Government Policy in the Formal and Informal Sectors*

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Abstract

The paper quantitatively investigates, in general equilibrium, the interaction between the firms' choice to operate in the formal or the informal sector and government policy on taxation and enforcement, given a level of regulation. A static version of Ghironi and Melitz's (2005) industry model is used to show that firms with lower productivity endogenously choose to operate in the informal sector. I use cross-country data on taxes, measures of informality, and measures of regulation (entry and compliance costs, red tape, etc) to back out how high the enforcement levels must be country by country to make the theory match the data. Welfare gains from policy reforms can be fairly large. I find also that welfare gains from reducing regulation are almost twice those computed for the tax policy reform. Finally, distortions associated with informality account for a factor of 1.5 of the output per capita difference between the richest and the poorest countries.

1 Introduction

The aim of this paper is to quantitatively investigate the interaction between firms' choice to operate in the informal sector and government policy on taxation and enforcement,

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given a country's institutional characteristics and regulation. I follow Schneider and Enste (2000) in defining informality as "unreported income from the production of legal goods and services, either from monetary or barter transactions, hence all economic activities that would generally be taxable were they reported to the tax authorities".[1] The size of the informal sector measures, therefore, the value of the production under informality. And informality is both a widespread phenomenon and quite significant part of the economy across countries. Recent estimates by Schneider (2007) show that the size of the informal economy in 2004 equals 7.9% of the official GDP in the United States, 16.3% in Sweden, 23.2% in Italy, an average of 15% in rich OECD countries, and about 42% on average in African and South American countries. Asian and Eastern European countries display similar patterns, with averages ranging from 30% to 40%. And the trend from 1999 to 2004 shows that for many countries, informality is indeed increasing. For others, at best, it has remained constant. And, as we see by the estimates, informal production is a major component of economic activities in developing economies and therefore a subject of great importance in the public policy debates in these countries. Thus, this paper also contributes to those debates.

There are at least two reasons why we should worry about informality. The first is a fiscal one. Assuming the existence of publicly provided goods to be financed from tax collection, a smaller tax base implies a higher tax burden on formal agents. The second reason concerns the informal agents being on the shadow of the law, with no or less access to the forementioned publicly provided goods, including courts of law, just to give one example. Moreover, they may be infringing regulatory, labor-market and product-market obligations, which can guarantee quality of the goods and services produced in the economy.

The reasons mentioned above are at the same time benefits of formality. Formal agents have a wider access to the goods provided by the government and some of collected taxes are to finance socially-efficient regulations. Farrell (2004) gives a more detailed description of these regulations. In the model, however, I only denote by regulation or red-tape

[1] Emphasis here should be given to the fact I am only considering legal activities, even though the non-compliance with taxes and regulations or the lack of proper registration (when mandatory) would typify them as illegal.

those obligations that are socially inefficient. Therefore, I consider low regulation as a sign of a country's good institutional quality. Making a parallel to what Djankov et al (2002a) name the "tollbooth" view of the public choice theory of regulation, countries with better institutional quality are those where bureaucrats are less able to extract rents or bribes through inefficient regulation.[2] In this interpretation, all social-efficient regulation is financed through taxes and is *ceteris paribus* represented by larger government sizes.

Traditionally, taxation has been blamed for the size of the informal sector. However, it cannot explain all the variation in informality that we observe across countries. An alternative explanation should also rely on the monitoring or enforcement against firms in the informal sector, on the level of regulation, and potentially on a country's institutional quality.[3] Hernando de Soto's *The Other Path* (1989) is very vocal about this new strand of literature which stresses other determinants than just taxation to impeding entrepreneurs of joining the official market economy. Following de Soto's work, many papers have attempted to qualitatively explain those mechanisms involved in the determination of informal economies. However, few have quantified the effects.[4] In this paper, I develop a quantitative theory using the main determinants of informality, namely taxation, enforcement, and regulation. In doing so, I am also able to analyze general equilibrium effects. My specific interest is in analyzing the elasticity of informality with respect those main determinants. I also perform some policy reforms, under a public finance perspective, exploring these elasticities.

Before presenting the model, I briefly review the literature on informality. As mentioned before, the informal economy is the subject of a vast literature. A thorough review of this literature can be found in Schneider and Enste (2000).[5] Rausch (1991), followed by Fortin, Marceau and Savard (1997), Amaral and Quintin (2006), Antunes and Cavalcanti

[2]The government in my model can be interpreted à la Banerjee (1997), where there is a conflict of interest between the government and bureaucrats. The government maximizes household's utility at the same time as bureaucrats want to use red tape (or bad regulation).

[3]Friedman, Johnson, Kaufmann, and Zoido-Lobaton (2000) compare different views explaining the determinants of informality and dismiss the pure taxation view.

[4]Antunes and Cavalcanti (2007) and Fortin, Marceau and Savard (1997) are among those few. However, they do not focus on the government policies studied in the present work.

[5]An even more recent survey of the literature can be found in Antunes and Cavalcanti (2007).

(2007), Paula and Scheinkman (2007) and many others, analyze informal economies using the "span of control" model of Lucas (1978). In these models, agents are heterogeneous in their managerial abilities.[6] In an alternative approach, I model firms with different productivities. Since my focus is not on occupational choice, a model with firms seems more appropriate. Fortin, Marceau and Savard (1997) and Sarte (2000) model firms closely to the model in the present work. However, the first paper considers a homogeneous good (while I have differentiated ones), and Sarte (2000) considers both informal and formal firms, equally dividing the production in a specific industry. In my model, a firm with productivity z produces a corresponding differentiated variety z and all firms with the same productivity level are in the same sector (formal or informal).

Rausch (1991) was probably the first to formally model the informal sector. However, he resorts to a minimum wage policy for large firms in order to create the informal sector. In Fortin, Marceau and Savard (1997), there is also a minimum wage. My model creates informality without resorting to minimum wage and still smaller firms endogenously choose to become informal. Azuma and Grossman (2003) provide a theoretical model of the informal sector where informality exists because firms' productive endowments are not perfectly observable. Then, the government cannot optimally extract resources from firms. Finally, Loayza (1996) adopts a different approach by studying an endogeneous growth model where informality impacts the rate of economic growth.

I consider an economy which consists of two sectors: a formal and an informal one. The sectors are structured in monopolistic competition à la Dixit-Stiglitz, with heterogeneous firms which draw a productivity level from some given probability distribution. There are no firms with different productivities producing the same variety or different goods being produced by firms with equal productivity. The model of monopolistic competition implies that the representative household consumes all varieties. My modeling strategy closely follows the static version of the industry model of Ghironi and Melitz (2005) and Melitz (2003), both based on Hopenhayn (1992).

There exists a fixed regulation cost κ in the formal sector.[7] Further, firms in the formal

[6]In the case of Fortin, Marceau and Savard (1997), the agents are, in fact, firms with different managerial abilities.

[7]We may interpret κ as a cost of complying with the formal sector, e.g. set-up costs, registration costs,

sector also pay a proportional tax on production at a constant rate τ.

Another choice for the firm is to operate in the informal sector. In this case, there is no fixed cost. However, there is an enforcement cost proportional to output. This cost is the result of the probability of being caught in informality and the corresponding fine (or punishment). Fortin, Marceau and Savard's (1997) interpretation of this kind of cost is that firms engage in some costly activity to avoid being caught and pay the penalty. It is assumed that firms are better off paying the cost than risking being caught. I model this enforcement mechanism as a constant rate e on the total production of informal firms. And this leads to a third interpretation, in which the government's enforcement technology destroys a fraction e of the output of informal firms.

The government relies on taxation on formal businesses and the net revenue from enforcement. It spends its revenue on exogenous government expenditures and on the costs of enforcing informal firms. The formal sector contributes to revenue, but generates a waste in the economy, due to regulation. Thus, regulation creates a distortion in the formal sector. Since government expenditures are given, a smaller formal sector would increase the tax burden on formal firms. At the same time, enforcement reduces informality, but is costly, thereby creating another distortion in the economy. The government task is to balance these distortions on the two sectors and raise enough revenue to finance its expenditures.

I use cross-country data on taxes, measures of informality, and measures of regulation (entry and compliance costs, red tape, etc) to back out how high the enforcement levels must be country by country to make the theory match the data. This quantitative exercise provides three outputs: first, the measures of enforcement can be compared with (indirect) measures of enforcement differences across countries, as a sort of "test" of the model. Second, I can ask a set of quantitative public-finance questions, for example concerning policy reforms on taxation and enforcement rates and the shadow dead-weight-loss of regulation costs. Third, I can use the model to account for how much informality reduces output per capita across countries.

The model quantitatively accounts for the degree of informality and other key aspects, such as size of government and regulation costs. The computed enforcement positively

red-tape, and resources spent on paper work.

correlates with measures of tax compliance. Moreover, enforcement is positively correlated with regulation and government expenditures and, as expected, it is negatively correlated with the size of the informal sector. There is some scope for policy reforms (using e and τ as instruments). In general, most countries would do better to decrease informality, although some would benefit from increasing it. In both cases, the welfare gains can be fairly large. Countries benefiting the most are those with lower regulation costs. This suggests that reducing regulation costs is a more effective policy for increasing private consumption and reducing informality. In particular, since regulation is a distortion in the formal sector, it should be zero. However, the model here takes regulation as given and its determination are outside the scope of this paper. Nonetheless, the model allows us to measure what countries would gain from decreasing regulation (κ). This is done by computing the shadow value of decreasing regulation. Thus, we do not know how much it would cost to allow this decrease, but the model allows us to compute the benefits. Finally, I perform some counterfactual experiments by reducing the regulation costs. As a by-product of the model, I can account for how much the distortions associated with informality reduce output per capita across countries. I found that these distortions account for a factor of 1.5 of the output per capita difference between the richest and the poorest countries.

The paper is organized as follows. The next section presents the model, the definition and the characterization of equilibrium as well as some comparative statics. The following section brings the baseline calibration and the quantitative assessment of the model. Section 4 considers some policy reforms. First, I analyze the reallocation of taxes and enforcement and second, the shadow value of regulation and a counterfactual experiment are analyzed. In section 5, the model accounts for income differences across countries. And finally, some concluding remarks are presented in section 6.

2 The model

2.1 Basics

Firms There is a continuum of firms of measure 1. Each firm produces a differentiated good indexed by $z \in \Omega$. Firms are heterogeneous as they produce with different technologies, z, given by a distribution probability $F(z)$ with support $[z_{\min}, \infty)$ and $z_{\min} > 0$. A firm with productivity z produces λz units of output per unit of labor, where λ is just a parameter (λ can be interpreted as aggregate labor productivity).[8] Productivity differences across firms then translate into differences in the unit cost of production ($w/\lambda z$). The production function can be written as

$$y(z) = \lambda z l(z), \tag{1}$$

where $l(z)$ is the labor employed by the firm with productivity z.

