

A perfectly competitive equilibrium for this economy features:

- Consumers maximizing their utility subject to their budget constraint. Their income stems from firm profits, wages, and the proceeds from extortions.
- Incumbent firms maximizing profits taking prices for their inputs and output given.
- New firms entering the market whenever the entry cost is lower than the expected firm value.
- Intermediaries choosing the extortion amount by maximizing their revenues minus their costs.
- All markets clearing.

Let the price of the consumption good in each period be equal to 1 as numeraire. Normally, the state variables in this problem are the shock z_t, the capital stock K_t, and the mass of firms M_t. The assumption that consumers sell their stock of capital to firms rather than rent it implies that we need to keep track of their investment in the last period, which effectively adds last period's capital stock as a state variable. Denote the aggregate state variables by $Z = \{z, \underline{K}, K, M\}$, where $\underline{K}$ denotes last period's capital stock.

The problem of the consumer is

$$
\begin{aligned}
V_c(\underline{K}, K, Z) \quad = \quad & \max_{C,K'} \ln(C) + \beta E V_c(K, K', Z') \\
s.t. \quad & \\
& C + K' - (1-\delta_k)K = w(Z) + K - (1-\delta_k)\underline{K} + \Pi(Z) + v(Z)\Gamma \\
& C \geq 0, K' \geq 0
\end{aligned}
$$

where w is the wage rate, Π are proceeds from the firms and v is the rate of payment to each venal politician. All these variables are functions of the aggregate state variables. Notice that the price at which individuals sell capital to firms is 1, the same as the price of the consumption good, since output can be turned into capital or consumption at a 1 to 1 rate.

Incumbent firms appropriate the present value of the firm net of bribes. Let $\tilde{V}_f(s, z, \underline{k}, Z)$ represent such value. Define

$$
\tilde{V}_f(s, z, \underline{k}, Z) = (1-s)V_f(z, \underline{k}, Z)
$$

where

$$
\begin{aligned}
V_f(z, \underline{k}, Z) \quad = \quad & \max_{k,h} \; e^z (k^\alpha h^{1-\alpha})^\gamma - w(Z)h - k + (1-\delta_k)\underline{k} + \\
& Eq(Z') \left[(1-\delta_f)(1-s(Z'))V_f(z', k, Z') + \delta_f k\right] \qquad (6)
\end{aligned}
$$

The incumbent firm hires h workers and purchases $k - (1 - \delta_k)\underline{k}$ units of capital to maximize output minus labor and capital costs plus the continuation value. This is the value of the firm net of bribes $(1 - s(Z'))V_f(z', k, Z')$ if it survives (with probability $1 - \delta_f$). If it dies, the firm sells the remaining capital. The market discount rate is $q(Z)$.

A new firm enters whenever the cost of starting a new firm is lower than the expected value of the firm. Free entry implies:

$$w(Z)\kappa \geq Eq(Z')(1 - \delta_f)(1 - s(Z'))V_f(z', 0, Z') \tag{7}$$

with equality whenever $N_t > 0$. Equations (6) and (7) can be combined to deliver a firm value function that can be written independently of its future value, as Proposition 1 shows.

Proposition 1. *With strictly positive entry, the value function is*

$$\begin{aligned} V_f(z, \underline{k}, Z) &= \max_{k,h} \; e^z(k^\alpha h^{1-\alpha})^\gamma - w(Z)h - k + (1 - \delta_k)\underline{k} + \\ &\quad w(Z)\kappa + Eq(Z')(1 - \delta_f)(1 - s(Z'))(1 - \delta_k)k + Eq(Z')\delta_f k \end{aligned}$$

Proof. See Appendix 1.

Corollary 1. *The relationship between the value function of an incumbent and an entrant is*

$$V_f(z, \underline{k}, Z) = V_f(z', 0, Z') + (1 - \delta_k)\underline{k}$$

Proof. See Appendix 1.

Intermediaries choose the bribe s. They do so by maximizing the extortion revenue minus the cost. Their problem is static. There are M firms per location, so the problem is:

$$\max_{\{h_e, P\} \geq 0} \; s(h_e, P)MV_f(z, \underline{k}, Z) - w(Z)h_e - v(Z)P$$

where $v(Z)$ is the rate per venal politician. Notice that by interpreting $s(h_e, P)$ as the product of the bribe amount times the proportion of firms visited, this problem would capture an alternative setting where only a fraction of firms are visited, determined endogenously, and the size of the bribe is fixed. Thus, this model can also represent a case where more resources are needed to visit more firms, rather than increasing the size of the bribe. This interpretation of s is also consistent with equation (6). The first order conditions are

$$\begin{aligned} w(Z) &= s_{h_e}(h_e, P)MV_f(z, \underline{k}, Z) \\ v(Z) &= s_P(h_e, P)MV_f(z, \underline{k}, Z) \end{aligned}$$

Proposition 2 shows that the analysis abstracts from income effects, by proving the intermediary makes zero profits, thus rebating all its proceeds to the consumer.

Proposition 2. *The representative intermediary makes zero profits.*

Proof. See Appendix 1.

3 Calibration

To assign parameter values, I target the U.S. as a benchmark economy. The parameters α and γ are set to match a labor share of 63% and a profit of 10% value added. About 9% of firms die every period. Capital depreciates at an annual rate of 8%. The discount factor β supports a steady state risk free interest rate of 4%. The parameter κ determines the mass of firms in steady state. Without a good reference for determining it, I set it equal to 1. Changing this parameter has no effects on the qualitative results.

The parameters that affect the TFP process, ρ and σ, are set to match the autocorrelation of GDP's cyclical activity in the United States. I use data on GDP per capita in the United States from 1960 to 2015 from the World Development Indicators (WDI).[5] I take the log of GDP per capita, and filter it using a Hodrick-Prescott filter with smoothing parameter 400. I then perform the following estimation on the deviations from the trend:

$$y_{t+1} = \rho_0 + \rho_1 y_t + \varepsilon_t, \ \ \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$

The results of this regression are listed on Table 1. I set the parameters ρ and σ so that the model delivers these statistics.

Table 1 - Autocorrelation process

Coefficient	Value
ρ_0	0.0001
	(0.9701)
ρ_1	0.6660
	(0.0000)
σ_ε	0.0166

Note: P-values shown in parenthesis

It is hard to find suitable targets for the parameters governing the extortion cost function. I set $\mu = 1/2$. This determines the curvature of the extortion production function. While this is arbitrary, choosing a different parameter does not affect the results qualitatively. Results under different choice of μ are available on request. I set Γ, the measure of venal politicians, so that the extortion rate in US is small, equal to 0.1%. Table 2 lists all parameter values.

[5] I choose these data because it is what I use later on in the paper.

Table 2 - Parameter values

Parameter	Value
α	0.3000
γ	0.9000
κ	1.0000
δ_f	0.0900
δ_k	0.0800
ρ	0.7367
σ	0.0087
β	0.9600
Γ	0.0220
μ	0.5000

4 Numerical Analysis

This section evaluates how different degrees of property rights enforcement affect macroeconomic outcomes. These are determined by Γ, so I describe how the endogenous variables react to an increase in TFP under different choices of Γ.

To do this, I proceed in three steps. The first computes different steady states, all under different choices of Γ. The second uses the benchmark value of Γ to compute key impulse response functions. The third step compares these impulse response functions under different values of Γ.

I compute the dynamics of the system using Matlab and Dynare.

