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Title: **Tax Toleration and Tax Compliance: How Government Affects the Propensity of Firms to Enter the Unofficial Economy**

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Tax Toleration and Tax Compliance: How Government Affects the Propensity of Firms to Enter the Unofficial Economy

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Abstract

We propose a model of how government-supplied institutional benefits and the taxation and regulation of producers affect the propensity of private firms to enter the unofficial economy and evade taxation. Our analysis implies that the incentive of firms to produce underground depends on tax rates relative to firm-specific thresholds of tax toleration that are decisively affected by quality of governance – in particular by the presence of high-grade institutions delivering services that profit-maximizing firms deem worth paying for. Some key predictions of the model concerning the determinants of firms' tax toleration and tax compliance receive broad support from empirical analyses of enterprise-level data from the World Bank's World Business Environment Surveys.

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1 Introduction

Unofficial production of goods and services is a big deal – an activity engaged in by millions of firms employing hundreds of millions of workers and producing trillions of dollars of output internationally.[1] The lion's share of research on the determinants of the scale of the unofficial economy investigates cross-national patterns among aggregate economic and institutional variables. The micro political-economic mechanisms by which institutions, policies and so forth influence the productive behavior of firms are much less well documented and understood, though empirical studies based on national aggregates sometimes draw inferences about the micro processes that might underlie the macro political-economic relationships uncovered.[2]

This paper focuses explicitly on the productive activity of private firms, which compared to individuals are relatively unaffected by moral sentiments – by the guilt and shame individuals may feel when evading taxation and failing to comply with other legal obligations. We propose a micro-level model specifying how institutional benefits, taxation and government regulations rationally influence a profit-maximizing firm's production choices. Unlike models that have firms making 'all or nothing' choices about producing officially or unofficially,[3] a central prediction of our model is that profit-maximizing firms frequently will operate simultaneously in both the official and unofficial sectors.[4] Moreover, contrary to a traditional view that high tax rates are intrinsically a major cause of large shadow economies, our model implies that the incentive of firms to produce underground and evade taxation depends on statutory tax rates relative to firm-specific, rationally calibrated

[1] For our purposes unofficial economic activity is defined by production and sale of goods and services that evade official registration and taxation. Such activity is undertaken either by firms that are not registered officially, or by firms that are registered officially but produce and sell at least part of their output unofficially. Common labels used in place of 'unofficial' are hidden, parallel, underground, shadow, clandestine, black, and unobserved. Schneider and Enste (2000) and Schneider and Enste (2002) are leading recent studies providing detailed discussion of various definitions of the concept and estimates of aggregate national magnitudes.

[2] Loayza (1996), Johnson, Kaufmann, and Shleifer (1997), Johnson, Kaufmann, and Zoido-Lobaton (1998), Friedman, Johnson, Kaufmann, and Zoido-Lobaton (2000) are important examples of research investigating model-derived relationships among government policies, institutions and the underground economy with empirical data for country aggregates. Johnson, Kaufmann, McMillan, and Woodruff (2000) investigates similar empirical relationships in firm-level data for five East European transition countries without reference to an explicit model.

[3] In Johnson, Kaufmann, and Shleifer (1997), for example, the quality of institutions and governance drive firms into an activity equilibrium allowing only one of two stable states: totally official and totally unofficial.

[4] Firm-level interview data indicate that simultaneous activity is commonplace. In the World Bank's WBES (2000) data that we use for empirical analyses in section 3, responses from an international sample of firm managers in 54 countries indicate that more than 60% of registered enterprises to some degree produce unofficially and evade taxes.

thresholds of tax toleration. The concept of firm-specific tax toleration helps explain why tax compliance and unofficial production vary so greatly across enterprises operating in the same national political-institutional environment and facing the same government regulations and tax rates.

The rest of the paper is organized as follows. The production setting of profit maximizing firms that optimally allocate labor and capital to official production, unofficial production, or both is defined in section 2. Official production is subject to taxes and regulations, but it benefits from government supplied and coordinated institutional services unavailable to underground producers. Unofficial production on the other hand escapes regulations and taxation of profits and labor, but it requires firms to bribe enforcement authorities who aim to maximize their own income from public employment and bribes, subject to the likelihood of being discovered selling corruption and suffering the penalties associated therewith. In this setting we derive the circumstances under which a firm will undertake at least some of its production in the underground economy and evade taxes. A central condition for unofficial production and tax evasion to arise is that statutory tax rates exceed firm-specific thresholds of tax toleration. Toleration thresholds are determined, among other things, by government-supplied institutional benefits available only when producing officially and by political-institutional variables affecting the costs of corruption required to produce unofficially. In the remainder of section 2 we graph some implications of the model for the responses of a firm's official, unofficial and total output to changes in tax rates and changes in tax toleration induced by shifts in outside policy variables affecting the demand for and supply of corruption.

In section 3 we test empirically the model's predications concerning the determinants of firms' tax toleration and tax compliance. Regression experiments are based on interview data obtained from managers of 3818 enterprises distributed over 54 countries by the World Bank's World Business Environment Surveys (WBES). Both structural and reduced form regressions yield broad support of the model's testable implications. Concluding observations about the policy implications of our theory and evidence appear in section 4.

2 The Setting

We consider private firms endowed with fixed endowments of capital, $\overline{K}$, and variable labor requirements in two sectors of production: L_o, denoting labor employed in official production, and L_u, denoting labor employed in unofficial production. We assume that the wage, w, is identical in the two sectors, but that labor cost in the official sector is $(1 + t_w) \cdot w$, where the labor tax rate t_w subsumes the formal payroll tax rate, t^L, and regulations on officially employed labor, R^L, imposing costs that are functionally equivalent to conventional labor taxes. k denotes the fraction of its capital that the firm allocates to official production, and $(1 - k)$ is the fraction allocated to unofficial production.[5] A firm's official output, y_o, which is legally declared and subject to taxation, is determined by the following standard Cobb-Douglas type (constant returns to scale) technology:

$$y_o = B^{\delta} \left(k\overline{K}\right)^{\alpha} L_o^{\beta}, \qquad \alpha + \beta + \delta = 1 \qquad \alpha, \beta, \delta > 0 \tag{1}$$

where B denotes the productive value of institutional services available *only* to official activity, such as contract enforcement by courts, police protection of property, customs services and official banking services.[6] We assume that B depends on firm-specific attributes (for example, size, area of activity, complexity of legal organization, managerial sophistication),[7] and country-specific availability of institutional services of given quality supporting official production. Hence even among firms with high need of institutional services owing to their characteristics, inputs of B may be low because of bureaucratic impediments to supply and generic deficiencies of national capacity.