Firms can choose to operate in the formal or the informal sector. Producing in the formal sector requires the payment of a (fixed) regulation cost κ (measured in terms of labor) and the payment of a proportional tax rate τ on the firm's total output $y(z)$. Firms in the informal sector pay a proportional enforcement tax e on their output. The profit maximization problem of a firm with productivity z is

$$\max_{p(z)} \Pi(z) \equiv (1 - \tau\mathcal{I}_F - e\mathcal{I}_I)p(z)y(z) - wl(z) - \mathcal{I}_F w\kappa, \tag{2}$$

where $\mathcal{I}_J$ is an indicator function that takes a value equal to 1 if the firm is operating in sector $J = F, I$ (formal or informal, respectively).

Representative Household The economy is populated by a unit mass of atomistic households. The representative household owns all firms and supplies L units of labor inelastically in each period at real wage w. She maximizes the utility from the composite household's consumption (C) and the level of publicly provided goods (G):

$$U \equiv u(C, G), \tag{3}$$

[8]To clarify, z indexes both the firm's variety and its productivity. Therefore, a firm with productivity z produces a corresponding variety z.

where $C \equiv \left(\int_{z\in\Omega} c(z)^{(\theta-1)/\theta} dz\right)^{\theta/(\theta-1)}$, $\theta > 1$ is the elasticity of substitution across goods and $c(z)$ is the household's consumption of good z. G takes the same aggregator form as C. Then, $G \equiv \left(\int_{z\in\Omega} g(z)^{(\theta-1)/\theta} dz\right)^{\theta/(\theta-1)}$. The utility function u is increasing in both arguments. The budget constraint of the representative household is:

$$C \leq wL + \Pi_F + \Pi_I. \tag{4}$$

The household earns labor income wL plus the profits in the formal (Π_F) and informal sectors (Π_I). She spends her total income buying the composite consumption C.

Government The government collects taxes and enforcement penalties. Enforcement generates a revenue $E \equiv eY_I$; however, there is a cost $\Psi(E)$ (with $\Psi'(E) > 0$) to exert this enforcement. The government spends its net revenue on the purchase of the publicly provided good G. The government budget constraint is:

$$G + \Psi(E) \leq \tau Y_F + eY_I, \tag{5}$$

where Y_J is total output in sector J.

Resource Constraint Define Y as total output. Then, we can write the resource constraint of this economy as:

$$Y = Y_F + Y_I = C + G + \Psi(E). \tag{6}$$

2.2 Prices and profits

Individual good demand The individual demand for good z is $y(z)$, such that

$$y(z) = Y\left[p_J(z)\right]^{-\theta}, \tag{7}$$

where $p_J(z)$ is the price charged by a firm with productivity z in sector J.[9]

Prices All firms face a residual demand curve with constant elasticity θ in the output market, and they set flexible prices that reflect the same proportional markup $\theta/(\theta-1)$ over the marginal costs given by

$$p_J(z) = \frac{\theta}{(\theta-1)} \frac{1}{(1-\tau\mathcal{I}_F - e\mathcal{I}_I)} \frac{w}{\lambda z}. \tag{8}$$

[9]See the appendix for the derivation of individual demand.

The above price is derived from the firms' profit maximization problem (2) subject to individual demand (7). The derivation is in the appendix.

Given the price function (8), we can write a relation between the price in both sectors:

$$p_F(z) = \frac{(1-e)}{(1-\tau)} p_I(z). \tag{9}$$

Prices in the formal sector are proportionally higher to those in the informal sector if enforcement is lower or taxes are higher.

Profits Now that we have derived the equilibrium price, we can express the profit of a firm with productivity z as:

$$\Pi_J(z) = \frac{(1-\tau\mathcal{I}_F - e\mathcal{I}_I)}{\theta} \left[p_J(z)\right]^{1-\theta} Y - \mathcal{I}_F w\kappa. \tag{10}$$

This allows us to study how profits change with productivity

$$\frac{\partial \Pi_J}{\partial z} = (1-\tau\mathcal{I}_F - e\mathcal{I}_I)\frac{\theta-1}{\theta} \left[p_J(z)\right]^{1-\theta} Y z^{-1} > 0. \tag{11}$$

Since θ must be greater than 1 and so far as $z \geq 0$, which I assume, profits are monotonically increasing in productivity, as should be expected.

Now let us check the second derivative:

$$\frac{\partial^2 \Pi_J}{\partial z^2} = (1-\tau\mathcal{I}_F - e\mathcal{I}_I)\frac{(\theta-2)(\theta-1)}{\theta} \left[p_J(z)\right]^{1-\theta} Y z^{-2} \gtreqless 0 \ \text{ if } \theta \gtreqless 2. \tag{12}$$

The profit function can be concave or convex in z, depending on the level of θ, i.e. the elasticity of substitution across goods. When goods are highly complementary ($1 < \theta < 2$), the function is concave with respect to z, whereas the profit function is convex when goods are more substitutable ($\theta > 2$).

2.3 Definition of equilibrium

Now that the model has been described, I proceed to define and verify the existence of the equilibrium for *exogenous* policy. Before, let me state some assumptions. If $\kappa = 0$, the problem is trivial. There is a bang-bang solution, where all firms choose the formal (informal) sector if and only if $e > (<)\ \tau$. This can be seen more clearly by checking the profit expression in (2). To make the problem more interesting, I assume that $\kappa > 0$:

Assumption 1 *The regulation cost is positive, $\kappa > 0$.*

Conceivably, κ could be lower than zero. And, in fact, Gordon and Li (2005) argue that governments could impose high taxes on formal firms while providing various kinds of subsidies in the form of tariff protection, inflation, etc. These benefits could be translated to negative regulation costs. However, this argument cannot be applied to the present work, since the model is in general equilibrium. Thus, high taxes are directly associated to higher publicly provided goods, G. The various kinds of subsidies and socially efficient regulation, if they exist, are in fact embedded into G.

The next proposition describes the conditions for equilibria in the model when $\kappa > 0$ and policy (e, τ) is exogenous.

Proposition 1 *Given assumption 1, for $e \leq \tau$, all firms operate in the informal sector. For $e > \tau$ and a sufficiently small $z_{\min} \geq 0$, there exists a unique threshold value $z^* \in [z_{\min}, \infty)$ such that $\Pi_F(z^*) = \Pi_I(z^*)$, firms with $z < z^*$ operate in the informal sector, and firms with $z \geq z^*$ operate in the formal sector.*

Proof. The first result of the proposition is quite trivial. If $e \leq \tau$ and $\kappa > 0$, the profit function for the informal sector is always above that for the formal sector. Intuitively, if operating in the formal sector becomes too costly (a higher proportional and fixed cost), then no firm is willing to be formal. To prove the second part of the proposition, for now assume $z_{\min} = 0$. Then, we know that $\Pi_F(0) = -w\kappa < 0$ (by Assumption 1) and $\Pi_I(0) = 0$. Thus, $\Pi_F(0) < \Pi_I(0)$. To prove the existence of a single crossing, I need to show that (i) the slope of the profit function in the formal sector is higher than the slope of the function in the informal sector; and that (ii) the crossing happens for a finite z^*. The slopes are given by the derivative $\dfrac{\partial \Pi_J}{\partial z}$. To show (i), we need that $\dfrac{\partial \Pi_F}{\partial z} > \dfrac{\partial \Pi_I}{\partial z}$:

$$\begin{aligned}
(1-\tau)\frac{\theta-1}{\theta}\left[p_F(z)\right]^{1-\theta} Y z^{-1} &> (1-e)\frac{\theta-1}{\theta}\left[p_I(z)\right]^{1-\theta} Y z^{-1} \\
(1-\tau)\left[p_F(z)\right]^{1-\theta} &> (1-e)\left[p_I(z)\right]^{1-\theta} \\
\frac{(1-\tau)}{(1-e)}\left[\frac{p_I(z)}{p_F(z)}\right]^{\theta-1} &> 1 \\
\left[\frac{(1-\tau)}{(1-e)}\right]^{\theta} &> 1 \qquad (13)
\end{aligned}$$

The last inequality is true *iff* $e > \tau$, which we assume. To prove (ii), we define $g(z) \equiv \Pi_F(z) - \Pi_I(z)$. We need to show that $\lim_{z\to\infty} g(z) > 0$:

$$g(z) = \frac{(1-\tau)}{\theta}\left[p_F(z)\right]^{1-\theta} Y - w\kappa - \frac{(1-e)}{\theta}\left[p_I(z)\right]^{1-\theta} Y$$

Using (9)

$$\begin{aligned}
g(z) &= \frac{(1-\tau)}{\theta}\left(\frac{1-e}{1-\tau}\right)^{1-\theta}\left[p_I(z)\right]^{1-\theta} Y - w\kappa - \frac{(1-e)}{\theta}\left[p_I(z)\right]^{1-\theta} Y \\
&= \left[(1-\tau)\left(\frac{1-e}{1-\tau}\right)^{1-\theta} - (1-e)\right]\left[\frac{\theta}{(\theta-1)}\frac{1}{(1-e)}\frac{w}{\lambda z}\right]^{1-\theta}\frac{Y}{\theta} - w\kappa \\
&= \left[(1-\tau)\left(\frac{1-e}{1-\tau}\right)^{1-\theta} - (1-e)\right]\left[\frac{\theta}{(\theta-1)}\frac{1}{(1-e)}\frac{w}{\lambda}\right]^{1-\theta}\frac{Y}{\theta} z^{\theta-1} - w\kappa
\end{aligned}$$

$\lim_{z\to\infty} g(z)$ is determined by $\lim_{z\to\infty} z^{\theta-1}$. Since $\theta > 1$, $\lim_{z\to\infty} z^{\theta-1} = \lim_{z\to\infty} g(z) = \infty > 0$. Naturally, what is left is to guarantee that $z^* \geq z_{\min}$. We assume $z_{\min}$ to be sufficiently small, so that the unique threshold always exists. In the case $z_{\min}$ is not sufficiently small, then $\Pi_F(z_{\min}) \geq \Pi_I(z_{\min})$ and all firms operate in the formal sector. In that case, $z^* = z_{\min}$ and the equilibrium is still unique. ■

The reason why we need the assumption that $e > \tau$ in the second part of the proposition is quite straightforward. If the opposite occurs, the first part of the proposition shows that no formal sector exists. The individual firm faces a decision to operate in the informal sector, paying an enforcement rate e, or to operate in the formal sector, where not only the tax rate is higher, but there also exists a positive fixed cost on top. Clearly, it is not worth being formal.