4.1 Steady State

I first find the steady state, then introduce shocks to z_t, and compute the reaction of different endogenous variables. Table 3 shows the values of the different variables in steady state. These values correspond to different values of the parameter Γ. The first column uses $\Gamma = 0.022$, the calibrated value, to match a 0.1% extortion rate. The second column triples Γ, and the third column multiplies Γ by 6. The associated extortion rates in steady state are 0.85% and 2.9%.

As property rights worsen, steady state GDP per capita drops. This the first prediction of the model. The reason is a reduction in capital, labor in production and the mass of firms. Capital drops because investment drops, as should be expected given the higher extortion rates. The second prediction is therefore that the ratio of investment to GDP is lower under weaker property rights. Investment drops because bribes reduce their returns, in a way similar to what corporate taxes would. Labor drops because, with more extortions, more labor goes into this sector. The mass of firms drops because the increase in extortions reduces the gains from creating a new firm

Table 3 - Steady State Values under Different* Γ*'s

Variable	$\Gamma = 0.0220$	$\Gamma = 0.0660$	$\Gamma = 0.1320$
z	0.0000	0.0000	0.0000
Y	1.2500	1.2034	1.0969
C	1.0206	0.9943	0.9308
I	0.2294	0.2090	0.1661
K	2.8991	2.8267	2.6613
Mh	0.9089	0.9001	0.8807
s	0.0010	0.0085	0.0292
$d(s)$	0.0021	0.0167	0.0490

4.2 Temporary Shocks to Productivity

Before describing the effects of changing Γ, it is worth describing the RBC features of the equilibrium. Figure 1 shows the impulse response functions of several variables, setting a value for $\Gamma = 0.022$. These figures show how different variables depart from their steady state levels in percentages, except for bribes. This being a percentage itself, I show how its level changes relative to the steady state.

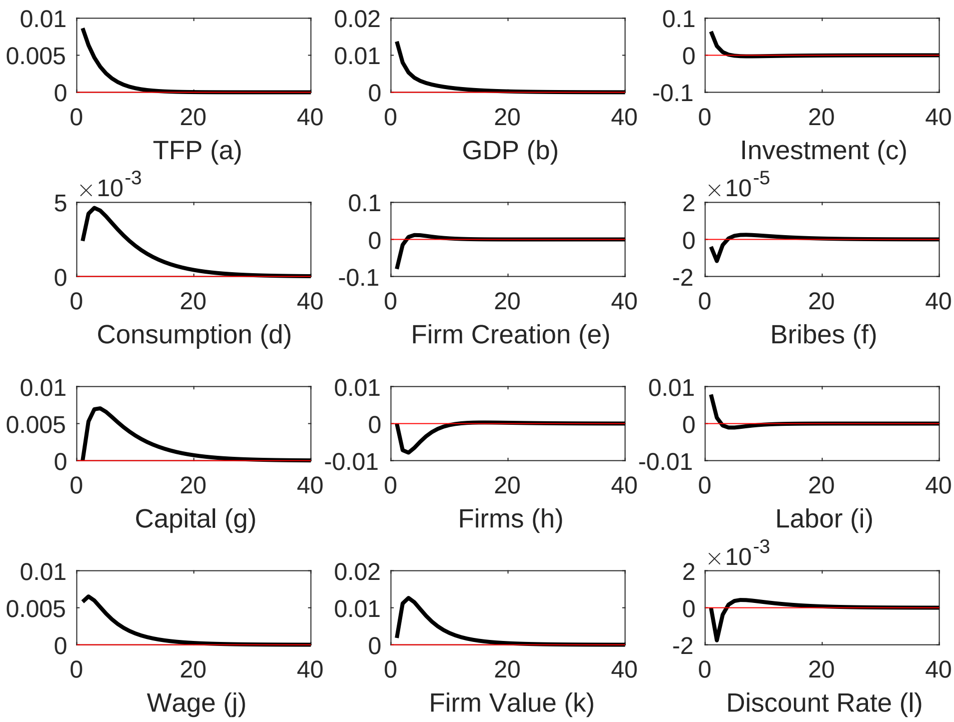
To compute impulse response functions, I simulate an increase in productivity of one standard deviation and let the productivity go slowly back to steady state following its autoregressive nature. Figure 1 shows the impulse response functions for different variables. Panel (a) shows the simulated path for TFP. Panel (b) shows the effects on GDP. GDP increases on impact, and then slowly converges to its steady state value. The increase exceeds that of TFP because the mass of workers into production increases (panel i). The additional workers are drawn from firm creation (panel e) and the extortion sector (panel f). These sectors demand less workers because the wage increases (panel j), and their return does not increase as much as GDP's.

Investment increases, since the high productivity makes the cost of investment low and the autoregressive nature of the shock increases the incentives to invest. Consumption also increases, but less than GDP and investment, consistent with standard RBC models and following consumption smoothing arguments. Consumption keeps increasing after the initial shock. This is because the additional capital allows for greater consumption and the incentives to invest are lower.

Capital increases steadily for several periods. The increase in capital explains why wages increase even after the initial shock: the increased capital stock increases the marginal productivity of workers.

The value of firms increases on impact, and keeps on increasing thereafter, as the stock of capital they own increases. Note that this does not imply additional firm creation (even if the value of firms with zero capital also increase, not shown). This is because of higher wages and extortions that start increasing soon after the initial shock. As wages start falling back down, and the value of incumbent firms increases, the incentives to extort increase. The drop in wages drives more labor into firm creation, so firms start accumulating to return to steady state levels.

Figure 1 - Impulse Response Functions



4.3 Property Rights and Impulse-Responses

This section shows the differences in reactions under different levels of property rights enforcement. I show the results for the benchmark $\Gamma = 0.022$ and then multiply Γ by 3 and then by 6. Figure 2 shows the effect of an increase in TFP of 1 standard deviation on GDP under different levels of property rights enforcement. Notice that there is not much effect on the reaction of GDP. In all cases, the response is very similar.

Figure 3 shows the behavior of investment. Initially, investment increases more when property rights are weak, but then falls very fast and soon is below responses with stronger property rights. This reaction suggests that weak property rights reduce the correlation between output and investment

Figure 2 - GDP

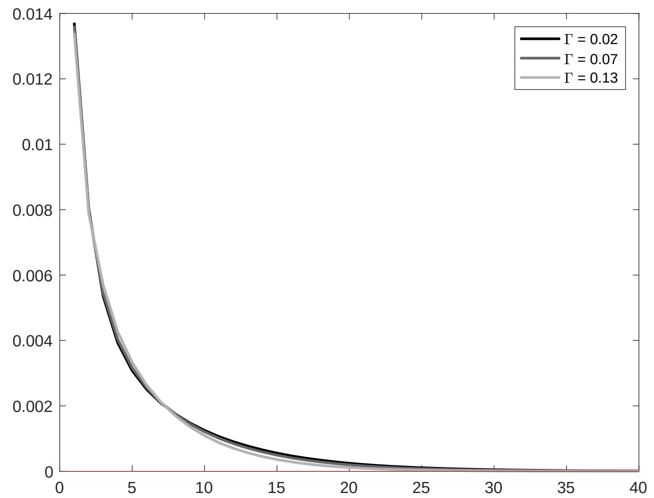
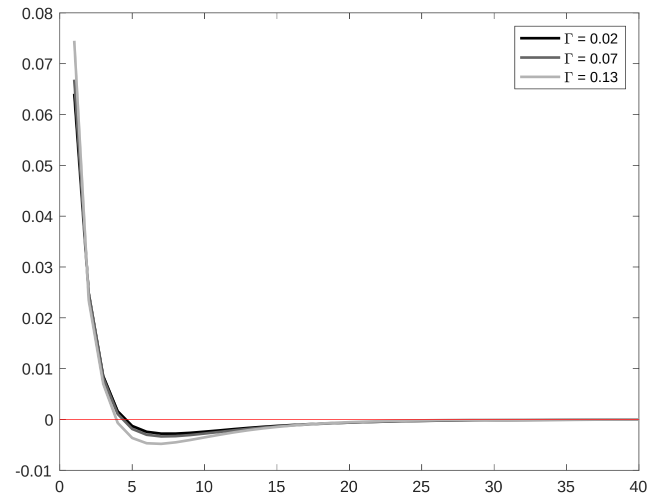


Figure 3 - Investment



and increases the volatility of investment relative to GDP, conjectures that I confirm in Section 5.