The production of unofficial, untaxed output, y_u, can take no benefit of government institutional

[5] Hence the model abstracts from capital accumulation and each firm's allocation of its capital endowment $\overline{K}$ reveals its disposition to produce in the official and unofficial economies.

[6] In other words institutional services exclusively supporting official production excludes public goods available to both official and unofficial producers. For simplicity we assume there are no 'user costs' attached to B; providing for them would add little to the formal analysis.

[7] The assumption that firms differ with respect to their need for and use of institutional services is consistent with some existing firm-level empirical evidence. For example, in their analysis of enterprises in transition economies Johnson, McMillan, and Woodruff (2002) found that court enforcement of contracts is more important to firms establishing new business relationships than to established firms, and is more important to industries with a relatively low specificity of investments. Data presented in Batra, Kaufmann, and Stone (2002) indicate that small firms by comparison to medium and large firms are less constrained by customs procedures, whereas small- and medium-sized firms are more constrained than large ones by access to official banking institutions.

services. Moreover, in order to employ capital and labor in the underground economy and avoid confiscation of unofficial output by omniscient bureaucrats, firms pursuing shadow operations must engage in corrupt transactions with enforcement officials – tax authorities, customs agents, construction site inspectors, the police and so forth.[8] Inputs of bureaucratic corruption are therefore necessary for a firm to produce and market unofficial output. We denote the quantity of those inputs by units of "C". The production technology of the unofficial sector has the same functional form and parameters of productivity as that of the official sector:

$$y_u = C^{\delta} \left((1-k) \overline{K} \right)^{\alpha} L_u^{\beta}. \tag{2}$$

By contrast to some previous studies that view corruption and bribery as forces driving firms out of official production into the underground economy,[9] equation (2) is based on the idea that the 'grabbing hands' of corrupt bureaucrats serve as 'helping hands' allowing firms to exploit profitable opportunities in the unofficial economy.

A profit maximizing firm needs to decide how much labor to employ in the official and unofficial sectors,[10] how to distribute its capital stock between them, and how much corruption to buy from

[8] The productive activity we model is not "criminal" in the sense that it would be legal if undertaken in the official, taxed economy. In other words, we are not dealing with activities generally treated as criminally illegal (and frequently controlled by criminal organizations), such as the drug trade, smuggling, prostitution and the like.

[9] See for example Choi and Thum (2005), Johnson, Kaufmann, and Shleifer (1997) and Friedman, Johnson, Kaufmann, and Zoido-Lobaton (2000)).

[10] We assume firms may allocate labor freely between official and unofficial activity. Treating labor as a passive resource is of course an abstraction from the real world in which workers as well as firms face incentives and disincentives to participate in the underground economy. The seminal economic analysis of tax compliance among utility maximizing individuals is Alingham and Sandmo (1972). Sandmo (2005) reviews developments in this tradition over the generation following the original 1972 paper.

corruptible bureaucrats.[11] The firm solves the problem

$$\max_{k,L_o,L_u,C} \pi = (1-t)\left[y_o - (1+t_w)\, wL_o\right] + \left[y_u - wL_u - mC\right] \tag{3}$$
$$s.t.\ \ 0 \leq k \leq 1;\ C, L_o, L_u \geq 0;\ \textit{and eqs.}\ (1)-(2).$$

where m denotes the unit price of C, and the tax rate t subsumes the formal profit tax rate, t^F, and regulatory burdens on official activity, R^F, that are analogous to taxes.

2.1 The Bureaucrat's Problem

In any given jurisdiction corruption is supplied monopolistically by a representative public official (a 'bureaucrat') who is responsible for enforcing the tax code and other regulations. We assume that the enforcement bureaucrat is able to accurately detect a firm's unofficial activity, but is willing to overlook it if compensated sufficiently by illegal payments.[12] The bureaucrat receives a salary equal to S. If involved in corrupt transactions and not caught, the bureaucrat enjoys additional income from bribes equal to $m \cdot C$. If discovered to be selling corruption, the bureaucrat loses employment and pays a fixed penalty P. The bureaucrat's expected income, $E(y_b)$, then is:

$$E(y_b) = \theta(S + mC) - (1-\theta)P \tag{4}$$

where $(1-\theta)$ is the probability that the bureaucrat is discovered to be selling C.

[11] Firms producing officially may also pay bribes to obtain or to speed up delivery of B from recalcitrant government authorities. (See Shleifer and Vishny (1993).) And both official and unofficial producers may engage mafia-type organizations to obtain criminally (and, indeed, sometimes more effectively) such official services as contract enforcement. We make no attempt to model such complications and confine attention to the bureaucratic corruption and bribery necessary for a firm to produce in the underground economy. Incorporating bribery to official activity would lead to results dependent upon relative corruption in the two sectors, without qualitatively affecting our conclusions. The path-breaking study of Peru by De Soto (1989) found that bribe payments by unofficial businesses vastly exceeded those made by official businesses.

[12] The setup below has elements in common with the rich, more complex model of Mookherjee and Png (1995) which is oriented to firms that pay bribes in order to evade pollution regulations. The basic setup involving the interplay of three constituents – an outside exposure or monitoring mechanism, and buyers and sellers of corruption – was pioneered by Klitgaard (1988). The seminal work launching modern social science treatment of corruption more generally is Rose-Ackerman (1978).

The probability θ is determined by an exogenous (un-modelled) mechanism exposing corruption

$$\theta = e^{-\mu C}, \qquad \mu > 0 \tag{5}$$

where μ indexes the effectiveness of exposure procedures at given C which is assumed to vary with firm-specific characteristics affecting the visibility of transactions in the corruption market.[13] Note that $\dfrac{\partial \theta}{\partial C} = -\mu e^{-\mu C} < 0$, so that the more units of corruption sold by the bureaucrat, the higher the chances $(1-\theta)$ of being caught and penalized. However if the exposure mechanism is weak (μ is small), the probability of being caught tends to be small, even when C is large.[14]

The bureaucrat's problem is to set a price m per unit of corruption that maximizes expected income (4), subject to (5) and the firm's demand for corruption. The optimal solution to the bureaucrat's problem yields the supply relation[15]

$$m = \frac{\mu\,(S+P)}{1-\mu C}\ . \tag{6}$$

Equation (6) implies that enforcement bureaucrats will supply corruption and overlook tax evasion only if firms will pay a unit price m higher than a minimum defined by $\underline{m} = \mu\,(S+P)$. The minimum acceptable price $\underline{m}$ rises as the bureaucrat's salary S increases, as the mechanism for exposing corruption becomes more effective (as μ increases), and as punishment becomes more stringent (as P increases). In other words, the higher are μ, S, and P, the more costly it is to induce bureaucrats to supply corruption. And the greater is the demand for corruption, the higher is the unit price of C acceptable to bureaucrats at given risks of exposure and punishment. Equation (6) also implies that a finite positive equilibrium price for corruption can exist only when $C < \dfrac{1}{\mu}$, reinforcing the point that the less effective are procedures for detecting corruption, the less

[13] The most important characteristics affecting visibility are likely to be aspects of firm size – for example, the magnitudes of the firm's capital stock $\overline{K}$ and its labor force L.