The following plot illustrates the single crossing property described in Proposition 1.

Now, the definition of the equilibrium follows:

Definition 1 *An equilibrium with exogenous policy is a set of allocations of the good* $\{y(z)\}$*, a productivity threshold* $z^\star$**,** *and prices* w *and* $\{p(z)\}$ *such that: (a) given exogenous government policy* (τ, e) *and wages* w*, firms maximize profit; (b) given prices* $(w, \{p(z)\})$ *and exogenous government policy* (τ, e, G)*, the representative household maximizes composite consumption* C*; (c) the budget constraint of the government holds with equality; (d) markets (for both labor and goods)*

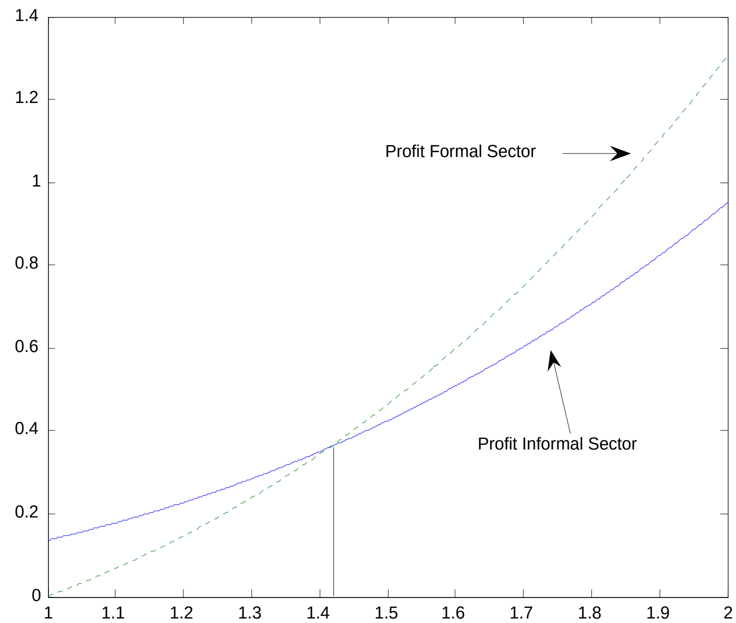

Figure 1: Single crossing property of the profit curves

clear; and, finally, (e) firms with productivity $z < z^*$ operate in the informal sector and firms with $z \geq z^*$ operate in the formal sector.

2.4 Parametrization of the productivity distribution

I parametrize the distribution of productivities following Ghironi and Melitz (2005). They assume the distribution to be Pareto with lower bound $z_{\min}$ and shape parameter $k > \theta - 1$. Parameter k indexes the dispersion of productivity. The standard deviation of log productivity is equal to $1/k$. And the condition that $k > \theta - 1$ ensures that the variance in firm size is finite. The distribution of productivity, which is Pareto, also induces the distribution of size of firms to be Pareto. Ghironi and Melitz (2005) claim that this distribution fits firm-level data for the U.S. quite well. The cumulative distribution function is $F(z) = 1 - (z_{\min}/z)^k$ and the probability distribution function is given by

$$f(z) = k z_{\min}^{k} z^{-k-1}. \tag{14}$$

Considering the threshold equilibrium described in Proposition 1, we can compute the share of firms in the formal sector using the CDF:

$$1 - F(z^*) = (z_{\min}/z^*)^k, \tag{15}$$

and since there is a measure one of firms, the number of firms in the formal sector, N_F, equals $(z_{\min}/z^*)^k$.

2.5 Determination of equilibrium

This section shows the analytical solution of the equilibrium considering the parametrization of the productivity distribution given in the previous subsection. It is enough to solve for only three endogenous variables to determine the equilibrium, namely, the threshold of productivity z^*, the wage w, and total output Y. For this purpose, we need three equilibrium conditions.

The first equilibrium condition is the cutoff condition $\Pi_F(z^*) - \Pi_I(z^*) = 0$, where the two profit functions cross. Using the profit expression (10), the condition becomes

$$\frac{(1-\tau)}{\theta}\left[p_F(z^*)\right]^{1-\theta} Y - w\kappa = \frac{(1-e)}{\theta}\left[p_I(z^*)\right]^{1-\theta} Y. \tag{16}$$

Substituting for the price equation (9) and after having done some algebra[10], we get the following expression:

$$\Phi_1(z^*; \tau, e, \kappa, \theta, \lambda) \equiv \left[(1-\tau)^\theta - (1-e)^\theta\right]\left(\frac{\theta}{\theta-1}\right)^{1-\theta}\frac{(\lambda z^*)^{\theta-1}}{\theta\kappa} = \frac{w^\theta}{Y}. \tag{17}$$

We can express the left-hand side as a function Φ_1 of the threshold z^*. The right-hand side is a simple function of the other two endogenous variables: w and Y. Remember that I consider τ and e to be exogenous policy variables. Moreover, so far, the equilibrium condition refers to the optimal choices of firms, which take these policies as given.

Another equilibrium condition to consider is the labor-market clearing, which is given by

$$\int_{z_{\min}}^{\infty} \frac{y(z)}{\lambda z} dF(z) + \kappa(1 - F(z^*)) = L. \tag{18}$$

[10]The complete derivation is in the appendix.

This condition can also be rewritten, in a similar fashion to (17), as follows:

$$\Phi_2(z^*;\tau,e,\kappa,\theta,\lambda) \equiv \frac{kz_{\min}^k\lambda^{\theta-1}}{L-\kappa(z_{\min}/z^*)^k}\left(\frac{\theta}{(\theta-1)}\right)^{-\theta}\times$$

$$\times\left((1-e)^\theta\int_{z_{\min}}^{z^*} z^{\theta-k-2}dz + (1-\tau)^\theta\int_{z^*}^{\infty} z^{\theta-k-2}dz\right) = \frac{w^\theta}{Y}, \tag{19}$$

where $\int_{z_{\min}}^{z^*} z^{\theta-k-2}dz = \frac{z^{*\theta-k-1}-z_{\min}^{\theta-k-1}}{\theta-1-k}$ and $\int_{z^*}^{\infty} z^{\theta-k-2}dz = \frac{-z^{*\theta-k-1}}{\theta-1-k}$. The left-hand side is expressed as a function Φ_2 of the threshold z^* and other exogenous variables. And the right-hand side is expressed as a function of w and Y.

Now, notice that the two equations (17) and (19) have the same right-hand side. Then, equating them, we get the equilibrium threshold z^* as a function of exogenous variables only:

$$\frac{kz_{\min}^k}{(L-\kappa(z_{\min}/z^*)^k)}\left((1-e)^\theta\int_{z_{\min}}^{z^*} z^{\theta-k-2}dz + (1-\tau)^\theta\int_{z^*}^{\infty} z^{\theta-k-2}dz\right) =$$

$$\left[(1-\tau)^\theta-(1-e)^\theta\right]\frac{z^{*\theta-1}}{(\theta-1)\,\kappa}. \tag{20}$$

Finally, we need a third equilibrium condition which is given by the goods' market clearing. The aggregate of all individual outputs equals total output in the economy:

$$Y = \left(\int_{z_{\min}}^{\infty} y(z)^{(\theta-1)/\theta}dF(z)\right)^{\theta/(\theta-1)}. \tag{21}$$

This condition yields the following expression of wage as a function of the threshold z^*:

$$w^{\theta-1} = kz_{\min}^k\left(\frac{(\theta-1)\,\lambda}{\theta}\right)^{\theta-1}\left\{(1-e)^{\theta-1}\frac{z^{*\theta-k-1}-z_{\min}^{\theta-k-1}}{\theta-1-k} - (1-\tau)^{\theta-1}\,\frac{z^{*\theta-k-1}}{\theta-1-k}\right\} \tag{22}$$

Given z^* (by equation 20), we can compute w using the above expression. And given z^* and w, we can compute Y, using either equations (17) or (19).

2.6 Comparative Statics

The equilibrium conditions allow us to do some comparative statics with respect to the fundamentals of the model. I summarize the results in the following subsubsections.

2.6.1 Tax rate τ

An increase in the tax rate makes it more costly to operate in the formal sector. At the margin, firms find it profitable to switch to the informal sector, which leads to an increase in z^*. The increase in taxes has two effects in the same direction, thereby reducing wages. The first effect is the direct effect of taxes, thereby reducing the demand for labor across sectors; the second effect is the movement of workers from formal firms to informal ones. Since informal firms have lower productivity, the marginal productivity of labor is reduced, as is the wage. For total output, the increase in taxes has three effects: (1) the direct effect of the higher tax rate, increasing Y thanks to less resources being wasted on the regulation cost κ; (2) the increase in z^*, reducing output; (3) the decrease in wages, further reducing output. The net effect on total output is therefore ambiguous. In most of the cases I studied, the first effect is larger than the sum of the last two; thus a higher Y as the tax rate rises.

2.6.2 Enforcement rate e

Compared to the tax increase, raising the enforcement rate generates an opposite effect. A higher e makes it more costly to operate in the informal sector, which makes firms on the margin switch to the formal sector, thereby decreasing z^*. Once more, there are two effects on wages. While the first effect, which reduces demand for labor, remains, the second effect is inverted, moving workers from informal to formal firms. The latter effect increases wages, since the marginal productivity of labor is higher (formal firms have higher productivity). This second effect is high for countries with *low* regulation costs[11]. If the first effect is higher, $w(e)$ is decreasing everywhere. If the first effect is higher for low levels of enforcement and lower after some threshold $\overline{e}$, then wages become U-shaped. As before, there are three separate effects on total output. Analyzing the separate effects on output as e increases: (1) the direct effect reduces Y, because of the distortionary effect of κ; (2) a decrease in z^* increases output; and (3) there is an ambiguous effect on wages. If wages are decreased, output drops. Instead, if wages increase, output also rises. In most

[11] In the model, κ works as a softener of the effects on productivity and it directly affects the formal firms, which are the more productive ones. Analytically, $w_{e\kappa} < 0$.

of the cases studied, the net effect on output is negative.

2.6.3 Regulation cost κ

An increase in regulation works in the same line as an increase in taxes. The threshold z^* increases and wages go down. Once more, the effect on output is ambiguous.

2.6.4 Elasticity of substitution across goods θ

The increase in θ can be translated as an increase in competition, since the elasticity of substitution determines the firms' markup over costs. Since there is a fixed cost in the formal sector, formal firms on the margin between being formal or informal are hurt proportionally more than the informal firms on the same margin. Then, the marginal formal firms switch to the informal sector, thus increasing z^*. The increase in θ also means that the demand for goods becomes more elastic and there is a strong increase in demand for goods with lower prices (i.e., for goods with higher productivity). This shifts labor to high productivity firms, which explains why there is an increase in wages. Finally, the increase in wages raises total output.