The initial increase is counterintuitive: why would investment increase more when property rights are weak? To understand this, one needs to consider what makes output increase, and what output is used for. The increase, aside from TFP, comes from the absorption of employment from extortions and firm creation. Figures 4 and 5 show the initial drop of employment in these sectors, that drop their demand for workers following the increase in wages shown in Figure 6. The drop is roughly the same for different property rights. This explains why GDP increases roughly the same for all levels of property rights. The additional output is turned into consumption and investment. Thus, the change in output must equal the change in investment plus the change in consumption, that is, $\Delta Y = \Delta I + \Delta C$. Dividing this equation by the steady state level of GDP delivers this equation in percentage terms:

$$\frac{\Delta Y}{Y} = \frac{\Delta I}{I}\frac{I}{Y} + \frac{\Delta C}{C}\frac{C}{Y}$$

where I and C are steady state levels. Consumption reacts very mildly, following the desire to smooth consumption. Figure 7 shows this. For intuition purposes, assume $\Delta C \approx 0$. Thus:

$$\frac{\Delta Y}{Y} \approx \frac{\Delta I}{I}\frac{I}{Y} \tag{8}$$

Figure 4 - Firm Creation

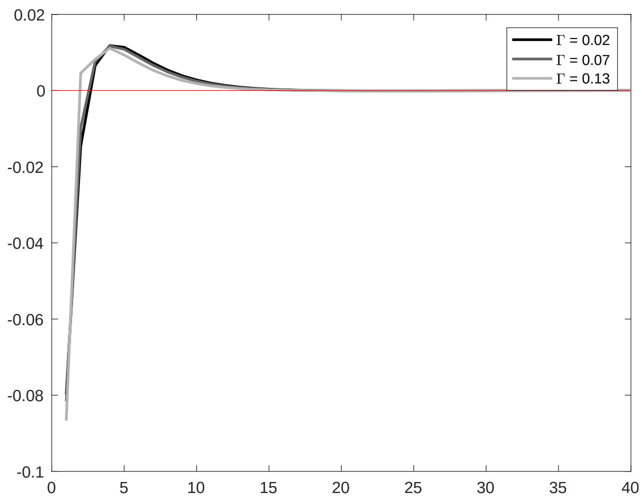


Figure 2 shows that the left hand side of equation (8) is roughly independent of property rights. This implies that $\Delta I/I$ is larger when I/Y is smaller. In other words, the increase in investment is greater when property rights are weaker.

Intuitively, the behavior of investment closely follows extortions. Figure 8 shows that on impact these drop the most under weak property rights. Notice that in percentage terms the drop is independent of property rights, as Figure 5 shows, which implies that bribes drops the most when they are largest.

Figure 5 - Extortion Workers

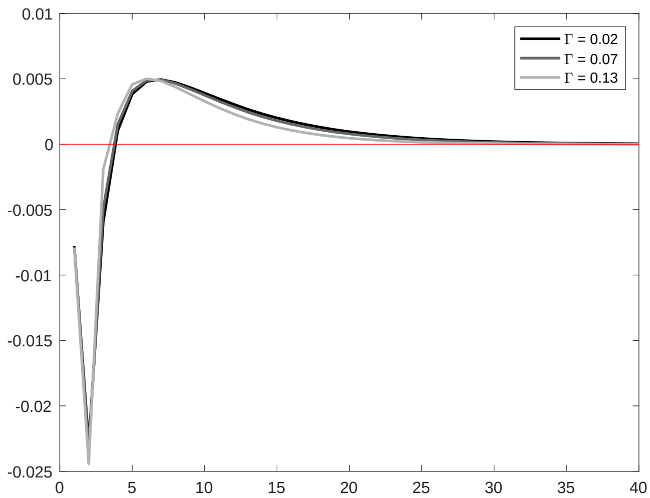
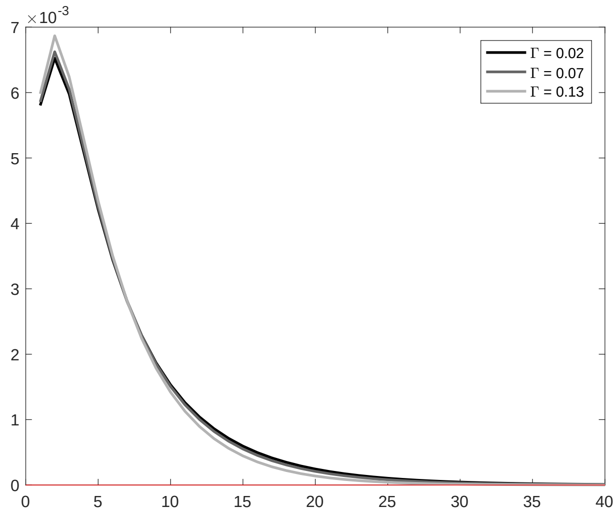


Figure 6 - Wages



Soon after the initial drop, investment falls fastest with weak property rights. As wages converge back to the steady state, the cost of increasing extortions drop. On the other hand, incentives increase, because firms now have more capital, as shown in Figure 9. The increase is the largest under weak property rights, because of the initial reaction of investment. Thus, extortions rise the fastest in this case, as in Figure 8.

Figure 7 - Consumption

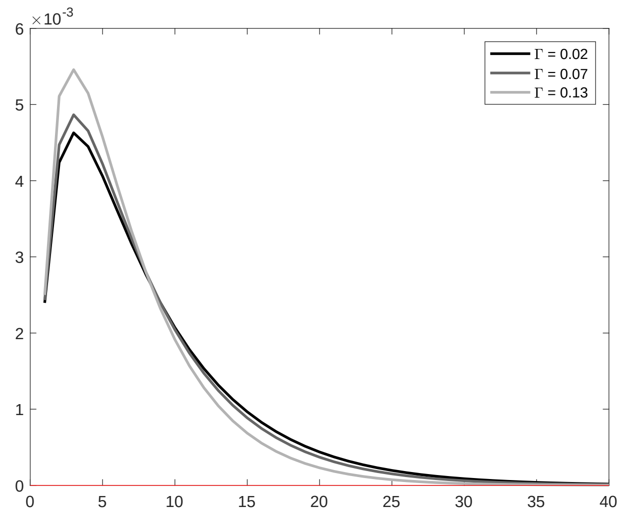
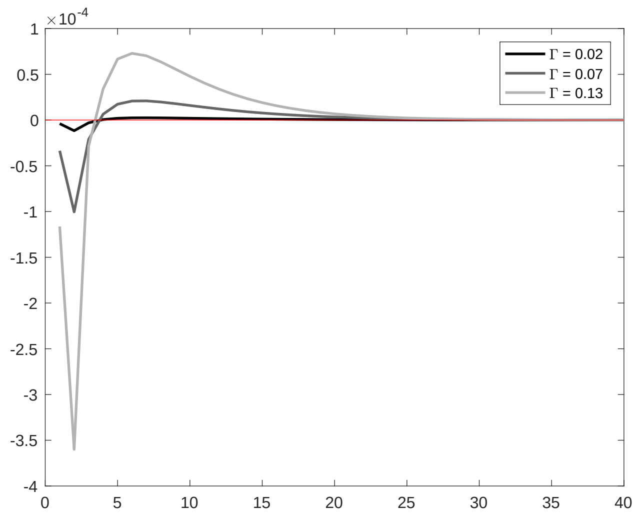