[14] If the exposure likelihood of corrupt transactions were to depend, say negatively, on their society-wide incidence ("$\overline{C}$") then multiple equilibria may arise of the sort studied by Andvig and Moene (1990). We make no attempt to analyze such complexities here.

[15] Proofs of all results asserted in the paper are given in an Appendix of Proofs available by request to the authors or at Douglas Hibbs's website: www.douglas-hibbs.com.

constrained is its supply from the bureaucracy, and the higher is the likelihood that a market for corruption will exist.[16]

2.2 Unofficial Production and the Existence of a Corruption Market

Assume that the firm has perfect information about the bureaucrat's supply schedule in (6). For given positive values B, t, t_w, μ, S, and P, the firm's maximization program in (3) admits two solutions: (1) an interior solution where the firm allocates capital and labor to both official and unofficial production, and (2) a corner solution where labor and capital are allocated wholly to official production. In the first case the firm enters into corrupt transactions with bureaucrats in order to protect its unofficial output, whereas in the second the firm has no incentive to evade taxes and produce unofficially, and thus has no need of C.[17] We consider the two cases sequentially.

When the firm finds it optimal to produce in both sectors simultaneously, the profit maximizing levels of output are:

$$y_o = \left(\frac{Bm}{\delta}\right)(1-t)^{\frac{\alpha}{\delta}}\left(\frac{1}{1+t_w}\right)^{\frac{\beta}{\delta}} \tag{7}$$

$$y_u = \left(\frac{\delta}{m}\right)^{\frac{\delta}{\alpha}}\left(\frac{\beta}{w}\right)^{\frac{\beta}{\alpha}}(1-k)\overline{K} \tag{8}$$

where the share of capital allocated to official production is

$$k = \frac{(1-t)^{\frac{\alpha+\delta}{\delta}} B \left(\frac{1}{1+t_w}\right)^{\frac{\beta}{\delta}}}{\left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w}\right)^{\frac{\beta}{\alpha}}}.$$

[16] Complicit firms are not punished in the same fashion as enforcement authorities discovered selling corruption because profit from unofficial production in (3) is not affected directly by the exposure probability $(1-\theta)$. Instead exposure effectiveness depresses profit via the positive effect of μ on the price of corruption m. Modifying the structure of penalties and costs falling on bureaucrats and firms yields analytical results qualitatively similar to those derived for the present model, though some plausible variations complicate enormously the comparative statics.

[17] The third hypothetical possibility in which the firm operates wholly in the unofficial sector emerges only in the fanciful case of confiscatory taxation ($t = 1$), or more realistically when official institutional services are either not needed by the firm or are not provided to any meaningful extent by government ($B = 0$). Small operations delivering personal services (often single-person 'firms') probably are the most common example of cases in which the value of B is practically zero, but our analysis does not feature such producers.

Intuitively, equations (7)-(8) can be interpreted as saying that the firm decides how much output to produce in the two sectors by first determining the maximum output it could produce in the unofficial sector where it avoids taxes on profits and labor. Setting $k = 0$ on the right-side of (8) gives notional maximum unofficial output as $y_u \max = \left(\frac{\delta}{m}\right)^{\frac{\delta}{\alpha}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{\alpha}} \overline{K}$. The firm then implicitly trades off part of $y_u \max$ for taxable output y_o up to the point where institutional benefits to official production compensate the firm for the tax liabilities incurred by producing officially. It follows that the firm will find it profitable to operate to some degree unofficially ($k < 1$ and $y_u > 0$) only if

$$\left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{\alpha}} \overline{K} > (1-t)^{\frac{\alpha+\delta}{\delta}} \left(\frac{1}{1+t_w}\right)^{\frac{\beta}{\delta}} B. \tag{9}$$

For a given capital stock $\overline{K}$, condition (9) indicates that the firm engages in tax evasion when cheap corruption and a low wage level in the underground sector combine with high profit taxation, high non-wage costs on officially employed labor and deficient institutional services in the official sector.

Recall from the analysis of the bureaucrat's problem that a positive supply of corruption requires m to be above the minimum price $\underline{m} = \mu(S + P)$. The firm, on the other hand, needs to pay bribes to purchase C only if it is active in the unofficial sector ($y_u > 0$), which by (9) requires that

$$m < \delta \left(\frac{\overline{K}}{B}\right)^{\frac{\alpha}{\alpha+\delta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{(\alpha+\delta)}} (1-t)^{-\frac{\alpha}{\delta}} (1+t_w)^{\frac{\beta\alpha}{\delta(\alpha+\delta)}}. \tag{10}$$

The right-side of (10) therefore defines the upper bound of C's unit price, which we denote $\overline{m}$. Corrupt transactions between firms and bureaucrats will exist only if $\underline{m} < \overline{m}$, that is only if

$$\mu(S + P) < \delta \left(\frac{\overline{K}}{B}\right)^{\frac{\alpha}{\alpha+\delta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{(\alpha+\delta)}} (1-t)^{-\frac{\alpha}{\delta}} (1+t_w)^{\frac{\beta\alpha}{\delta(\alpha+\delta)}}. \tag{11}$$

When (11) holds, firms and enforcement bureaucrats will agree on a unique price for units of C, and an active corruption market enabling unofficial production will exist.