2.6.5 Labor supply L

An increase in L makes all firms hire more, but more jobs are proportionally created in the formal (high productivity) sector, thereby increasing wages. More workers imply more production. And, in fact, total output increases linearly with L. Informal firms on the margin switch to the formal sector, thereby reducing z^*.

2.6.6 Total factor productivity λ

In this model, parameter λ, which represents total factor productivity in the economy, only works as a scale parameter. The production function is $y(z) = \lambda z l(z)$ and total output can be written as:

$$Y = \lambda \left(\int z l(z)^{(\theta-1)/\theta} dF(z) \right)^{\theta/(\theta-1)}.$$

Then, it increases total production and since it augments labor productivity, there is an increase in wages. Since it is just a scale parameter, no effect on the threshold z^* is observed.

2.6.7 Lower bound for productivity $z_{\min}$

An increase in the minimum productivity level shifts the distribution of firm productivity to the right. Clearly, marginal productivity of labor is higher and wages increase. The effect on output is also positive. As $z_{\min}$ increases, the threshold z^* also increases. However, the size of the informal sector as a percentage of formal output remains constant.

2.6.8 Shape parameter k

Parameter k indexes the dispersion of productivity draws: dispersion decreases as k increases, and the firm productivity levels are increasingly concentrated toward their lower bound, $z_{\min}$. By definition, an increase in k decreases the marginal productivity of labor and wages go down. Since firms are more concentrated towards $z_{\min}$, the threshold z^* is reduced. The wage reduction implies that total output is also lower.

3 Quantitative assessment

So far, we have studied the mechanisms qualitatively involved in the model. In this section, I calibrate the model to 29 countries and make some quantitative experiments. The countries chosen are the OECD countries plus Brazil. The reason for using OECD countries is that the data on total government revenue is more uniform and, most importantly, available. Moreover, firms' characteristics of those countries are more similar when calibrating for the distribution of productivities. Nonetheless, the cross-section of countries is quite diverse, including both developed and emerging economies.

3.1 Solving the model

The model is solved as follows. This is the implementation of the equilibrium described in subsection 2.5.

1. Given $(z_{\min}, \theta, k, L, \tau, e, \kappa)$, z^* is computed. The TFP parameter λ does not affect z^*.

2. Then, wage w and total output Y are calculated using equations (22) and either (17) or (19). Here, λ is just a level parameter and does not affect the results.

3. The size of the informal sector (INF) is the ratio of informal sector output Y_I and total output in the formal sector Y_F.

$$INF = \frac{Y_I}{Y_F} = \left(\frac{1-e}{1-\tau}\right)^{\theta-1} \frac{z_{\min}^{\theta-k-1} - z^{*\theta-k-1}}{z^{*\theta-k-1}} \tag{23}$$

where

$$Y_F = Y * kz_{\min}^k \left[\frac{\theta}{(\theta-1)} \frac{w}{(1-\tau)\lambda}\right]^{1-\theta} \frac{z^{*\theta-k-1}}{k+1-\theta} \tag{24}$$

and

$$Y_I = Y * kz_{\min}^k \left[\frac{\theta}{(\theta-1)} \frac{w}{(1-e)\lambda}\right]^{1-\theta} \frac{z^{*\theta-k-1} - z_{\min}^{\theta-k-1}}{\theta-1-k}. \tag{25}$$

4. Per capita GDP is formal sector output Y_F divided by L.

5. The amount of labor employed in each sector is computed, respecting that the labor market clearing condition $L_F + L_I + \kappa \left(z_{\min}/z^*\right)^k \equiv L$, where $\left(z_{\min}/z^*\right)^k$ is the proportion of formal firms in the economy.

6. Then, I calculate government expenditures as a percentage of formal GDP ($g \equiv G/Y_F$).

3.2 Choosing the parameters

The parameters that need to be calibrated are: (1) productivity distribution parameters: $z_{\min}, k$; (2) elasticity of substitution across goods, θ; (3) regulation cost, κ; and (4) labor supply, L. The model also has two policy variables: τ and e, the tax and enforcement rates, respectively. Table 1 presents the general baseline calibration.

TABLE 1 GOES HERE

Following what Ghironi and Melitz (2005) did, I use the value of θ from Bernard et al (2003). They set $\theta = 3.8,$ which is calibrated to fit U.S. plant data. They report that the standard deviation of $\log$ U.S. plant sales is 1.67. This standard deviation in the model is equal to $1/(k - \theta + 1)$. The choice of θ implies that $k = 3.4$ (which satisfies the requirement that $k > \theta - 1$). Across all computations, I normalize the size of the work force L to 1 and the lowest value of productivity $z_{\min}$ is also set to 1[12]. Moreover, the scale parameter λ (the "TFP") is set to 1 on the baseline calibration[13]. The cost of enforcement for the government is set equal to the revenue from enforcement, $\Psi(E) = E$, so that the government only benefits from taxation on formal firms. This way of modeling enforcement costs capture an important trade-off that informal firms face. When De Soto (1989) talks about determinants of informality other than taxation, he is talking about exclusion from institutions available to the formal sector, like property rights, access to capital markets, etc. These should be modeled as costs of informality, and the payments from these more realistic informality costs cannot enter the government's budget revenue. Here, informal firms spend resources that the government does not benefit from, which can be checked in equation (5).

I match government expenditures, regulation cost and the size of the informal sector by choosing τ, e, κ. The data on government expenditures for OECD countries is the total government revenue from OECD (2003). The data on Brazil's total government revenue comes from Central Bank of Brazil. The data on the size of the informal sector as a share of official GDP is from Schneider (2007). I refer to his paper for a detailed explanation of how the size of the informal economy is estimated. In short, the informality is computed by indirect measures, like money or electricity demand and latent estimation methods using the DYMIMIC (dynamic multiple-indicators multiple-causes) model. To be consistent with other measures, all data refer to the year 1999.

The data on regulation cost comes from Djankov et al (2002a). They provide a measure of regulation of entry (monetary fees + time). I use their measure as a proxy for socially-inefficient regulation. I recompute their figures by using updated World Bank (2006) data

[12] We can do that since the location parameter ($z_{\min}$) does not affect the shape parameter. And, by using the same general baseline calibration (see Table 1), only the differences on taxation, enforcement and regulation across countries affect the results.

[13] In Section 5, it is calibrated to different values for each country when analyzing output per capita differences among countries.

on the countries' per capita GDP in 1999 in current US$. Still, the calculated regulation cost is not exactly κ, used in the model. Djankov et al (2002a)'s measure is the monetary cost (of fees and time) as a percentage of formal per capita GDP. Then, the relation between the model parameter κ and the reported regulation cost is:

$$\kappa = \frac{Y_F}{L} * \frac{\text{regulation cost}}{w}. \tag{26}$$

Therefore, the model is solved with a system of six non-linear equations to determine six variables: $z^*, Y, w, \tau, e, \kappa$. The six equations are: 17 (or 19), 20, 23, 25, 26, $g = G/Y_F$.

3.3 Baseline results

Table 2 brings the results for the baseline calibration. The data used in the calibration is found in the first three columns: government expenditures as a percentage of formal GDP, the size of the informal economy as a percentage of formal GDP and the regulation cost. The next three columns give the results for tax and the fixed cost on formal businesses and the enforcement rate on informal business for the 29 countries in the sample. The table is sorted by the enforcement rate. Countries with lower enforcement rates are at the top of the table.

TABLE 2 GOES HERE

This baseline computation provides two results. The first is that I can match key facts of the data for each country. The second result is the enforcement rates that I backed out. This measure of enforcement can be compared with other (indirect) measures of enforcement differences across countries, as a sort of "test" of the model. The idea here is to check that the figures I obtain are really measuring tax enforcement. In lieu of better data, I constructed two measures of tax compliance using data on staffing of government audit offices in OECD countries (OECD, 2004). One measure is the ratio of total audit staff and total population. The second is the same ratio, but just considering the labor force in the denominator. Enforcement is strongly positively correlated with these two measures. The correlations are 0.58 and 0.59, respectively[14]. Figure 2 illustrates the relation between enforcement and total audit personnel per population (in million).

[14] Both correlation coefficients are significant at 1%.

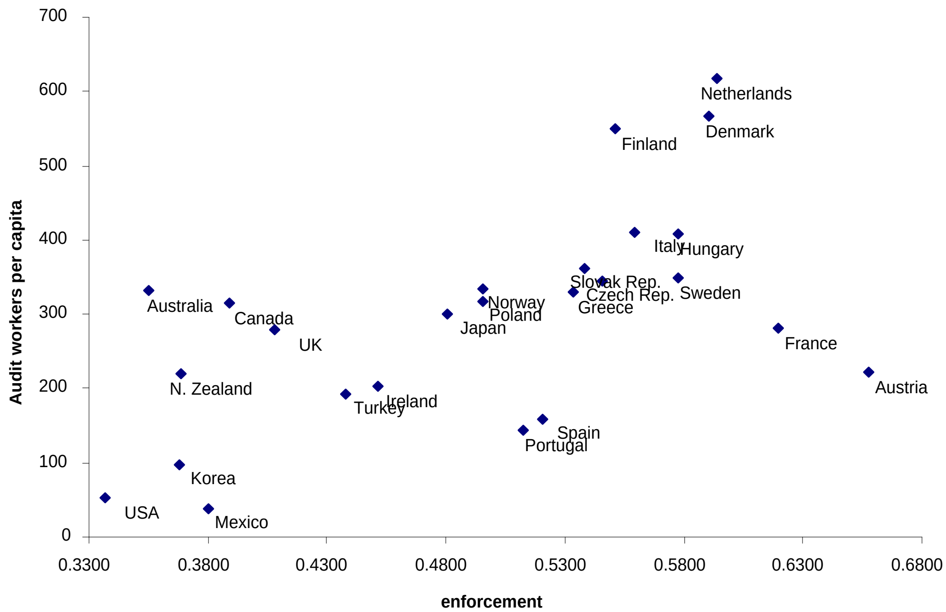

Figure 2: Enforcement and total audit workers per capita

The computed enforcement allows us to better understand its relationship with the other variables in the model, namely, regulation, the tax rate and the size of the informal sector. Take the case of Switzerland and the United States with similar levels of informality. The U.S. have the smallest enforcement rate in the sample while Switzerland has a large one. The difference between these two countries is that the U.S. have much smaller regulation costs than Switzerland. The same can be said of Austria as compared to the United States. Austria has the largest enforcement rate in the sample and a small level of informality, like the U.S. and Switzerland. But since Austria has such high regulation costs (in the order of 20 times more), it needs to enforce the informal sector to a considerably larger extent. Otherwise, it does not create enough incentives to make firms switch to the formal sector. At the other side of the spectrum, consider countries with a large informal sector, like Brazil, Mexico and Turkey. These countries have low enforcement, as would be expected. Another point about why these countries can exert low enforcement is that taxation is not so high, especially in the case of Mexico. Greece has the same level of informality and the same amount of regulation cost as Mexico. However, these countries present very different enforcement levels. This is driven by the fact that Greece has more than twice the level of government expenditures than Mexico.