Figure 8 - Extortions (level change)

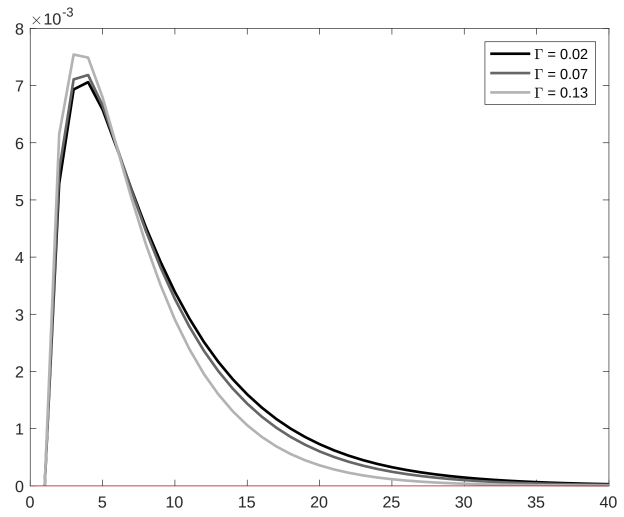


4.4 The Cyclicality of Extortions

Comparing the reaction of extortions with GDP shows that an increase in productivity increases GDP and reduces extortions. As GDP drops back to its steady state, extortions increase. This suggests that the behavior of extortions in equilibrium is countercyclical.

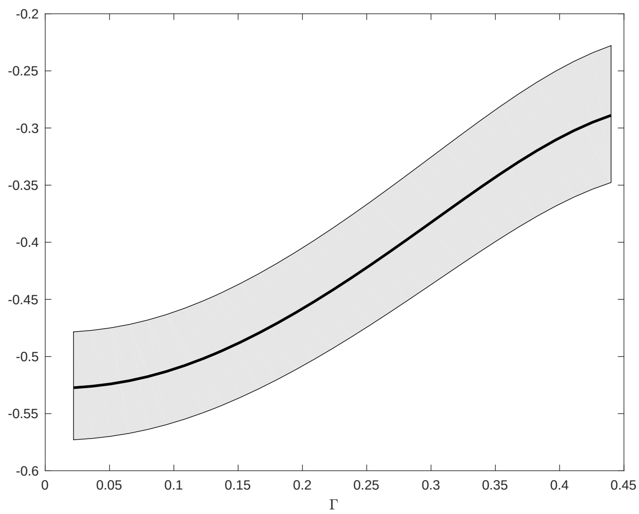
Figure 10 shows the correlation between extortions and the log of GDP,

Figure 9 - Capital



along with a 5% confidence interval. This correlation is negative, indicating a countercyclical behavior. As property rights worsen, the (counter) cyclicality drops, and extortions become more acyclical.

Figure 10 - Countercyclical Extortions



5 Model Implications and the Data

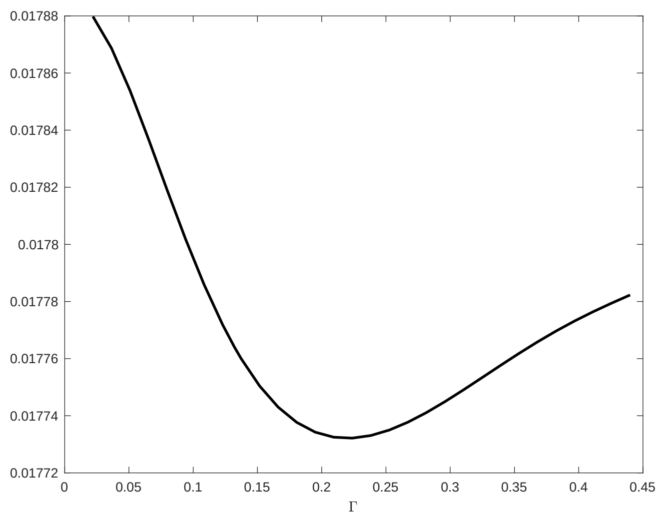
This section first identifies implications in the model concerning the effects of property rights. It then investigates whether these hold in the data.

5.1 Model Implications

In steady state, stronger property rights increase GDP per capita and the ratio of investment to GDP. Table 3 shows this. The reason is similar to the effect of an increase in corporate taxes: high extortion levels act as an increase in corporate taxes in steady state, that reduce the incentives to start new firms, lowering the steady state GDP per capita. These effects are in line with the findings of Besley (1995) and Goldstein and Udry (2008) for Ghana.

Figure 11 shows that there is a very small effect of property rights on aggregate volatility. Focusing on the scale of the vertical axis, it is clear that the effects are close to zero.

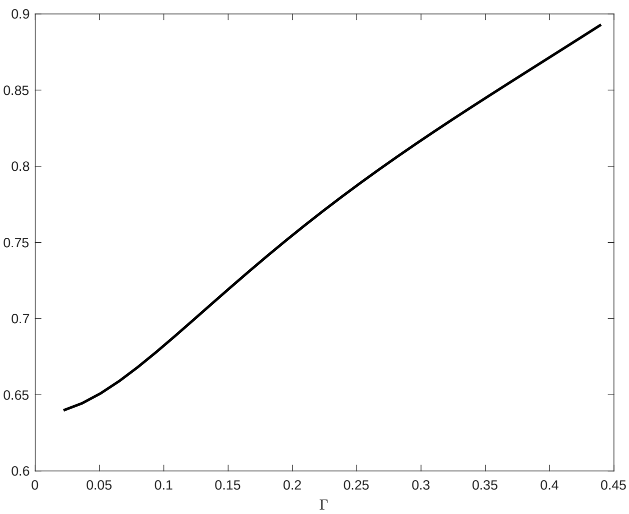
Figure 11 - GDP Volatility



Figures 2, 3 and 7 suggest that weak property rights have a stronger effect on consumption and investment than on GDP. Consequently, we can expect effects on the relative volatility of consumption and investment, and on their correlations with output.

In fact, the effects on the volatility of consumption are much larger. Figure 12 shows the volatility of consumption relative to GDP. As property rights improve, this volatility decreases. The reason is that strong property rights allow more consumption smoothing, since the initial increase in productivity can be used more efficiently to accumulate capital and spread consumption in time.

Figure 12 - Relative Volatility of Consumption



The argument above assigns an important role to investment: more investment under strong property rights allows for more consumption smoothing. Figure 3 shows that upon an increase of TFP, investment increases more when property rights are weak. But it falls sharply as TFP converges back to the steady state, preventing the smoothing of consumption. In consequence, the relative volatility of investment also increases under weaker property rights, as Figure 13 shows.

The contemporaneous correlations between consumption and GDP and investment and GDP are also strongly affected by property rights. Figures 14 and 15 show this. Consumption becomes more correlated to GDP as property rights become weaker. Investment becomes less correlated. It is worth noting that the effect on investment is stronger: the same deterioration of property rights drops the correlation by almost 30 percentage points in the case of investment, and increases it by 6 points for consumption. Also, these correlations are more precisely estimated in the case of investment, as evidenced by the confidence intervals.