The firm's demand for corruption, implied by the first order condition for C in (3), is

$$C = \left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{\alpha}} (1-k)\overline{K} \tag{12}$$

where recall that k is a positive function of B, m and w and a negative function of t, t_w and $\overline{K}$ (see eq. 8). Figure 1 uses sensible values for terms in the corruption supply and demand functions (eqs. 6 and 12) to show that a unique equilibrium (m^*, C^*) exists in the admissible range $(\underline{m},\ \overline{m})$.[18]

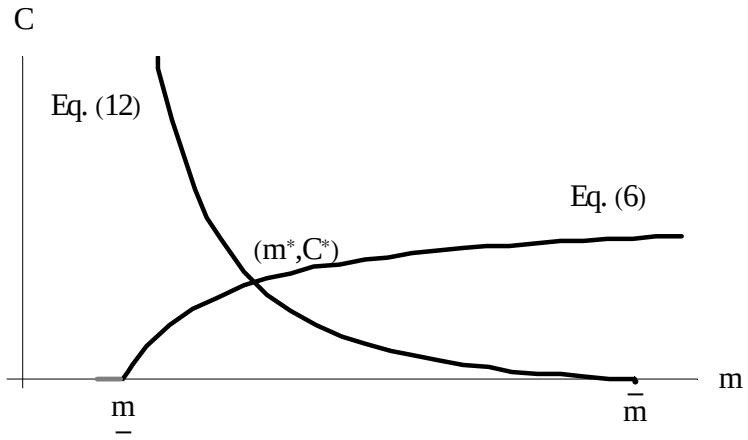

Figure 1: Prices and Quantities in the Corruption Market. When a firm is willing to pay a price per unit of C exceeding the minimum price $\underline{m}$ acceptable to enforcement bureaucrats, an active market for corruption will exist with equilibrium (m^*, C^*).

2.3 Tax Toleration and Tax Compliance

In addition to defining conditions for the existence of a corruption market, eq. (11) has important implications for the impact of profit taxation on tax compliance and the unofficial economic activity. Solving (11) for the profit tax rate on the left-side shows that unofficial production emerges when

[18] A more formal demonstration runs as follows. The optimal relation (6) implies the supply function $C^S(m) = \frac{m-\mu(S+P)}{\mu m}$. Eq. (12) gives demand as $C^D(m) = \left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{\alpha}} (1-k)\overline{K}$. As illustrated in Figure 1, at $C^S(\underline{m}) = 0$, $C^S(\underline{m}) < C^D(\underline{m})$, and at $C^D(\overline{m}) = 0$, $C^D(\overline{m}) < C^S(\overline{m})$. Since $C^S(m)$ is monotonically increasing in m and $C^D(m)$ is monotonically decreasing in m, it follows that there exists a unique value m^* in the interval $(\underline{m},\ \overline{m})$ such that $C^S(m^*) = C^D(m^*)$. Therefore, when the maximum unit price a firm is willing to pay for C is higher than the minimum unit price the bureaucrat is willing to accept, they will always find a price m^* they can agree upon. When condition (11) does not hold, then $\underline{m} > \overline{m}$ and the firm will not purchase corruption required to produce unofficially and evade taxes. Consequently, there will be no transactions for C and an active corruption market will not exist. The conventional price-quantity axes in Figure 1 are interchanged because the forgoing argument is somewhat easier to interpret from the graph lines when C is on vertical axis and m on the horizontal.

$$t > \underline{t}$$

(13)
$$\underline{t} \equiv 1 - \left(\frac{\delta}{\mu\left(S+P\right)}\right)^{\frac{\delta}{\alpha}} \left(\frac{\overline{K}}{B}\right)^{\frac{\delta}{\alpha+\delta}} \left(\frac{\beta}{w}\right)^{\frac{\beta\delta}{\alpha(\alpha+\delta)}} \left(1+t_w\right)^{\frac{\beta}{\alpha+\delta}}.$$

We interpret $\underline{t}$ as identifying the firm's threshold of tax toleration. What matters for a firm's optimal production strategy is not the absolute rate of profit taxation, but instead the magnitude of t relative to the rate a firm perceives to be "worth paying" in light of institutional benefits enjoyed only in the official sector and the cost of corruption required to produce in the unofficial sector. In terms of variables amenable to policy influence, (13) says that tax toleration increases with firm-specific institutional benefits B and corruption prices $\underline{m}$, which in turn are determined by firm-specific effectiveness of corruption exposure μ and nation-specific bureaucratic salaries plus penalties $S+P$. On the other hand, toleration of taxation falls as the relative price of labor deployed in official production $(1+t_w)$ rises.

When the profit tax rate facing a firm is below its toleration threshold, the value of tax evasion in the underground economy is outweighed by a combination of the cost of corruption necessary to produce unofficially, and profitable opportunities in the taxable sector where production benefits from government supplied institutional services. Consequently when $t \leq \underline{t}$, unofficial production and corruption are nil, and firms comply fully with the tax code. Formally, this case represents a corner solution to the firm's problem in (3) with $k=1$, $y_u = 0$ and $C = 0$. Total output (y_{total}) at the corner is

(14)
$$y_o = B^{\frac{\delta}{\alpha+\delta}} \overline{K}^{\frac{\alpha}{\alpha+\delta}} \left(\frac{\beta}{\left(1+t_w\right)w}\right)^{\frac{\beta}{\alpha+\delta}} = y_{total}.$$

An implication of the equilibrium results is that it is possible for government to impose high rates of profit tax without triggering large diversions of resources to underground production and large scale tax evasion *if* political authorities are able to raise B, μ, S and P enough to create

even higher thresholds of tax toleration. This connection of tax compliance and tax toleration among firms in our model is comparable to the concept of "fiscal exchange" between citizens and government developed in studies of tax compliance among individuals. High tax compliance and positive perceptions of fiscal exchange arise when taxpayers regard the tax system as fair and as responsive to citizen preferences, financing government programs delivering personal benefits and public goods citizens approve of.[19] Yet the correspondence is far from perfect. As we mentioned earlier, firms inherently are less susceptible than individuals to behavioral pressure from moral sentiments. The anguish of bad conscience may weigh upon individuals; rational calculations of the bottom line drives the firm.

Figure 2 depicts the pattern of firms' production choices as the profit tax rate t varies around a fixed threshold of tax toleration $\underline{t}$. The constituents of t (the profit tax rate proper, t^F, and regulations on official producers, R^F) are of course core policy instruments in any national political economy. Total output in the Figure cumulates production in the official and unofficial sectors.

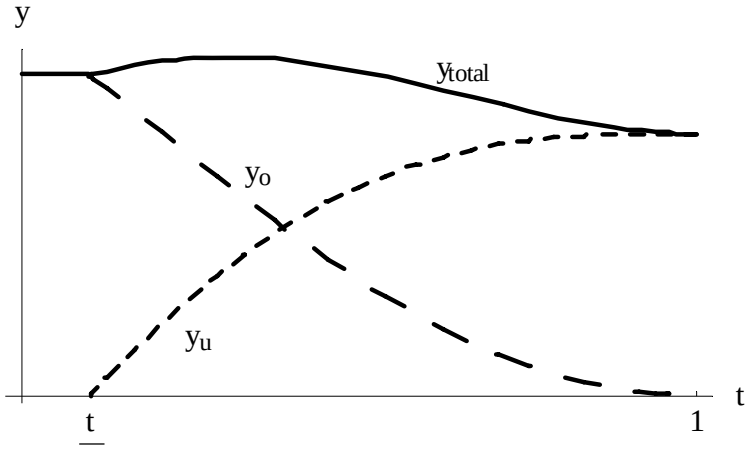

Figure 2: Optimal Output Levels as the Profit Tax Rate Varies. Official output y_o decreases and unofficial output y_u increases monotonically as the tax rate t rises above a firm's tax toleration threshold $\underline{t}$. Consequently the official output share $y_o/(y_o+y_u)$ decreases, but the firm's total output $y_{total} = (y_o+y_u)$ may expand or contract, depending on the initial condition of t. At $t < \underline{t}$ all production is official, and at $t = 1$ all production is unofficial.