Next, table 3 presents some OLS estimations using the computed enforcement as a dependent variable. In column (1), we see that there is a positive correlation between the regulation fixed cost (κ) and enforcement. However, the effect is weak since other factors that are also relevant for endogenously determining the enforcement rate are omitted. The next columns present the effect of regulation on enforcement controlling for these other factors, namely the size of government (G/Y_F) and the size of the informality (Y_I/Y_F). In columns (2) to (4), the correlation of regulation and enforcement becomes very significant. Moreover, less enforcement is linked to more informality, as would be expected. Moreover, a larger size of government is associated with more enforcement. The results remain the same, even when replacing κ by the regulation measure used as the input in the computations or when using the tax rate τ instead of the size of government.

TABLE 3 GOES HERE

4 Policy reforms

4.1 Reallocating taxes and enforcement

After considering the baseline case, a natural question is whether the government is choosing tax and enforcement in the best possible way. I take the level of government expenditures and the regulation cost, from the previous section, as given and maximize household utility choosing the tax and enforcement rates. The problem of the government is:

$$\max_{\tau,e} \ u(C,\overline{G}), \tag{27}$$

where $\overline{G}$ is the level of public good given by the baseline calibration.

Since $u_C > 0$, the choice here is basically the pair (τ^*, e^*) which delivers the largest possible C. The following table gives the results for the resulting policy reform. The first four columns bring the τ, e, and the size of the informal sector, which were computed in the baseline calibration. The next two columns present the new policy in terms of taxes and enforcement. The following column presents the percentage gain of consumption with the policy reform, while the last column brings the resulting size of informality after the policy.

TABLE 4 GOES HERE

Comparing the enforcement to the baseline, 13 countries out of 29 increased the enforcement rate. Nine of these are the countries with the lowest regulation costs in the sample. The average gain in consumption is 1.2%. Canada and Austria had the largest increases in C. Canada benefits from a large decrease in taxes whereas Austria benefits from a decrease in enforcement, generating an increase in the informal sector. In the Canadian case, the country had low informality and low regulation. Then, a small increase in enforcement is enough to reduce further informality and allow for tax cuts in the formal sector. In the case of Austria, it had the largest enforcement rate and quite low informality. The optimal policy was to increase informality and avoid wasting resources with regulation. The economy with regulation made it possible to substantially boost private consumption, keeping the government revenue constant by increasing taxes in the formal sector by 1.7 percentage points.

The countries with lowest regulation are also those that manage to reduce their informal sectors substantially more. In particular, the U.S., New Zealand, and Canada managed to completely eliminate the informal sector with the policy reform. What happens here is that the elasticity of informality with respect to tax and enforcement is pretty large and larger for countries with lower regulation. For the other countries, most of them end up with sizes of the informal sector between 20% and 33%, except Mexico which gets an increase to 61%. The suggested reform for Mexico is to increase taxes[15] and, therefore, decrease the tax base in the formal sector. This allows Mexico to raise the same government revenue and decrease the distortions associated to formality, namely high regulation costs. Why is this policy which hikes informality up desirable? The reason is that enforcement is reduced in the informal sector, which is now 60% of the formal economy. This reduction in enforcement increases profits in the informal sector, which directly benefits

[15]Keep in mind that Mexico had very low taxes to start with.

the representative household's consumption, thereby reducing the distortionary effect of enforcement in the informal sector. At the same time, the distortions associated with regulation in the formal sector are also reduced. It is important to stress that regulation costs are a waste in the economy and, in the case of Mexico, they are quite high. In a study of benefits and costs of informality, Djankov et al (2002b) alude to the possibility of benefits for governments[16].

Concerning the choice of enforcement levels, one could ask what makes the U.S. want such a low e and Denmark, for example, a much higher one? The answer about the difference between U.S. and Denmark lies in the size of government. Remember that e must be larger than τ, otherwise no formal sector exists and the supply of public good is zero. Then, Denmark starts with a "lower bound" for enforcement that is much higher than that of the U.S. Due to the high Danish level of government expenditures as compared to the U.S., Denmark needs a tax rate almost twice the American one. Why is this preferred? Denmark manages to keep a not so large informal sector (18% in the baseline calibration; and 12% after the policy reform), having a large government and a five times larger regulation. The U.S. starts off in much better conditions: 40% smaller government size and very low regulation.

The facts that the suggested reforms in many countries are close to their previous policies and most of the countries with high regulation still keep significant levels of informality suggest that the regulation costs play an important role in determining the level of the informal sector. If these countries reduce the regulation costs, this would allow them to substantially reduce the informal sector. This is exactly what is observed for the countries with lowest regulation in the sample.

4.2 Reforming regulation

4.2.1 Shadow value of regulation

As seen in the previous section, regulation plays a significant role in determining the size of the informal sector. But it is not the scope for government policy in this model.

[16]They mention especifically the case of small businesses that would not be able to exist, were both taxes and enforcement high.

Nonetheless, the model can be useful in measuring the benefits of reducing regulation. Then, the natural question to ask is what is the shadow value of regulation costs (κ) in the equilibrium I have computed. Table 5 presents the percentage consumption increase for three different changes in regulation: (1) a reduction of 1% in κ; (2) a reduction of 10% in κ; and (3) a reduction of κ by 0.01.

TABLE 5 GOES HERE

It is clear that reducing regulation makes informality smaller. It becomes "cheaper" to operate in the formal sector. However, production in the formal sector is also taxed. Then, the results for the first two columns (the percentage decreases in κ) show that countries with higher taxation benefit more from the reduction in regulation. Take the case of Mexico, with low taxation, which is the country that benefits the least from the policy. Meanwhile, Sweden and Denmark are the countries which benefit the most. Not by coincidence, they have the largest size of government. The third column shows results for a decrease of 0.01 in the regulation cost. This time, the countries which benefit more were exactly the countries with lower regulation. This is not surprising, since those are the countries with the largest percentage decrease in regulation.

4.2.2 A counterfactual experiment

The purpose of this counterfactual experiment is to explore the shadow value of regulation. What reduction in the regulation cost κ is needed to achieve the level of informality of Switzerland, 8.6%?[17] The following table presents the answer to this question.

TABLE 6 GOES HERE

Once more, the countries benefitting the most are those with a large regulation. The average unweighted increase in consumption is 2.1%. It is important to mention that this experiment is done keeping the level of government expenditures of the baseline calibration and holding taxes and enforcement constant. Comparing these gains to those

[17] Switzerland was chosen because it has the informal sector with the lowest size in the sample of 29 countries.

obtained reforming taxes and enforcement gives another indication that the reduction in regulation can be a more effective policy in both increasing welfare and reducing the size of the informal sector.

5 Accounting for income differences

One interesting question that can be answered with the baseline model is to what extent the distortions associated with informality can account for the income differences among the richest and the poorest countries. Since λ, total factor productivity works as a level parameter in the model, I set it equal to 1 for all countries in the baseline calibration so that TFP differences do not influence the results. Therefore, the level of formal output computed for the baseline calibration, Y_F, only captures the effects due to regulation, enforcement, and taxation associated with the size of the informal economy in each country. When comparing Y_F to measures of actual per capita GDP, the correlation is very strong, as can be observed in the following plot. To be more concrete, the R^2 of regressing GDP per capita from the data on Y_F is 0.58. This is an indication that the distortions associated with informality play a role in accounting for income differences across countries.

Let the total-factor productivity parameter λ be calibrated so that per capita GDP in the model, Y_F, equals the value in the data. The first result is that the calibrated λ is also strongly correlated with measures of TFP in the data. This is very reassuring. The correlation between λ and a measure of TFP computed by Hall and Jones (1999) is 0.7 and significant at the 1% level.

Table 7 brings figures for: (1) actual GDP per capita (PPP, measured in current US$) in 1999; (2) the same figure relative to the U.S level; (3) the computed output per capita (Y_F) with $\lambda = 1$; (4) the ratio between Y_F and Y_F^{USA}, the U.S. formal output per capita; (5) the TFP λ relative to that of the U.S.; and (6) the Hall and Jones's (1999) TFP A relative to the U.S.

Hall and Jones (1999) report that the richest countries in the world have an output per worker that is roughly 35 times that of the poorest countries. Not surprisingly, the U.S. per capita GDP is much higher than that of Burkina Faso, for example (just to do the same

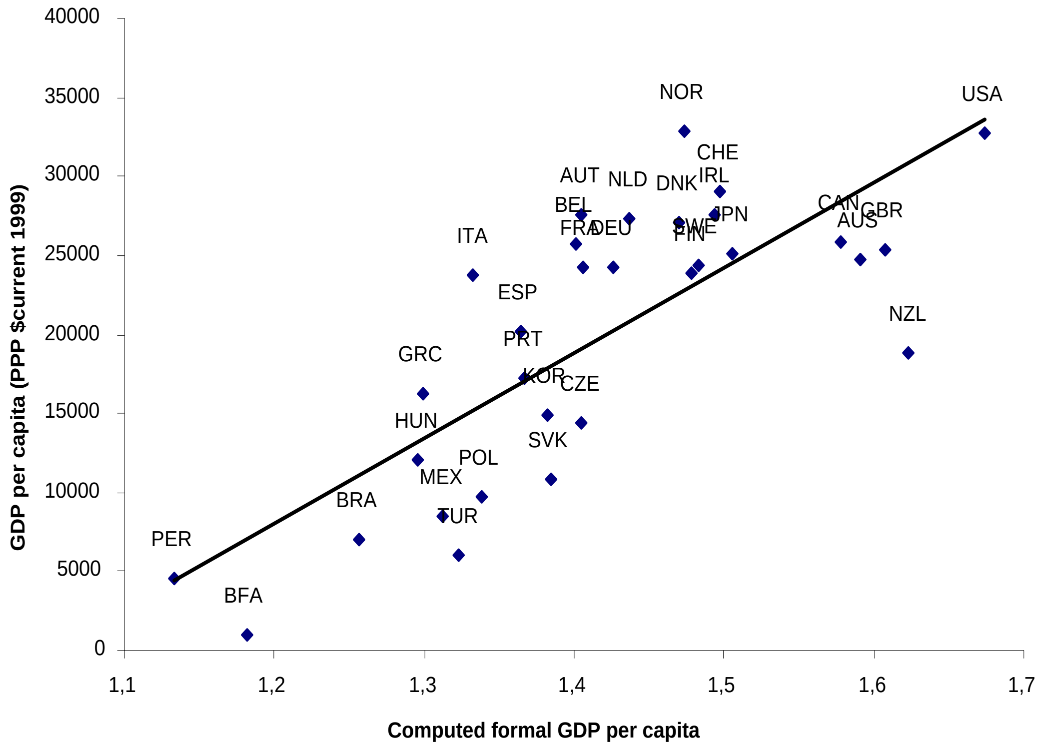

Figure 3: GDP per capita: data vs. model

kind of income comparision between the top and bottom 5% countries). Following Hall and Jones (1999), we can break down the differences in the actual output into differences associated with savings, human capital, and total factor productivity. The last item is a remainder and can be considered to capture differences in "social infrastructure", a term used by Hall and Jones (1999). They argue that savings rates account for a factor of 1.5 and human capital accounts for a factor of 3. We observe that Y_F^{USA} is higher by a factor of 1.5 in our model. It is not huge, but it is nontrivial. Building on Hall and Jones (1999), I conclude that regulation, enforcement, and taxation of formal activities leading to a large informal sector account for roughly a factor of 1.5 of the output differences. TFP differences account for the remaining factor of 5, so that $1.5 \times 3 \times 1.5 \times 5 \approx 35$.