Intuitively, the reason why consumption and GDP are more correlated when property rights are weak is that property rights have effects similar to financial constraints, preventing consumption smoothing, accounting for the increase in the correlation. This also implies a lower correlation between investment and GDP. Without any financial constraint, an increase in GDP is likely to generate large increases in investment, because of consumption smoothing arguments. When consumption cannot be smoothed, invest-

Figure 13 - Relative Volatility of Investment

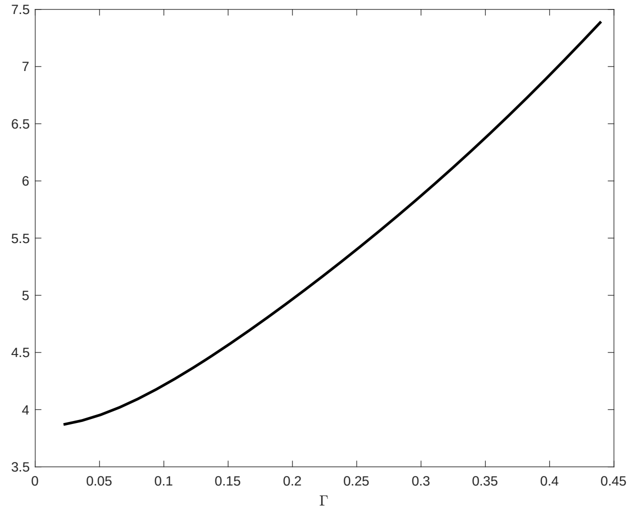
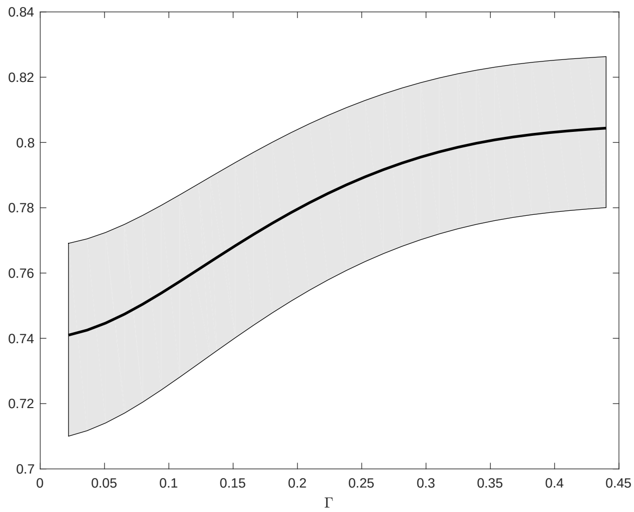
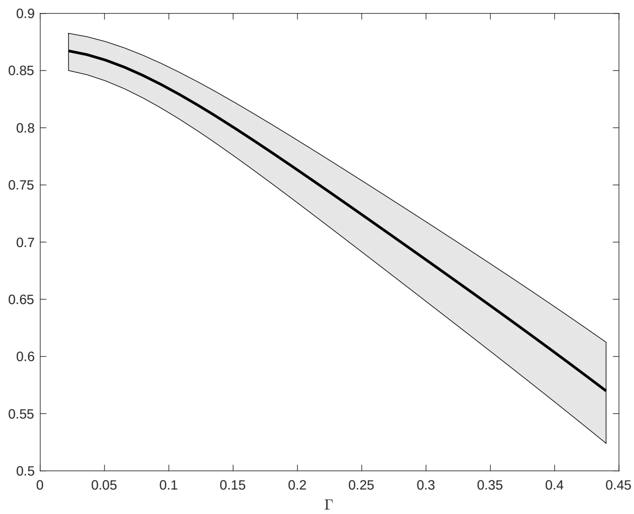


Figure 14 - Correlation Between Consumption and GDP



ment reacts less. This implies that bribes have a similar effect than financial constraints. Thus, the model generates similar implications to Garcia-Cicco et al. (2010), who explicitly model financial constraints.

Figure 15 - Correlation Between Investment and GDP



5.2 Data Validation

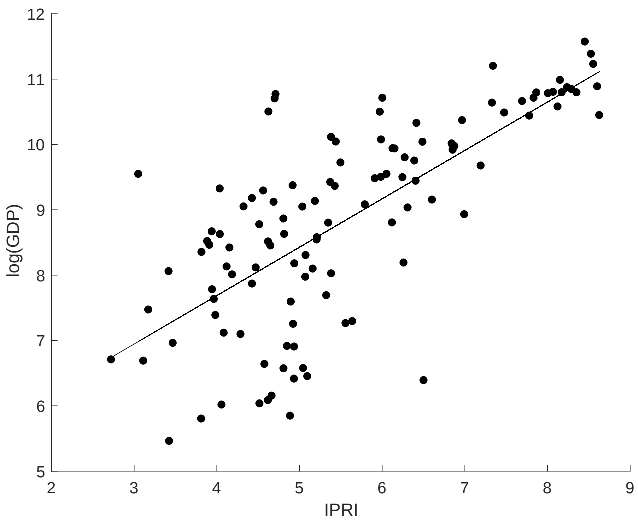
Next, I explore whether the implications of the model hold in the data. Namely, the model concludes that weak property rights reduce GDP per capita and the investment to output ratio in steady state. Along the business cycle, they increase the volatility of consumption and investment relative to GDP, increase the correlation between consumption and GDP, and reduce the correlation between investment and GDP.

To measure property rights, I use an index published by the Property Rights Alliance, the International Property Rights Index (IPRI). The IPRI index is a combination of other indices that measure: judicial independence, rule of law, political stability, control of corruption, property rights, ease of registering property, ease of access to loans, intellectual property rights protection, patent protection, and copyright piracy level. It covers 127 countries, and has been published annually since 2007. I use the latest index, 2017, but the analysis does not change much choosing a different year. The overall grading scale of the IPRI ranges from 0 to 10, where 10 indicates the strongest enforcement, and 0 the weakest.

Data on GDP, consumption and investment comes from the World Development Indicators (WDI) and is at the annual level. The reason for this choice is that the WDI is the most comprehensive dataset for countries with poor IPRI scores. Data selection is described in Appendix 2.

Levy-Carciente (2017) shows that the correlation between the IPRI and GDP per capita is close to 80%, in line with the model's first prediction. Using the data from the WDI, this correlation is 77%. Figure 16 shows a scatter plot along with a fit between the IPRI and GDP per capita (using year 2012, which maximizes the number of countries included).

Figure 16 - The IPRI and GDP per capita



A problem with the IPRI is that, it being an index of a series of indices, it is hard to rely on it for statistical analysis. This being said, in most cases, the correlation between the IPRI and the different statistics is of the sign predicted by the model, but rarely significant (available on request).

Rather than rely on statistical analysis, I divide the sample of countries into those with larger-than-median IPRI and those with smaller-than-median IPRI. For each moment, I compute the average across countries within the group. Table 4 compares the different relevant moments between these groups. GDP per capita corresponds to the year 2012 to maximize the number of countries in the sample. The investment to GDP ratio is an average from 1997 to 2012. The other statistics vary per country, and include all consecutive observations available.[6]

The results are all consistent with the model, except for the correlation between consumption and GDP. Weaker property rights are associated with lower GDP per capita, a lower ratio of investment to GDP, higher relative volatility of consumption and investment, and lower correlation between investment and GDP, in line with the model implications. Regarding the correlation between consumption and GDP, the model predicts an increase as property rights weaken, whereas the data shows a small decrease.

[6] A difference between my empirical results and Aguiar and Gopinath (2007)'s is that they find the correlation between investment and GDP is higher in developing countries. When using the countries in their dataset, which exclude very poor countries, I find almost no difference in these correlations, suggesting that countries with very weak property rights are needed to deliver the results I find.