In the graph region where $t < \underline{t}$ (to the left of $\underline{t}$ on the horizontal axis) all production is official;

[19] Notable studies include Alm, Jackson, and McKee (1993), Cummings, Martinez-Vazquez, McKee, and Torgler (2005), Feld and Frey (2002), Feld and Frey (2007), Pommerehne, Hart, and Frey (1994), Pommerehne and Weck-Hannemann (1996), Roberts and Hite (1994), Schloz and Lubell (1998a) and Schloz and Lubell (1998b).

$y_{total} = y_o$. As t rises above the threshold $\underline{t}$, firms begin to find activity in the underground sector profitable and they produce y_o and y_u simultaneously. The response of production decisions to increases of the profit tax rate among firms perceiving $t > \underline{t}$ and, consequently, already evading taxes to some degree, is composed of direct and indirect effects. Tax rate hikes directly depress marginal returns on labor and capital in the official sector, which by itself prompts firms to shift resources to the unofficial sector – k falls and y_u rises (eq. 8). Higher production in the underground economy, however, requires bigger inputs of corruption, and the associated upward shift in demand for C prompts an upward adjustment of the price m (eq. 6) in the corruption market which mutes the increase in unofficial activity ultimately induced by a higher t (eqs. 7-8).[20] Nonetheless, in the range $t > \underline{t}$, higher tax rates unambiguously lead to equilibrium increases of y_u and decreases of y_o and, therefore, to decreases in the share of official output in total production.[21]

The effect of changes to profit tax rates on total output, $y_{total} = y_o + y_u$, depends on t's initial condition. As suggested by Figure 2, in the range $t >> \underline{t}$ an increase in t induces a decline in official output that more than offsets the corresponding rise of unofficial output, thereby contracting the firm's aggregate production.[22] The underlying reason is that when profit tax rates are relatively high, firms tend to be heavily engaged in unofficial production and to be paying high prices for the big quantities of corruption required to sustain the large scale of underground operations. As a result, increases to already high tax rates yield only modest expansions of unofficial activity, and these are more than offset by contractions of official output. Hence total output declines. At lower initial tax rates, however, the firm's aggregate output may well increase due to increases of profit taxation because the tax-induced expansion of unofficial production exceeds the associated tax-induced contraction of official production.[23] The implications of those patterns among firms for

[20] In other words the impact of tax rate changes on a firm's output decisions would be stronger, and the equilibrium level of corruption would be higher, in the absence of interactions in the corruption market between firms and bureaucrats over the price of C that prompt bureaucrats to adjust m in response to shifts in the demand for corruption.

[21] Formally, for any $t > \underline{t}$ it can be shown that $\frac{\partial \ln m}{\partial \ln t} > 0$, $\frac{\partial \ln C}{\partial \ln t} > 0$, $\frac{\partial \ln y_o}{\partial \ln t} < 0$, $\frac{\partial \ln y_u}{\partial \ln t} > 0$ and $\frac{\partial \ln\left(\frac{y_o}{y_o + y_u}\right)}{\partial \ln t} < 0$. More detailed analysis of the comparative statics appears in the Appendix of Proofs.

[22] Specifically, $\frac{\partial \ln(y_o + y_u)}{\partial \ln t} < 0$ if $t > \frac{\delta}{\alpha + \delta}(1 - C\mu)$.

[23] Note that results here and ahead assume firms do not internalize potential feedback from increased official production to higher government tax revenues, which in turn might finance lower tax rates or improved government services benefiting official production. The impact of an individual firm's production choices on government resources

international patterns in macroeconomic performance depend on the distribution across countries of national rates of profit tax t in relation to firm-specific levels of tax toleration $\underline{t}$.

2.4 Demand- and Supply-Side Determinants of Tax Toleration and Compliance

We next evaluate how movements in tax toleration affect a firm's optimal production decisions. Figures 3 and 4 illustrate the effects of changes in tax toleration originating with an increase to institutional services, B, and with an increase to the effectiveness of corruption exposure, μ, respectively. Recall that B is a principal determinant of the demand for corruption, whereas μ is a key variable affecting the supply side of the corruption market. Along with the demand-side variable t_w and the supply-side variables S and P, the availability and quality of institutional services and the effectiveness of corruption detection are potential policy instruments that could be used by national authorities to influence tax toleration, and through that route tax compliance and underground production.

Figure 3 graphs how firms' profitable production possibilities shift owing to an increase in B raising tax toleration from $\underline{t}_0$ to $\underline{t}_1$, with other outside variables held constant. The enhancement of B induces all firms to increase official output (eqs. 7 and 14). Moreover, firms initially operating to some degree in the underground economy whose tax toleration threshold is pushed above the profit tax rate by improvement to institutional services (firms with $\underline{t}_0 < t < \underline{t}_1$) will cease producing in the shadow economy. Firms active from the start in the unofficial sector whose new toleration threshold remains below the profit tax rate (firms with $\underline{t}_0 < \underline{t}_1 < t$) will continue operating unofficially, but will reallocate some resources out of underground production to official production. Hence both official output y_o and the share of official output in total output $\frac{y_o}{y_o+y_u}$ increase with improvements to B. And although transaction prices for corruption m will adjust downward in response to the across-the-board decline in demand for corruption, in equilibrium both the level and the price of corruption will be lower in the wake of the expansion among all firms of both official and total

is negligible and so potential feedback effects rationally would be disregarded in optimal decision making.

production.[24]