TABLE 7 GOES HERE

6 Concluding Remarks

I construct a simple general-equilibrium micro-founded model to quantitatively account for the degree of informality across countries. In the model, firms choose to which sector to belong based on proportional taxation in the formal sector, "regulation" of formal firms (fixed, red-tape cost κ), and enforcement of/punishment against informality. Sufficiently large firms find formality to be beneficial. Using the model, I back out what enforcement level is needed, country by country, to match the data for 29 countries. The model quantitatively accounts for the degree of informality and other key aspects, such as size of government, regulation costs, and income differences. The computed enforcement is positively correlated with indirect measures of tax compliance. Moreover, enforcement is positively correlated with regulation and government expenditures and, as expected, negatively correlated with the size of the informal sector. I find that there is some scope for policy reform (using e and τ as instruments). In general, most countries would do better to decrease informality, although some would benefit from increasing it. In both cases, the welfare gains can be fairly large. The countries benefiting the most are those with lower regulation costs.

The previous result suggests that regulation plays a significant role in the equilibrium determination and its reduction can potentially be a more effective policy for increasing private consumption and reducing informality. In particular, since regulation is a distortion in the formal sector, it should be zero. Then, I look at what countries would gain from decreasing regulation (κ), in a hypothetical exercise. I do not have a model for determining the regulation cost, but I can compute the shadow value of decreasing regulation. Thus, we do not know how much it would cost to allow this decrease, but my model allows us to compute the benefits. The result is that benefits are very large, almost twice the welfare gains of reforming taxes and enforcement. Finally, I perform some counterfactual experiments by reducing the regulation cost. I conclude that a policy reducing this waste factor in the economy has a positive impact on the supply of both private and publicly provided goods, effectively reducing the informal sector.

A by-product of the model is that I can account for how the distortions associated with informality reduce output per capita across countries. The output per capita and total-factor productivity delivered by the model are highly correlated with its counterpart in the data. I find that the aforementioned distortions account for a factor of 1.5 of the output per capita difference between the richest and the poorest countries.

References

[1] Amaral, Pedro S. and Erwan Quintin (2006): "A Competitive Model of the Informal Sector", *Journal of Monetary Economics*, 53, 1541-1553.

[2] Antunes, Antonio R. and Tiago V. de V. Cavalcanti (2007): "Start Up Costs, Limited Enforcement, and the Hidden Economy", *European Economic Review*, 51, 203-224.

[3] Azuma, Yoshiaki and Herschel I. Grossman (2003): "A Theory of the Informal Sector", mimeo.

[4] Banerjee, Abhijit V. (1997): "A Theory of Misgovernance", *The Quarterly Journal of Economics*, 112, 1289-1332.

[5] Bernard, Andrew B., Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum (2003): "Plants and Productivity in International Trade", *American Economic Review*, 93,1268–1290.

[6] De Soto, Hernando (1989) The Other Path: the Invisible Revolution in the Third World, Harper and Row.

[7] Djankov, Simeon, Rafael La Porta, Florencio Lopez-de-Silanes and Andrei Shleifer (2002a): "The Regulation of Entry," *The Quarterly Journal of Economics*, 117, 1-37.

[8] Djankov, Simeon, Ira Lieberman, Joyita Mukherjee, and Tatiana Nenova (2002b): "Going Informal: Benefits and Costs," mimeo.

[9] Farrell, Diana (2004): "The hidden dangers of the informal economy". *McKinsey Quarterly*, 3, 26–37.

[10] Fortin, Bernard, Nicolas Marceau and Luc Savard (1997): "Taxation, Wage Controls, and the Informal Sector", *Journal of Public Economics*, 66, 293-312.

[11] Friedman, Eric, Simon Johnson, Daniel Kaufmann, and Pablo Zoido-Lobaton (2000): "Dodging the grabbing hand: the determinants of unofficial activity in 69 countries", *Journal of Public Economics*, 76, 459-493.

[12] Ghironi, Fabio and Marc J. Melitz (2005): "International Trade and Macroeconomic Dynamics with Heterogeneous Firms", *The Quarterly Journal of Economics*, 120, 865-915.

[13] Gordon, Roger and Wei Li (2005): "Tax Structures in Developing Countries: Many Puzzles and a Possible Explanation", NBER Working Paper # 11267, April 2005.

[14] Hall, Robert E. and Charles I. Jones (1999): "Why do some countries produce so much more output per worker than others?", *The Quarterly Journal of Economics*, 114, 83-116.

[15] Hopenhayn, Hugo (1992): "Entry, Exit, and Firm Dynamics in Long Run Equilibrium", *Econometrica*, 60, 1127-1150.

[16] Loayza, Norman V. (1996): "The economics of the informal sector: a simple model and some empirical evidence from Latin America", *Carnegie-Rochester Conference Series on Public Policy*, 45, 129-162.

[17] Lucas, Robert E., Jr. (1978): "On the Size Distribution of Business Firms", *Bell Journal of Economics*, 9, 508-523.

[18] Melitz, Marc J. (2003): "The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity", *Econometrica*, 71, 1695-1725.

[19] OECD (2003): "Revenue Statistics 1965-2002", *Revenue Statistics*, 4, 1-319.

[20] OECD (2004): "Tax Administration in OECD Countries: Comparative Information Series", mimeo.

[21] Paula, Aureo de and José A. Scheinkman (2007): "The Informal Sector", mimeo, Princeton University and University of Pennsylvania.

[22] Polinsky, A. Mitchell and Steven Shavell (2000): "The Economic Theory of Public Enforcement of Law", *Journal of Economic Literature*, 38, 45-76.

[23] Rausch, James E. (1991): "Modelling the Informal Sector Formally", *Journal of Development Economics*, 35, 33-47.

[24] Sarte, Pierre-Daniel G. (2000): "Informality and Rent-Seeking Bureaucracies in a Model of Long-Run Growth", *Journal of Monetary Economics*, 46, 173-197.

[25] Schneider, Friedrich (2007): "Shadow Economies and Corruption all over the World: New Estimates for 145 Countries", Johannes Kepler University of Linz, mimeo.

[26] Schneider, Friedrich and Dominik H. Enste (2000): "Shadow Economies: Size, Causes and Consequences", *Journal of Economic Literature*, 38, 77-114.

[27] Tybout, James R. (2000): "Manufacturing Firms in Developing Countries: How Well Do They Do, and Why?", *Journal of Economic Literature*, 38, 11-44.

[28] World Bank (2006): "World Development Indicators," available at `http://devdata.worldbank.org/dataonline/`

Appendix (Not necessarily to be published)

A1 Basics of the model

Individual good demand Define the aggregate output Y as the numeraire in the economy. We can maximize it subject to the constraint that the sum of the value of the required varieties should equal the total value of production.

$$\max_{y(z)} Y \equiv \max_{y(z)} \left(\int_{z \in \Omega} y(z)^{(\theta-1)/\theta} dF(z) \right)^{\theta/(\theta-1)}, \tag{28}$$

subject to:

$$\int_{z \in \Omega} p(z) y(z) dF(z) = Y \tag{29}$$

Maximizing the above problem yields the following first-order condition:

$$y(z)^{-1/\theta} \left(\int_{z \in \Omega} y(z)^{(\theta-1)/\theta} dF(z) \right)^{1/(\theta-1)} = \mu p(z),$$

where μ is the multiplier in the constraint. We can now multiply $y(z)$ on both sides of the above expression:

$$\begin{aligned}
y(z)^{(\theta-1)/\theta} \left(\int_{z \in \Omega} y(z)^{(\theta-1)/\theta} dF(z) \right)^{1/(\theta-1)} &= \mu p(z) y(z) && (30) \\
\int_{z \in \Omega} y(z)^{(\theta-1)/\theta} dF(z) \left(\int_{z \in \Omega} y(z)^{(\theta-1)/\theta} dF(z) \right)^{1/(\theta-1)} &= \int_{z \in \Omega} \mu p(z) y(z) dF(z) \\
Y &= \mu Y \\
\mu &= 1. && (31)
\end{aligned}$$

Now we can substitute the multiplier in the FOC:

$$\begin{aligned}
y(z)^{-1/\theta} \left(\int_{z \in \Omega} y(z)^{(\theta-1)/\theta} dF(z) \right)^{1/(\theta-1)} &= p(z) \\
y(z)^{-1/\theta} Y^{1/\theta} &= p(z) \\
y(z)^{-1/\theta} &= Y^{-1/\theta} p(z) \\
y(z) &= Y p(z)^{-\theta}. && (32)
\end{aligned}$$

The rest of the algebra follows directly and equation (32) gives the individual demand for good z.