Table 4 - Property rights and different statistics

Statistic	Low IPRI countries	High IPRI countries
IPRI	4.3903	6.7921
log GDP per capita (2012)	7.8918	9.8399
Investment/GDP (1997-2012)	0.2143	0.2317
std(C)/std(GDP)	0.9042	0.8915
std(I)/std(GDP)	3.1412	2.9720
Correlation C-GDP	0.6480	0.6653
Correlation I-GDP	0.5793	0.6857
Sample size	58	57

An alternative approach that allows for statistical analysis is to use GDP per capita as a proxy for the quality of property rights, based on the results in Table 3, Figure 16 and the strong empirical correlation between these series. I use GDP per capita in two different ways. The first simply regresses the relevant moments on GDP per capita:

$$y_j = \nu_0 + \nu_1 x_j + \epsilon_j \tag{9}$$

where y_j is the relevant moment and x_j is the logarithm of GDP per capita in country j. I include an error term that is normally distributed with zero mean and a constant.

The second way performs a two step least squares regression, using GDP per capita as an instrument for IPRI. This has the advantage of correcting any bias due to omitted variables. The disadvantage is that it is limited to the countries that report IPRI. I add a third case, where I perform the regression in (9) using only countries that report IPRI.

In all regressions, GDP per capita corresponds to the year 2012. The investment to GDP ratio averages the years 1997 through 2012. All other statistics vary per country, and include the longest consecutive series available in each case.

Just as in the case with the IPRI, the relevant moments are the ratio of investment to GDP, the relative volatilities of consumption and investment, and the correlations between consumption and GDP and investment and GDP. Table 5 shows the result of these regressions, along with the associated $p-$values. It omits the estimate for ν_0.

6 Institutions and Policy Implications

Empirical studies find that the effect of growth policies typically depend on the institutional framework. These tend to lack a theoretical background. This section attempts to use the theory developed in this paper to account

Table 5 - Regressions using GDP per capita as proxy for property rights

Moment	WDI countries (OLS)		IPRI countries (OLS)		IPRI countries (2SLS)	
	ν_1	p	ν_1	p	ν_1	p
Investment/GDP	0.0487	0.0036	0.0494	0.0021	0.0670	0.0024
std(C)/std(GDP)	-0.0890	0.0004	-0.0599	0.0051	-0.0849	0.0056
std(I)/std(GDP)	-0.1925	0.0163	-0.2317	0.0076	-0.3284	0.0094
Correlation C-GDP	0.0346	0.0248	0.0125	0.4500	0.0177	0.4466
Correlation I-GDP	0.0857	0.0000	0.0679	0.0000	0.0962	0.0000
Sample Size	152		115		115	

for their results.

I divide these findings into three groups. The first rests on a long list of papers started by Burnside and Dollar (2000) showing the effect of international aid on the growth rate of recipient countries. The second relates to Collier and Goderis (2012) who study the effects of a change in the price of an exported commodity on the growth rate. While the change in the price of a commodity is not itself policy, understanding these effects can guide policy, such as export subsidies or innovation incentives, since Rubini (2014) shows strong links between exports and innovation. The third is Isham et al. (1997), who study the returns of government investment.

6.1 The Effect of Foreign Aid on Growth

Burnside and Dollar (2000) find a very provocative result that suggests that aid contributes to growth only in countries that share some ?healthy? characteristics, such as low inflation, openness and small fiscal deficits. These characteristics are recurrent among countries with strong property rights. Other papers arrive at similar conclusions. Dalgaard et al. (2004) find a positive relationship among countries far from the tropics. Typically, countries closer to the tropics have weaker institutions. Galiani et al. (2017) find a local positive effect of aid on growth using a regression discontinuity design for countries located around an income threshold defined by the International Development Association. When incomes are lower than this threshold, the effects fade away. Again, income in countries with weak institutions is lower than in those with stronger ones.

There has been much debate about these findings. In particular, a great number of publications have shown the lack of robustness of those findings. A good example is Easterly et al. (2004), who show that adding new data nullifies Burnside and Dollar (2000)?s results. On the opposite end, Bauer (1954) argues that free money allows aid recipients to consume without producing, building a dependence on richer countries, and Rajan and Subramanian (2011) find that more aid is associated with lower development of the manufacturing sector. Soderbom and Teal (2002), find that more aid is associated with smaller exporting sectors.

Easterly (2003) reviews the literature that emerged as a reaction to Burnside and Dollar (2000), including Hansen and Tarp (2001), Dalgaard and Hansen (2001), Guillaumont and Chauvet (2001), Collier and Dehn (2001), Lensink and White (2001) and Collier and Dollar (2002), with some papers in favor of the original findings and others against. A problem according to Easterly is that without a theoretical model, it is hard to identify the relevant variables to include in a regression. This paper proposes a theory of high frequency macroeconomic effects under varying degrees of property rights enforcement.

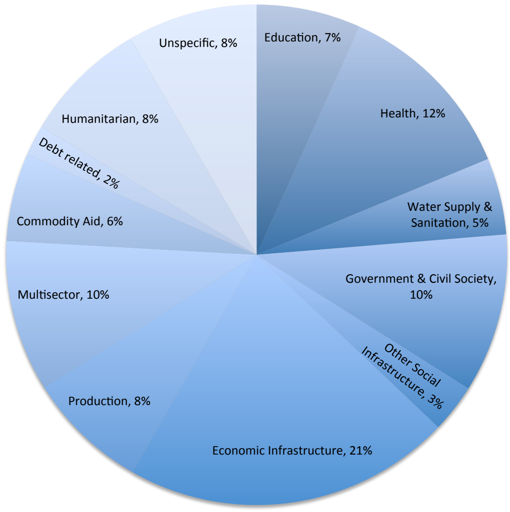
The conclusions of these models come from regressing the growth rate on the ratio of aid to GDP. I argue that an increase in aid can be thought of as an increase in TFP. A big part of what recipients receive is, at least in theory, able to increase productivity. Radelet (2006) argues that aid can directly affect productivity through education, transport and investment in general. Hansen and Tarp (2000) show that aid is often complemented by private investment, increasing capital and therefore productivity.

Figure 17 shows the allocation of aid into different sectors. The data corresponds to total aid granted in 2013, and comes from the Organization for Economic Cooperation and Development (OECD). Most aid is concentrated in economic infrastructure, which mostly contains transport related aid (46%), such as road building, and energy (34%). These are clear items that constitute positive externalities for firms, providing better ways to transport their goods, employees, and better access to electricity. As such, they (should) increase productivity. The second largest aid source is in health. This provides for healthier workers, that consequently have less sick days and become more productive. A large share of aid goes directly to production, which acts as a positive shock to productivity. Education also receives a large chunk. With more spending in education, children attend schools more frequently, making it easier for both parents to work, increasing labor supply and GDP per capita. Water supply and sanitation also improves productivity, by improving the health of employees, mainly attacking problems such as diarrhea, a big concern among aid recipients.

Thus many categories of aid granted can be thought of as increasing TFP. More importantly, the question of whether aid increases growth makes more sense when aid is related to productivity. Consequently, the model interprets changes in aid as changes in total factor productivity.