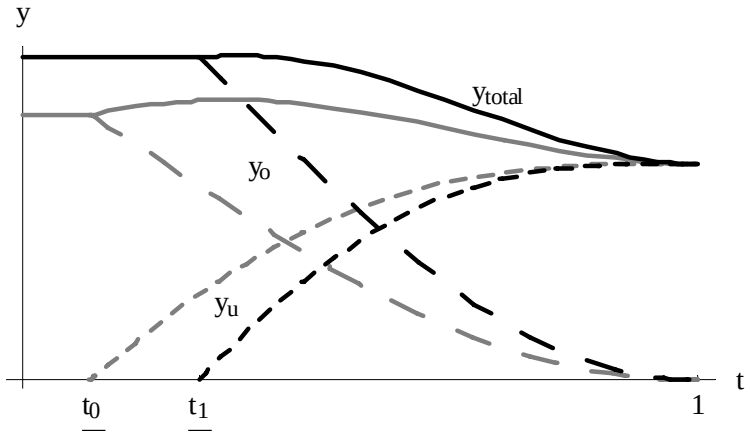

Figure 3: Output Effects of an Improvement to Institutional Benefits B. An increase in B raises a firm's threshold of tax toleration from $\underline{t}_0$ to $\underline{t}_1$. Optimal production decisions under $\underline{t}_1$ are shown by the black graph lines and under $\underline{t}_0$ by the grey graph lines. At any given tax rate t, the rise in $\underline{t}$ prompts the firm to produce more official output y_o, and less unofficial output y_u. The increase of y_o always exceeds the decrease of y_u, and so total output y_{total} rises along with the official output share $y_o/(y_o + y_u)$.

Figure 4 illustrates the output effects of an increase in the effectiveness of the corruption exposure mechanism μ that raises the firm's threshold of tax toleration from $\underline{t}_0$ to $\underline{t}_1$, with other outside variables again held constant. An increase in μ contracts the supply of corruption, which induces higher official production and lower unofficial production among all firms with initial condition $t > \underline{t}$. By contrast to B, however, μ is not a factor of production and it therefore exerts no influence on the output decisions of firms with initial condition $t < \underline{t}$, that is, among firms initially active wholly in the official economy. In this sense the carrot of improved institutions has wider impact than the stick of improved detection of corruption because the former affects the behavior of all firms.

Moreover, unlike the case of improvements to institutional benefits which always raise total as well as official production, improved detection of corruption does not yield higher total output because the ensuing decline of the firm's unofficial output exceeds the growth of its official output. Intuitively, the explanation of this result may be described by the following sequence of events.

[24]Formally, it can be shown that $\frac{\partial \ln C}{\partial \ln B} < 0$, $\frac{\partial \ln m}{\partial \ln B} < 0$, $\frac{\partial \ln y_u}{\partial \ln B} < 0$, $\frac{\partial \ln y_o}{\partial \ln B} > 0$, $\frac{\partial \ln(y_o+y_u)}{\partial \ln B} > 0$ and $.\frac{\partial \ln\left(\frac{y_o}{y_o+y_u}\right)}{\partial \ln t} > 0$. Changes to t_w yield the same pattern of effects but with opposite signs.

The heightened probability of being caught and punished for selling corruption brought about by an increase to μ leads income-maximizing enforcement bureaucrats to require higher unit prices m to supply given quantities of corruption. More expensive corruption reduces firms' demand for inputs of C necessary to produce unofficially without affecting the marginal products of inputs to official production. With lower unofficial production and higher exposure probability, the quantity of corruption decreases and its price increases. In the new environment firms will tend to transfer some of their resources to the official sector, but only to the extent that additional official profits compensate for the unofficial profits forgone due to higher costs of corruption. Firms that in the first instance were evading taxes will sometimes even find it profitable to exit the underground economy completely (firms with $\underline{t}_0 < t < \underline{t}_1$). Yet like firms that remain to some degree in the underground economy under $\underline{t}_1$, the expansion of official production among exiting firms will not fully compensate for loss of unofficial output. Consequently, among firms initially located in the range $t > \underline{t}$, increases to μ yield rises in the official share of output but declines in aggregate output.[25]

In the next section we take the model to data and test some of its main implications concerning determinants of tax toleration and tax compliance.

3 Some Empirical Evidence

From late 1998 to mid-2000 the World Bank sponsored interviews with managers of more than 10,000 enterprises in 80 countries covering the main regions of the world – The World Business Environment Surveys ("WBES 2000").[26] The interviews dealt, among other things, with managers' perceptions of the operational difficulties posed by taxation, government regulations, corruption of public officials, functioning of the judiciary, and access to financial services. The surveys also

[25] More precisely, as shown in the Appendix of Proofs, even though an increase in μ has positive effect on a tax evading firm's official production, $\frac{\partial \ln y_o}{\partial \ln \mu} > 0$, and on its official share of total production, $\frac{\partial \ln\left(\frac{y_o}{y_o+y_u}\right)}{\partial \ln \mu} > 0$, the effect on its total output is negative, $\frac{\partial \ln(y_o+y_u)}{\partial \ln \mu} < 0$. The effects of changes in S and P are qualitatively the same.

Institutional benefits B and effectiveness of corruption exposure μ will generally be imperfectly correlated positively (as they are for the rough measures used in our empirical analysis ahead) because both reflect an underlying generic capacity of the state. Hence the opposite responses of total output to shifts in B and μ depicted in Figures 3 and 4, respectively, will to some degree be offsetting if both variables move at once; nonetheless it is illuminating to understand the partial-conditional effects of those distinctive channels of influence.

[26] For detailed information about the surveys see Batra, Kaufmann, and Stone (2002).

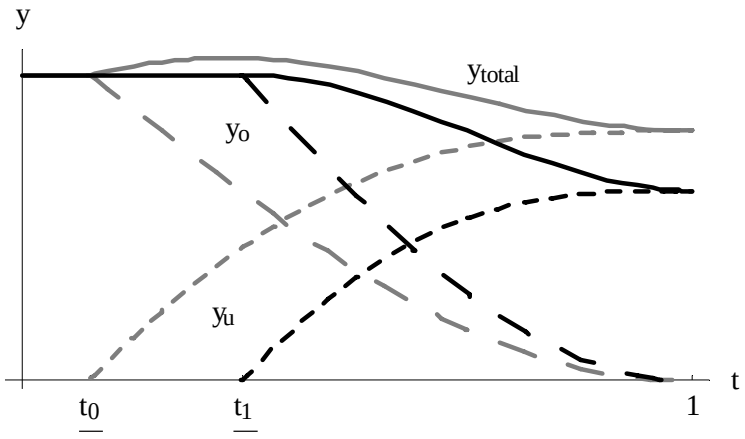

Figure 4: Output Effects of an Increase in Corruption Exposure Effectiveness μ. An increase in μ raises a firm's threshold of tax toleration from $\underline{t}_0$ to $\underline{t}_1$. Optimal production decisions under $\underline{t}_1$ are shown by the black graph lines and under $\underline{t}_0$ by the grey graph lines. The increase of tax toleration induced by higher μ prompts less unofficial and more official production among firms with $t > \underline{t}$. However the decline of y_u is bigger than the rise of y_o, and so although the official output share $y_o/(y_o + y_u)$ rises, total output y_{total} falls. Production choices of firms with $t < \underline{t}$ are not affected by changes in μ.

obtained reports about the degree of tax compliance among firms. These WBES data make possible rough empirical tests of key implications of our model concerning (i) direct determinants of firm-level toleration of taxation, and (ii) direct and indirect determinants of the share of total output declared officially and subjected to tax among firms.