Firms' profit maximization problem The price charged by a firm with productivity z in the sector $J = F, I$ is derived below from the firms' profit maximization problem (2), subject to individual demand (7).

$$\max_{p_J(z)} \Pi(z) \equiv (1 - \tau\mathcal{I}_F - e\mathcal{I}_I)p_J(z)y(z) - wl(z) - \mathcal{I}_F w\kappa,$$

subject to

$$y(z) = Y p_J(z)^{-\theta}.$$

We can start by replacing $l(z)$ by the production function (1). Then, we can replace $y(z)$ by individual demand into the objective function:

$$\Pi(z) = \max_{p_J(z)} (1 - \tau\mathcal{I}_F - e\mathcal{I}_I)p_J(z)Y p_J(z)^{-\theta} - w\frac{Y p_J(z)^{-\theta}}{\lambda z} - \mathcal{I}_F w\kappa.$$

Now, we can take a first-order condition with respect to $p_J(z)$:

$$\begin{aligned}
(1-\theta)(1 - \tau\mathcal{I}_F - e\mathcal{I}_I)Y p_J(z)^{-\theta} + \theta\frac{wY}{\lambda z}p_J(z)^{-\theta-1} &= 0 \\
(1-\theta)(1 - \tau\mathcal{I}_F - e\mathcal{I}_I)p_J(z) + \theta\frac{w}{\lambda z} &= 0 \\
(\theta-1)(1 - \tau\mathcal{I}_F - e\mathcal{I}_I)p_J(z) &= \theta\frac{w}{\lambda z}.
\end{aligned}$$

And the price of good z is:

$$p_J(z) = \frac{\theta}{(\theta-1)}\frac{1}{(1 - \tau\mathcal{I}_F - e\mathcal{I}_I)}\frac{w}{\lambda z}. \tag{33}$$

A2 Equilibrium conditions

Profit crossing condition We start with condition (16):

$$\frac{(1-\tau)}{\theta}\left[p_F(z^*)\right]^{1-\theta} Y - w\kappa = \frac{(1-e)}{\theta}\left[p_I(z^*)\right]^{1-\theta} Y.$$

Using the expression for the price condition (9), we get:

$$\begin{aligned}
\frac{(1-\tau)}{\theta}\left[\frac{(1-e)}{(1-\tau)}p_I(z^*)\right]^{1-\theta} Y - w\kappa &= \frac{(1-e)}{\theta}\left[p_I(z^*)\right]^{1-\theta} Y \\
\frac{(1-\tau)^{\theta}}{\theta}(1-e)^{1-\theta}\left[p_I(z^*)\right]^{1-\theta} Y - w\kappa &= \frac{(1-e)}{\theta}\left[p_I(z^*)\right]^{1-\theta} Y
\end{aligned}$$

$$\left\{(1-\tau)^{\theta}(1-e)^{-\theta} - 1\right\}\frac{(1-e)\left[p_I(z^*)\right]^{1-\theta}}{\theta} = \frac{w\kappa}{Y}.$$

Now, we can use replace the price function by (8):

$$\begin{aligned}
\left[\left(\frac{1-\tau}{1-e}\right)^{\theta}-1\right]\frac{(1-e)\left[\frac{\theta}{(\theta-1)}\frac{1}{(1-e)}\frac{w}{\lambda z^{*}}\right]^{1-\theta}}{\theta} &= \frac{w\kappa}{Y} \\
\left[\left(\frac{1-\tau}{1-e}\right)^{\theta}-1\right](1-e)\left[\frac{\theta}{(\theta-1)}\frac{1}{(1-e)\lambda}\right]^{1-\theta}\frac{z^{*\theta-1}w^{1-\theta}}{\theta\kappa} &= \frac{w}{Y}
\end{aligned}$$

$$\left[\left(\frac{1-\tau}{1-e}\right)^{\theta}-1\right]\left(\frac{\theta}{\theta-1}\right)^{1-\theta}\frac{(1-e)^{\theta}\left(\lambda z^{*}\right)^{\theta-1}}{\theta\kappa}=\frac{w^{\theta}}{Y} \tag{34}$$

Labor-market clearing condition We start with the condition (18) and apply the parametrization in subsection 3.4:

$$\begin{aligned}
L_F+L_I+\kappa N^F &\equiv L \\
\int_{z_{\min}}^{\infty}\frac{y(z)}{\lambda z}dF(z)+\kappa(1-F(z^{*})) &= L \\
\int_{z_{\min}}^{\infty}\frac{y(z)}{\lambda z}kz_{\min}^{k}z^{-k-1}dz+\kappa\left(z_{\min}/z^{*}\right)^{k} &= L
\end{aligned}$$

We can replace $y(z)$ by (7):

$$\begin{aligned}
\int_{z_{\min}}^{\infty}\frac{Yp_J(z)^{-\theta}}{\lambda}kz_{\min}^{k}z^{-k-2}dz+\kappa\left(z_{\min}/z^{*}\right)^{k} &= L \\
\int_{z_{\min}}^{z^{*}}p_I(z)^{-\theta}z^{-k-2}dz+\int_{z^{*}}^{\infty}p_F(z)^{-\theta}z^{-k-2}dz &= \frac{L-\kappa\left(z_{\min}/z^{*}\right)^{k}}{Yk\lambda^{-1}z_{\min}^{k}}
\end{aligned}$$

We can now use the the price functions (8) to get:

$$\int_{z_{\min}}^{z^{*}}\left[\frac{\theta}{(\theta-1)}\frac{1}{(1-e)}\frac{w}{\lambda z}\right]^{-\theta}z^{-k-2}dz+\int_{z^{*}}^{\infty}\left[\frac{\theta}{(\theta-1)}\frac{1}{(1-\tau)}\frac{w}{\lambda z}\right]^{-\theta}z^{-k-2}dz=$$

$$=\frac{L-\kappa\left(z_{\min}/z^{*}\right)^{k}}{Yk\lambda^{-1}z_{\min}^{k}}$$

$$(1-e)^{\theta}\int_{z_{\min}}^{z^{*}}z^{\theta-k-2}dz+(1-\tau)^{\theta}\int_{z^{*}}^{\infty}z^{\theta-k-2}dz=$$

$$=\left[\frac{\theta}{(\theta-1)}w\right]^{\theta}\frac{L-\kappa\left(z_{\min}/z^{*}\right)^{k}}{Yk\lambda^{\theta-1}z_{\min}^{k}}$$

We can rearrange the terms to get the desired final expression:

$$\left[(1-e)^{\theta}\int_{z_{\min}}^{z^*} z^{\theta-k-2}dz + (1-\tau)^{\theta}\int_{z^*}^{\infty} z^{\theta-k-2}dz\right]\times$$
$$\times\left[\frac{\theta}{(\theta-1)}\right]^{-\theta}\frac{kz_{\min}^{k}\lambda^{\theta-1}}{L-\kappa\left(z_{\min}/z^*\right)^{k}} = \frac{w^{\theta}}{Y} \qquad (35)$$

Equilibrium condition for the threshold z^* We can then equate equations (34) and (35), cancel out some terms and and get:

$$\left[(1-e)^{\theta}\int_{z_{\min}}^{z^*} z^{\theta-k-2}dz + (1-\tau)^{\theta}\int_{z^*}^{\infty} z^{\theta-k-2}dz\right]\left[\frac{\theta}{(\theta-1)}\right]^{-\theta}\times$$
$$\times\frac{kz_{\min}^{k}\lambda^{\theta-1}}{L-\kappa\left(z_{\min}/z^*\right)^{k}} = \left[\left(\frac{1-\tau}{1-e}\right)^{\theta}-1\right]\left(\frac{\theta}{\theta-1}\right)^{1-\theta}\frac{(1-e)^{\theta}\left(\lambda z^*\right)^{\theta-1}}{\theta\kappa}$$
$$\left[(1-e)^{\theta}\int_{z_{\min}}^{z^*} z^{\theta-k-2}dz + (1-\tau)^{\theta}\int_{z^*}^{\infty} z^{\theta-k-2}dz\right]\frac{kz_{\min}^{k}}{L-\kappa\left(z_{\min}/z^*\right)^{k}} =$$
$$= \left[(1-\tau)^{\theta}-(1-e)^{\theta}\right]\frac{z^{*\theta-1}}{(\theta-1)\kappa} \qquad (36)$$

Goods' market condition

$$\begin{aligned} Y &= \left(\int_{z_{\min}}^{\infty} y(z)^{(\theta-1)/\theta}dF(z)\right)^{\theta/(\theta-1)} \\ Y &= \left(\int_{z_{\min}}^{z^*} y(z)^{(\theta-1)/\theta}dF(z) + \int_{z^*}^{\infty} y(z)^{(\theta-1)/\theta}dF(z)\right)^{\theta/(\theta-1)} \end{aligned}$$

We can replace $y(z)$ by (7):

$$\begin{aligned} Y &= \left(\int_{z_{\min}}^{z^*}\left[Yp_I(z)^{-\theta}\right]^{(\theta-1)/\theta}dF(z) + \int_{z^*}^{\infty}\left[Yp_F(z)^{-\theta}\right]^{(\theta-1)/\theta}dF(z)\right)^{\theta/(\theta-1)} \\ Y &= \left(Y^{(\theta-1)/\theta}\int_{z_{\min}}^{z^*} p_I(z)^{1-\theta}dF(z) + Y^{(\theta-1)/\theta}\int_{z^*}^{\infty} p_F(z)^{1-\theta}dF(z)\right)^{\theta/(\theta-1)} \\ 1 &= \left(\int_{z_{\min}}^{z^*} p_I(z)^{1-\theta}dF(z) + \int_{z^*}^{\infty} p_F(z)^{1-\theta}dF(z)\right)^{\theta/(\theta-1)} \end{aligned}$$

We use the price expressions (8) to substitute for $p_J(z)$:

$$\left[\frac{\theta}{(\theta-1)}\frac{w}{\lambda}\right]^{\theta-1} = (1-e)^{\theta-1}\int_{z_{\min}}^{z^*} z^{\theta-1}dF(z) + (1-\tau)^{\theta-1}\int_{z^*}^{\infty} z^{\theta-1}dF(z)$$

Rearranging some terms and applying the parametrization in subsection 3.4 yields the desired expression:

$$w^{\theta-1} = kz_{\min}^{k}\left(\frac{(\theta-1)\,\lambda}{\theta}\right)^{\theta-1}\left\{(1-e)^{\theta-1}\frac{z^{*\theta-k-1}-z_{\min}^{\theta-k-1}}{\theta-1-k}-(1-\tau)^{\theta-1}\,\frac{z^{*\theta-k-1}}{\theta-1-k}\right\}$$

Tables

Table 1: General baseline calibration

Parameter	Economic interpretation	Value
$z_{\min}$	lowest productivity value	1
k	parameter productivity distribution	3.4
θ	elasticity of substitution across goods	3.8
L	labor supply	1
λ	total-factor productivity	1