Burnside and Dollar (2000) obtain their results by regressing the growth rate of GDP between periods t and $t+1$ against the ratio of aid to GDP in period t, interacting this ratio by different measures that represent healthy economies. To replicate this, I regress the growth rate of GDP on the ratio of

Figure 17 - Total Aid Split into Sectors



TFP to GDP. More specifically, I perform the following regression:

$$\Delta y_t = \nu_{0,BD} + \nu_{1,BD} \frac{e^{z_t}}{Y_t} + \epsilon_{t,BD}$$

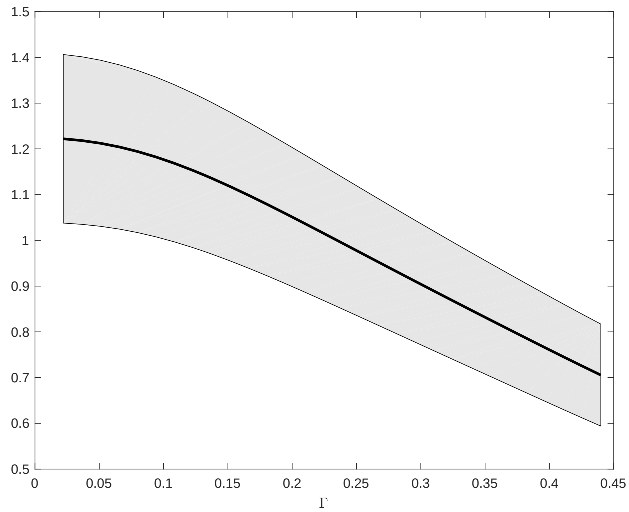
where $y_t = \ln(Y_t)$, Y_t is GDP in year t, and $\Delta y_t = y_{t+1} - y_t$. I perform this regression on data simulated by the model under different choices of Γ, and study how the coefficient $\nu_{1,BD}$ depends on this measure (where BD stands for Burnside and Dollar). Figure 18 shows the estimates of $\nu_{1,BD}$ under different values of Γ. The larger the Γ, the smaller the effect of the ratio of TFP to GDP on growth. In words, an increase in TFP is likely to generate more growth in countries with strong property rights. Associating aid with TFP, and acknowledging that low property rights countries are prone to high inflation, high fiscal deficits, and are relatively less open, this paper provides a theoretical background to the results in Burnside and Dollar (2000).

6.2 The Effect of the Price of Exports on Growth

A natural experiment representing an increase in TFP is an increase in the price of an exported commodity. This brings about a temporary increase in profits, very similar to the increase in TFP in the model. Collier and Goderis (2012) study the impact of such shocks to commodity prices.

They find that price shocks have larger effects on GDP in countries with high governance. It is worth mentioning that Collier and Goderis (2012) find this relationship to hold in the non-agriculture sector, but not in the agriculture sector. They argue that the distinction between these sectors concerns

Figure 18 - Accounting for Burnside and Dollar (2000)



mainly rents. In the agricultural sector, an increase in prices leads to an increase in supply spread over many potential producers, so the increase in rents is small, if any. The non-agricultural sector includes industries such as oil and natural gas, where new firms cannot start producing, competing with incumbents. As a result, these price increases tend to generate rents.

It is in the non-agricultural, rent-prone sectors that governance matters for the effects of price shocks. This sector is better represented in the model than the agricultural sector: rents are key to my mechanism, since otherwise firms would not be able to pay bribes. The measure of governance in the International Country Risk Guide published by the Political Risk Services group. This includes political, financial, and economic risk ratings, and is a good proxy for institutional quality.

To measure the increase in prices, the authors construct a commodity export price index, which measures a geometric weighted average of the price of different exported commodities relative to the export unit price published by the International Financial Statistics. The weights are given by the trade balance in each commodity. Thus, they study the effect of an increase in the price of exported commodities beyond that of this price index.

An increase in the price of an exported commodity can be thought of as an increase in TFP: more GDP can be obtained using the same inputs. In this sense, it would be interesting to ask to what extent an increase in TFP leads to an increase in growth rates. As in Collier and Goderis (2012), I need to normalize TFP. Recall that their measure of commodity price is relative to a price index. Thus, it is the increase in the price relative to other prices that matter.

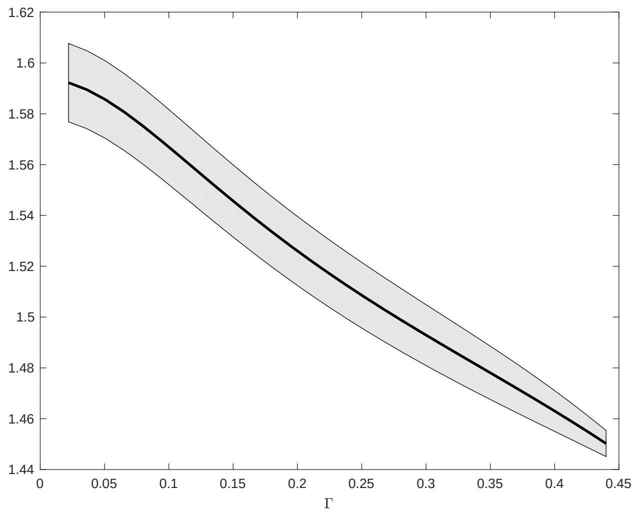
This presents a challenge regarding my current framework, since there is only one output good. To work around this, I proxy the effects of an increase in the price of an exported commodity as the *increase* in TFP in period t, that is, TFP in period $t+1$ relative to TFP in period t.

In sum, to replicate their results, I perform the following regression on simulated data:

$$\Delta y_t = \nu_{0,CG} + \nu_{1,CG} \Delta z_t + \epsilon_{t,CG} \tag{10}$$

where y_t is the logarithm of GDP in year t and $\Delta y_t = y_{t+1} - y_t$. Similarly, $\Delta z_t = z_{t+1} - z_t$. I perform this regression under different choices of Γ, and study how the coefficient $\nu_{1,CG}$ depends on this measure (CG stands for Collier and Goderis). Figure 19 shows the estimate for ν_1 along with a 5% confidence interval. It supports the findings of Collier and Goderis (2012): when property rights are stronger, an increase in TFP produces a larger increase in GDP.

Figure 19 - Accounting for Accounting for Collier and Goderis (2012) and Isham et al. (1997)



6.3 The Returns to Government Investment

My results can also account for the differing degrees of success of government investments. Isham et al. (1997) find that the returns on these investments are between 8 and 22 percent larger when the recipient of these investments have strong civil liberties.

The type of investments studied are those financed by the World Bank. These typically include investments in transportation, infrastructure, industry, water, urban development, agriculture, energy and tourism, likely to increase productivity.

Civil liberties are measured by Freedom House, and include measures such as freedom from unjustified political terror, free businesses and cooperatives, the right to own property, freedom from government corruption, and the upholding of the rule of law. The larger the civil liberty ranking, the stronger the property rights enforcement.

The World Bank staff, together with staff from the recipient country, get together to assess the returns associated with the investment. Isham et al. (1997) use this return and regress it against the civil liberty index, to find that improving from the lowest ranking of civil liberty to the highest would increase the returns of government investment somewhere between 8 and 22 percent.

By interpreting the increase in government investment as the increase in TFP, equation 10 shows the desired effects: that changes in government investment are more successful when property rights are strong.

7 Conclusion

The enforcement of property rights is key to determine the reaction of investment and growth to different shocks within a country. If firms are likely to face extortions, positive shocks are less likely to lead to growth. While this thinking has always been understood, this is the first paper to endogenize the reaction of extortions to high frequency shocks as a function of property rights via a theoretical model.

A country with worse property rights is represented by a country with more venal politicians. It is natural to expect that, when property rights are weak, more politicians become venal. Thus, the setting seems to be fitting of the problems faced by developing countries, where too many politicians are open for business.