Empirical analyses were undertaken for a subset of the enterprises sampled. First, because the model pertains to the behavior of private firms, we excluded the public sector firms surveyed. Second, we excluded enterprises in African countries because in that region the data were obtained predominately from mail surveys, rather than from in-person interviews which were undertaken everywhere else. We regard the postal survey data as far less reliable than the personal interview data.[27] Finally, the usable sample was reduced further due to missing data for one or more variables in our multivariate analyses. Sample attrition from this source included all Middle Eastern countries. All tolled, the regression experiments presented ahead are based on a common sample of personal interview responses from managers of 3818 firms distributed over 54 countries.

[27] Among other problems, the African postal surveys yielded very low response rates and implausibly low reports of tax evasion – hardly surprising in view of the fact that respondents were asked to commit reports of illegal behavior to writing.

3.1 Tax Toleration

A central message of our model is that a firm's propensity to produce officially and pay taxes is driven by the gap between its tax toleration $\underline{t}$ and tax rate t. Let i be an index for firms and j an index for countries. Because the profit tax rate subsumes conventional country-level rates, t_j^F, and regulations on official activity which generally impact individual firms in different ways, R_{ij}^F, we have firm-specific profit tax rates $t_{ij} = t\left[t_j^F, R_{ij}^F\right]$. Similarly, because the labor tax rate subsumes conventional national payroll rates, t_j^L, and labor regulations which generally affect firms in different ways, R_{ij}^L, we have firm-specific labor tax rates $t_{w_{ij}} = t_w\left[t_j^L, R_{ij}^L\right]$.

The expression defining $\underline{t}_{ij}$ in (13) shows that tax toleration is affected positively by institutional benefits, B_{ij}, which vary over firms in every country, negatively by payroll tax rates, $t_{w_{ij}}$, which vary over firms in every country, and positively by corruption price minima $\underline{m}_{ij} = \mu_{ij}(S_j + P_j)$, which vary over firms (owing to firm-specific visibility effects embodied in the detection parameter μ_{ij}) in various countries (owing to national salary levels S_j and malfeasance penalties P_j). The model also implies that a firm's capital stock $\overline{K}_{ij}$ directly decreases $\underline{t}_{ij}$. At the same time $\overline{K}_{ij}$ most likely increases $\underline{t}_{ij}$ indirectly by affecting positively the visibility of corruption (operating through μ_{ij}) and wage levels w_{ij} – particularly since our calibration of corruption prices is weak and we are unable to measure wage levels at all.[28] (See ahead.) The functional relations are therefore

$$\underline{t}_{ij} = F\left[\overset{+}{B}_{ij},\ \overset{-}{t}_{w_{ij}},\ \left(\mu_{ij}, \overset{+}{S}_j, P_j\right),\ \overset{+/-}{\overline{K}}_{ij}\right] \tag{15}$$

where the expected sign of $F'(\cdot)$ appears above each term on the right-side of (15).

We measure tax toleration, $\underline{t}_{ij}$, by answers to the following WBES question: *"Please judge on a four point scale how problematic are high taxes for the operation and growth of your business"* with ordered response categories *1 ='major obstacle', 2= 'moderate obstacle', 3='minor obstacle',* and *4 = 'no obstacle'.*[29] We take these data to yield ordinal measurement of an underlying continuum

[28] Positive influence of $\overline{K}$ on w would represent so-called efficiency wage effects associated with large, capital rich firms.

[29] The percentage of responses falling in each category 1 to 4 were 59%, 21%, 11% and 9%, respectively.

running from low to high values of firm-specific tax toleration. As shown by the descriptive statistics presented ahead, at given objective national rates of taxation, the perceptions of firm managers to the burden imposed by taxes vary enormously.

Institutional benefits perceived by firms, B_{ij}, are measured by responses to the WBES question *"Please judge on a four point scale how problematic are these different regulatory areas for the operation and growth of your business"* for items pertaining to access to financial services, functioning of the judicial system, and customs procedures. The surveys supplied four response options for each item, which again run from *1 = 'major obstacle'* to *4 = 'no obstacle'*. We constructed a composite index of B_{ij} by taking the arithmetic average of the rating codes across the three items.[30]

A composite measure of regulatory burdens imposed on firms' official activities, R_{ij}^F, which are analogous to conventional profit taxes, was constructed in the same way as the variable for institutional benefits by using responses to the above question for items dealing with problems concerning business licensing, environmental regulations, fire and safety regulations, and foreign exchange regulations. Regulations of officially employed labor, R_{ij}^L, which are akin to conventional payroll taxes, were measured by responses to the same question pertaining to problems with government labor regulations.

The capital endowment of firms, $\overline{K}_{ij}$, is measured by responses to the WBES question that asked managers to "estimate your firm's fixed assets (land, buildings, equipment)". The surveys provided eleven response categories ranging from less than 250,000 USD to 500,000,000 USD or more. Though truncated at the upper end, these data supply good calibration of physical (but not human) capital stocks.

The WBES data provide much weaker empirical referents for $\underline{m}_{ij} = \mu_{ij}\,(S_j + P_j)$ – the minimum price of corruption necessary to induce tax officials to overlook unofficial production and tax evasion among firms in various countries.[31] The best proxy of that concept available in the WBES are reports about the frequency of bribery. Specifically, enterprise managers were asked "*Thinking*

[30] We also generated a composite score for B using the first principal component of the survery items, but empirical results obtained using this approach were not appreciably different from those obtained using averages.

[31] The same measurement deficiencies of course apply to other combinations of μ_{ij}, S_j, and P_j that affect equilibrium corruption prices and sectoral output decisions and output shares. See the discussion ahead.

about government officials, is it common for firms in your line of business to have to pay some irregular 'additional payments' to get things done" with ordered response categories ranging from *1 = 'always'* to *6 = 'never'*.[32] We assume that the minimum price of corruption faced by firms to be proportional to the response codes for this question. In other words we assume that the bribe frequency data reflect underlying firm-specific prices determining enforcement officials' willingness to engage in corrupt transactions.