Table 2: Baseline computation

Countryname	Data			Model		
	G/Y_F	Informal/Y_F	Regulation cost	τ	κ	e
United States	28.9	8.7	0.0205	0.289	0.0355	0.3369
Australia	30.8	14.3	0.0292	0.308	0.0495	0.3553
Korea	23.6	27.5	0.2526	0.236	0.3509	0.3677
New Zealand	33.9	12.8	0.0169	0.339	0.0305	0.3688
Mexico	17.3	30.1	0.7682	0.173	0.9748	0.3803
Canada	35.9	16.0	0.0211	0.359	0.0382	0.3891
United Kingdom	36.1	12.7	0.0290	0.361	0.0538	0.4081
Brazil	31.7	39.8	0.5362	0.317	0.7681	0.4344
Turkey	31.3	32.1	0.3781	0.313	0.5648	0.4376
Ireland	31.0	15.9	0.1515	0.310	0.2497	0.4513
Japan	26.4	11.2	0.2104	0.264	0.3322	0.4803
Norway	40.4	19.1	0.1158	0.404	0.2161	0.4953
Poland	35.0	27.6	0.4641	0.350	0.7503	0.4958
Portugal	34.0	22.7	0.4768	0.340	0.7806	0.5122
Spain	35.0	22.7	0.4846	0.350	0.8046	0.5206
Greece	37.0	28.7	0.7692	0.370	1.2702	0.5335
Slovak Rep	34.4	18.9	0.4940	0.344	0.8285	0.5384
Switzerland	29.8	8.6	0.2422	0.298	0.4011	0.5442
Czech Rep	38.9	19.1	0.3324	0.389	0.5974	0.5460
Finland	47.0	18.1	0.1071	0.470	0.2250	0.5508
Germany	37.7	16.0	0.3203	0.377	0.5738	0.5532
Italy	43.3	27.1	0.4407	0.433	0.8122	0.5595
Belgium	45.3	22.2	0.2316	0.453	0.4562	0.5612
Hungary	39.1	25.1	1.0068	0.391	1.7445	0.5773
Sweden	52.3	19.2	0.0746	0.523	0.1733	0.5773
Denmark	51.5	18.0	0.1104	0.515	0.2522	0.5907
Netherlands	41.2	13.1	0.3016	0.412	0.5764	0.5940
France	45.7	15.2	0.3472	0.457	0.7059	0.6197
Austria	44.0	9.8	0.4140	0.440	0.8253	0.6578

Source: Data: Djankov et al (2002a), OECD(2003), Schneider (2006); Model: own computations

Table 3: Relation of enforcement and regulation, informality, and government size

	(1)	(2)	(3)	(4)
Regulation	0.097**	0.101***	0.148***	0.135***
	(0.038)	(0.022)	(0.041)	(0.022)
Size of government		0.008***		0.008***
		(0.001)		(0.001)
Informality			-0.005**	-0.004***
			(0.002)	(0.001)
constant	0.446***	0.145***	0.521***	0.215***
	(0.025)	(0.042)	(0.039)	(0.044)
Adj. R-squared	0.17	0.73	0.29	0.79

*Notes: Number of observations: 29. Standard errors in parenthesis: *significant at 10%; **significant at 5%; ***significant at 1%*

Table 4: Policy reforms on taxes and enforcement

	Benchmark			Optimal policy			
Countryname	τ	e	Y_I/Y_F	τ^*	e^*	$\Delta C(\%)$	Y_I/Y_F
United States	0.289	0.3369	8.7	0.2699	0.3552	1.69	0.0
Australia	0.308	0.3553	14.3	0.2784	0.3924	2.23	0.5
Korea	0.236	0.3677	27.5	0.2408	0.3591	0.06	30.9
New Zealand	0.339	0.3688	12.8	0.3055	0.3710	3.90	0.0
Mexico	0.173	0.3803	30.1	0.2041	0.3103	2.00	61.4
Canada	0.359	0.3891	16.0	0.3169	0.3975	4.77	0.0
United Kingdom	0.361	0.4081	12.7	0.3310	0.4388	2.54	0.4
Brazil	0.317	0.4344	39.8	0.3068	0.4445	0.14	33.9
Turkey	0.313	0.4376	32.1	0.3086	0.4432	0.04	29.5
Ireland	0.310	0.4513	15.9	0.3145	0.4408	0.07	18.5
Japan	0.264	0.4803	11.2	0.2828	0.4094	1.52	24.8
Norway	0.404	0.4953	19.1	0.3915	0.5112	0.46	13.4
Poland	0.350	0.4958	27.6	0.3521	0.4929	0.01	28.8
Portugal	0.340	0.5122	22.7	0.3509	0.4923	0.31	29.3
Spain	0.350	0.5206	22.7	0.3603	0.5022	0.28	28.9
Greece	0.370	0.5335	28.7	0.3764	0.5247	0.09	32.4
Slovak Rep	0.344	0.5384	18.9	0.3603	0.5025	0.85	29.2
Switzerland	0.298	0.5442	8.6	0.3187	0.4504	2.65	24.1
Czech Rep	0.389	0.5460	19.1	0.3965	0.5322	0.17	23.3
Finland	0.470	0.5508	18.1	0.4556	0.5653	0.74	12.1
Germany	0.377	0.5532	16.0	0.3892	0.5249	0.61	23.3
Italy	0.433	0.5595	27.1	0.4279	0.5652	0.06	24.5
Belgium	0.453	0.5612	22.2	0.4454	0.5700	0.18	18.6
Hungary	0.391	0.5773	25.1	0.4043	0.5564	2.66	33.2
Sweden	0.523	0.5773	19.2	0.4948	0.5911	0.48	9.0
Denmark	0.515	0.5907	18.0	0.5007	0.6028	0.84	12.2
Netherlands	0.412	0.5940	13.1	0.4256	0.5574	1.10	21.5
France	0.457	0.6197	15.2	0.4678	0.5963	0.70	21.6
Austria	0.440	0.6578	9.8	0.4571	0.5903	3.54	23.3

Table 5: Consumption % increase for different changes in κ

Countryname	-1%	-10%	-0.01
United States	0.05	0.50	1.42
New Zealand	0.04	0.45	1.48
Canada	0.06	0.58	1.52
United Kingdom	0.08	0.84	1.57
Australia	0.07	0.72	1.45
Sweden	0.14	1.43	0.81
Finland	0.12	1.25	0.54
Denmark	0.14	1.45	0.56
Norway	0.10	1.03	0.46
Ireland	0.08	0.81	0.31
Japan	0.07	0.73	0.21
Belgium	0.11	1.20	0.25
Switzerland	0.08	0.82	0.19
Korea	0.06	0.62	0.17
Netherlands	0.10	1.13	0.18
Germany	0.09	1.01	0.16
Czech Rep	0.10	1.05	0.17
France	0.13	1.28	0.17
Turkey	0.04	0.79	0.12
Austria	0.12	1.23	0.14
Italy	0.11	1.13	0.14
Brazil	0.07	0.81	0.11
Poland	0.08	0.89	0.11
Portugal	0.09	0.90	0.11
Spain	0.09	0.93	0.11
Slovak Rep	0.07	0.92	0.11
Greece	0.09	0.96	0.07
Mexico	0.04	0.52	0.04
Hungary	0.12	1.07	0.06

Table 6: Reduction in κ to achieve Swiss informality

Countryname	κ'	$\Delta\kappa$	$\Delta C(\%)$
Switzerland	0.4011	0.0	0.0
United States	0.0353	-0.6	0.0
New Zealand	0.0248	-18.7	0.1
United Kingdom	0.0432	-19.7	0.2
Canada	0.0267	-30.1	0.2
Australia	0.0367	-25.9	0.3
Sweden	0.0926	-46.6	0.7
Austria	0.6813	-17.4	0.8
Japan	0.2477	-25.4	1.0
Denmark	0.1330	-47.3	1.1
Finland	0.1188	-47.2	1.1
Norway	0.1071	-50.4	1.2
Ireland	0.1387	-44.5	1.4
Netherlands	0.3410	-40.8	1.8
Belgium	0.1638	-64.1	2.2
France	0.3404	-51.8	2.3
Germany	0.2663	-53.6	2.4
Korea	0.0986	-71.9	2.5
Czech Rep	0.2254	-62.3	2.7
Turkey	0.1169	-79.3	3.2
Italy	0.1899	-76.6	3.4
Slovak Rep	0.2800	-66.2	3.5
Brazil	0.1096	-85.7	3.6
Poland	0.1688	-77.5	3.6
Portugal	0.2159	-72.3	3.7
Spain	0.2212	-72.5	3.7
Greece	0.2231	-82.4	4.8
Mexico	0.1626	-83.3	5.0
Hungary	0.3216	-81.6	5.4

Table 7: Income and TFP across countries

Country	GDP per capita[a]	GDPpc/GDPpc$^{\text{USA}}$	Y_F	Y_F/Y_F^{USA}	$\lambda/\lambda^{\text{USA}}$	TFP[b]
United States	32732	1.00	1.674	1.00	1.000	1.000
New Zealand	18843	0.58	1.623	0.97	0.594	0.631
Canada	25811	0.79	1.577	0.94	0.837	1.034
United Kingdom	25399	0.78	1.608	0.96	0.808	1.011
Australia	24699	0.75	1.591	0.95	0.794	0.856
Sweden	24377	0.74	1.483	0.89	0.841	0.897
Finland	23900	0.73	1.478	0.88	0.827	0.728
Denmark	27120	0.83	1.469	0.88	0.944	0.705
Norway	32854	1.00	1.474	0.88	1.140	0.699
Ireland	27556	0.84	1.494	0.89	0.943	0.709
Japan	25105	0.77	1.506	0.90	0.853	0.658
Belgium	25743	0.79	1.401	0.84	0.940	0.978
Switzerland	28991	0.89	1.498	0.89	0.990	0.883
Korea. Rep.	14849	0.45	1.382	0.83	0.550	0.580
Netherlands	27332	0.84	1.437	0.86	0.973	0.946
Germany	24231	0.74	1.427	0.85	0.869	0.912
Czech Republic	14442	0.44	1.405	0.84	0.526	0.241
France	24241	0.74	1.405	0.84	0.882	1.126
Turkey	6018	0.18	1.323	0.79	0.233	0.503
Austria	27534	0.84	1.405	0.84	1.002	0.979
Italy	23721	0.72	1.333	0.80	0.910	1.207
Brazil	6985	0.21	1.256	0.75	0.284	0.758
Poland	9726	0.30	1.338	0.80	0.372	0.235
Portugal	17221	0.53	1.367	0.82	0.644	0.755
Spain	20187	0.62	1.365	0.82	0.756	1.107
Slovak Republic	10800	0.33	1.384	0.83	0.399	0.241
Greece	16269	0.50	1.299	0.78	0.640	0.674
Mexico	8433	0.26	1.313	0.78	0.329	0.926
Hungary	12017	0.37	1.296	0.77	0.474	0.293
Peru	4561	0.14	1.133	0.68	0.206	0.409
Burkina Faso	990	0.03	1.182	0.71	0.043	0.101

Source: [a] *World Bank (2006),* [b] *Hall and Jones (1999)*