The framework produces implications that are consistent with the data. Namely, stronger property rights produce higher levels of GDP per capita, larger investment to GDP ratios, weaker correlations between investment and GDP, and higher volatility of consumption and investment relative to GDP. Consequently, this mechanism can account at least partially for some of the different cyclical properties between rich and poor countries. This adds to other existing explanations, such as volatile trends in Aguiar and Gopinath (2007) and financial frictions in Garcia-Cicco et al. (2010).

Additionally, this paper provides a theoretical foundation to several empirical findings in need of it, providing an explanation as to why growth policies tend to be more successful where property rights are well enforced.

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Appendix 1. Mathematical Proofs.

Proof of Proposition 1

I first show that the value function is linear in $\underline{k}$, and then derive its exact functional form. To show linearity, apply the operator defined by equation (6) to a function that is linear in $\underline{k}$. Let $g(z, \underline{k}, Z) = A(z, Z) + B\underline{k}$. Applying the contraction operator that defines the value function:

$$\begin{aligned} Tg(z, \underline{k}, Z) &= \max_{k,h} e^z (k^\alpha h^{1-\alpha})^\gamma - w(Z)h - k + (1-\delta_k)\underline{k} + \\ & \quad Eq(Z') \left[(1-\delta_f)(1-s(Z'))(A(z', Z') + Bk) + \delta_f k\right] \end{aligned}$$

It is straightforward to see that the optimal choices of k and h do not depend on $\underline{k}$. Let these optimal choices be $k(z, Z)$ and $h(z, Z)$. Then

$$\begin{aligned} Tg(z, \underline{k}, Z) &= e^z (k(z, Z)^\alpha h(z, Z)^{1-\alpha})^\gamma - w(Z)h(z, Z) - k(z, Z) + (1-\delta_k)\underline{k} + \\ & \quad Eq(Z') \left[(1-\delta_f)(1-s(Z'))(A(z', Z') + Bk(z, Z)) + \delta_f k\right] = \\ & \quad A(z, Z) + B\underline{k} \end{aligned}$$

where $B = (1 - \delta_k)$. Given this linearity and strictly positive entry, the free entry condition is

$$w(Z)\kappa = Eq(Z')(1-\delta_f)(1-s(Z'))(V(z', k, Z') - (1-\delta_k)k)$$

Rearranging,

$$\begin{aligned} & Eq(Z')(1-\delta_f)(1-s(Z'))V(z', k, Z') = \\ & w(Z)\kappa + Eq(Z')(1-\delta_f)(1-s(Z'))(1-\delta_k)k \end{aligned}$$

Replacing this condition into equation (6) proves the proposition.

Proof of Corollary 1

Follows from the linearity of $V_f(z, \underline{k}, Z)$ and $B = (1 - \delta_k)$.

Proof of Proposition 2

Profits of the intermediary are

$$\Pi_E(Z) = s(h^*, \Gamma)MV_f(z, \underline{k}, Z) - w(Z)h^* - v(Z)\Gamma$$

where $h^* = argmax_{h_e \geq 0} s(h_e, \Gamma)MV_f(z, Z) - w(Z)h_e - v(Z)\Gamma$. Adding the first order conditions, and replacing $s(h^*, P)$ by its functional form,

$$\begin{aligned} \Pi_E(Z) &= h^{*\mu}\Gamma^{1-\mu}MV_f(z, \underline{k}, Z) - (w(Z)h^* + v(Z)\Gamma) = \\ &= h^{*\mu}\Gamma^{1-\mu}MV_f(z, \underline{k}, Z) - \\ & \quad (\mu h^{*\mu-1}\Gamma^{1-\mu}MV_f(z, \underline{k}, Z)h^* + (1-\mu)h^{*\mu}\Gamma^{-\mu}MV_f(z, \underline{k}, Z)\Gamma) = \\ &= 0 \end{aligned} \quad (11)$$

Appendix 2. Data.

I use data on GDP, Investment, and the International Property Rights Index (IPRI). This section details how I obtain that data.

The IPRI comes straight from the Property Rights Alliance. I use the IPRI published in 2017. This index does not change too much year after year, so alternative years would produce similar results. The IPRI is published for 127 countries.

GDP, Investment and Population come from the World Bank database, the World Development Indicators (WDI). They list 217 countries between 1960 and 2016. I eliminate countries with less than 10 years of consecutive data. This eliminates 65 countries. The remaining 152 countries are included in the analysis. Of these, 115 are also present in the IPRI database. Table **??** lists these countries. Countries with a * are also present IPRI data.

My measure of investment to GDP ratio in country j is the average ratio from the year 1997 to 2012. I stop in 2012 because many countries report data only until 2012.

Notice that investment may be negative, which is problematic when taking logs. This is because the series reports net investment. In that case, I ignore such information. This only happens in 1979 for Nicaragua and in 1990 for Namibia. Removing these countries rather than the observations does not change the results.

To compute the RBC statistics, I first take logarithms and then run a Hodrick Prescott filter with smoothing parameter 400. The correlation between GDP and investment is the correlation between the cycles computed this way. I also use the cycles for GDP per capita to calibrate the parameters σ and ρ, as discussed in the main text.

Table A.1 - List of WDI countries included in the analysis

Country Name	Country Name	Country Name	Country Name
Albania*	Algeria*	Antigua & Barbuda	Argentina*
Armenia*	Australia*	Austria*	Azerbaijan*
Bahamas	Bahrein*	Bangladesh*	Barbados
Belarus	Belgium*	Belize	Benin*
Bhutan	Bolivia*	Bosnia*	Botswana*
Brazil*	Brunei *	Bulgaria*	Burkina Faso
Burundi*	Cambodia	Cameroon*	Canada*
Chad	China*	Colombia*	Comoros
Congo, D. R.*	Congo, Rep.	Croatia*	Cuba
Cyprus*	Czech Republic*	Denmark*	Dominican Republic*
Ecuador*	Egypt*	El Salvador*	Equatorial Guinea
Eritrea	Estonia*	Finland*	France*
Gabon*	Gambia	Germany*	Ghana*
Greece*	Greenland	Guatemala*	Guinea
Guinea-Bissau	Haiti	Honduras*	Hong Kong*
Hungary*	Island*	India*	Indonesia*
Iran*	Ireland*	Israel*	Italy*
Jamaica	Japan*	Jordan*	Kazakhstan*
Kenia*	Korea, R.*	Kosovo	Kyrgyz, Rep.
Latvia*	Lebanon*	Lesotho	Liberia*
Lithuania*	Luxembourg*	Macao	Macedonia*
Madagascar*	Malawi*	Malaysia*	Mali*
Malta*	Mauritania*	Mauritius*	Mexico*
Moldova*	Mongolia	Montenegro	Morocco*
Mozambique*	Namibia	Nepal*	Netherlands*
New Zealand*	Nicaragua*	Niger	Nigeria*
Norway*	Oman*	Pakistan*	Panama*
Paraguay*	Peru*	Phillippines*	Poland*
Portugal*	Puerto Rico	Qatar*	Romania*
Russia*	Rwanda*	Saudi Arabia*	Senegal*
Serbia*	Sierra Leone*	Singapore*	Slovakia*
Slovenia*	South Africa*	Spain*	Sri Lanka*
Sudan	Suriname	Swaziland	Sweden*
Switzerland*	Tajikistan	Tanzania*	Thailand*
Timor-Leste	Togo	Trinidad & Tobago*	Tunisia*
Turkey*	Uganda*	Ukraine*	U.A.E.*
U.K.*	U.S.*	Uruguay*	Vanuatu
Venezuela*	Vietnam*	Gaza	Zimbabwe*

Note: List of WDI countries included in the analysis. A * indicates presence in IPRI.