Our indirect calibration of the forces underlying corruption prices from the *irregular 'additional payments'* responses has obvious deficiencies. First, we do not observe any of the direct determinants specified by the model – namely, firm-specific effectiveness of corruption detection in various countries, μ_{ij}, or the salaries received by and penalties imposed upon enforcement bureaucrats in various countries, S_j and P_j. Second, the available survey question pertains to illegal payments associated with all corrupt deals between firms and government officials, not only to bribes paid to make possible production in the unofficial economy, which is the object of our model. Firms of course may pay bribes not only to engage in unofficial production and avoid taxation, but also to circumvent all manner of regulations when producing officially. Finally, although the bribery question was worded with reference to "firms in your line of business," we assume along with others[33] that responses mainly supply information about bribery at the own-firm level, rather than bribery among comparable firms in various areas of activity.[34] As noted earlier, in view of the weak indirect measurement of effects from μ_{ij}, S_j and P_j, we expect that that some corruption price effects will be picked up by $\overline{K}_{ij}$ because the visibility and detection of corrupt transactions are likely to increase with firm size.

Measurement of remaining variables in (15) is more straightforward. The profit tax rate, t_j^F, is

[32] The intervening response options scored from 2 to 5 were *mostly*, *frequently*, *sometimes*, and *seldom*. 49.9 percent of the firm managers reported that bribery occurred "sometimes" or even more frequently and only 36 percent reported that bribery "never" occurred.

[33] See, for example, Johnson, Kaufmann, McMillan, and Woodruff (2000), Batra, Kaufmann, and Stone (2002) and Svensson (2003).

[34] Interviewers of course could not expect managers to go on record about having engaged in criminal behavior. At least some respondents, however, most likely were in fact reporting common practice in their area of activity rather than own-firm behavior per se, and this is a source of measurement error that will tend to depress the magnitudes of coefficient estimates of regressors based on these data.

measured by the top marginal tax rate on corporate profits in each country for year 2000,[35] and the payroll taxation, t_j^L, is measured by social security contribution rates for year 1999.[36] Descriptive statistics reported in Table 1 show that among variables varying by i and j, within-country standard deviations are nearly twice the magnitude of the between-country standard deviations, implying that firm-specific characteristics affecting those variables are generally much more variable than country-specific attributes.

3.2 Tax Compliance and the Official Share of Production

The WBES data also allow us to test the model's implications concerning determinants of tax compliance as registered by the share of output declared officially and subject to tax. Figures 2-4 and the associated theoretical analyses implied that the share of taxed, official output in total output, $\left(\frac{y_o}{y_o+y_u}\right)_{ij}$, increases as the gap between the tax rate t_{ij} and and the level of tax toleration $\underline{t}_{ij}$ falls, where $\underline{t}_{ij}$ is in turn a function of the outside variables on the right-side of (15). The measurement metrics of t_{ij} and $\underline{t}_{ij}$ are incompatible, so direct computation of tax gap variables is infeasible. The model nonetheless implies the following pattern of empirical relations:[37]

$$(16) \qquad \left[\overset{+}{B}_{ij},\ t_w\left(\overset{-}{t}_j^L, \overset{+}{R}_{ij}^L\right),\ \left(\mu_{ij}, \overset{+}{S}_j, P_j\right),\ \overset{+/-}{\overline{K}}_{ij}\right] \Rightarrow \begin{array}{l} \overset{+}{\underline{t}}_{ij} \Rightarrow \\ t\left[\overset{-}{t}_j^F, \overset{+}{R}_{ij}^F\right] \Rightarrow \end{array} \left(\frac{y_o}{y_o+y_u}\right)_{ij}$$

We measure the relative scale of official production, $\left(\frac{y_o}{y_o+y_u}\right)_{ij}$, with responses to the WBES question *"Recognizing the difficulties many enterprises face in fully complying with taxes and regulations, what percentage of total sales would you estimate the typical firm in your area of activity*

[35] Data are from the World Tax Database maintained by the Ross School of Business at the University of Michigan and are available at http://www.bus.umich.edu/otpr/otpr/introduction.htm. Measurement of effective rather than top rates no doubt would have better suited our purposes but relevant data are not available.

[36] We added up contributions pertaining to old age, disability and death, sickness and maternity, work injury, and unemployment. The data mix contributions from employers and employees in the various payroll systems. The constituent data are from *"Social Security Programs Throughout the World"* available at the US Social Security Administration web site http://www.ssa.gov/policy/docs/progdesc/ssptw/1999/index.html.Teh

[37] The expected signs given for the 'analogous-to-tax', regulation variables R_{ij}^L and R_{ij}^F are opposite to those of the conventional tax variables t_j^L and t_j^F because the response codes run from 1=Major Obstacle to 4=No Obstacle, implying that regulatory costs decline with higher code values.

Table 1: Descriptive Statistics

	Analysis Level		Mean	St. Dev.	Min	Max
Tax Toleration (1=Major Obstacle to 4=No Obstacle), $\underline{t}_{ij}$	Firms (3818) Countries (54)	overall	1.7	0.99	1	4
		between		0.48		
		within		0.87		
Institutional Services (1=Major Obstacle to 4=No Obstacle), B_{ij}	Firms (3818) Countries (54)	overall	2.62	0.74	1	4
		between		0.38		
		within		0.65		
Labour Regulations (1=Major Obstacle to 4=No Obstacle), R^L_{ij}	Firms (3818) Countries (54)	overall	2.73	1.07	1	4
		between		0.58		
		within		0.93		
Regulations on Official Activity (1=Major Obstacle to 4=No Obstacle), R^F_{ij}	Firms (3818) Countries (54)	overall	2.94	0.70	1	4
		between		0.34		
		within		0.62		
Infrequency of Bribes (1=Always to 6=Never), $(\mu, S, P)_{ij}$	Firms (3818) Countries (54)	overall	4.33	1.62	1	6
		between		0.81		
		within		1.46		
Capital Assets (1000s USD), $\overline{K}_{ij}$	Firms (3818) Countries (54)	overall	115,315	201,544	125	500,000
		between		118,265		
		within		169,236		
% Reported Sales (1=<60% to 3=100%), $\left(\frac{y_o}{y_o+y_u}\right)_{ij}$	Firms (3818) Countries (54)	overall	2.1	0.81	1	3
		between		0.39		
		within		0.73		
% Corporate Tax Rate, t^F_j	Countries (54)	overall	30.1	6.3	15.0	45.5
% Payroll Tax Rate, t^L_j	Countries (54)	overall	27.5	13.0	4.2	53.0

Notes: Index i denotes firms and j denotes countries. Theoretical model variables appear after text labels.

reports for tax purposes?."[38] The response options included eight 'percentage of total sales' categories with irregular intervals ranging from '*0-25%*' sales reported up to '*100%*' sales reported. We collapsed the responses into three categories, *1=<60%, 2=60-99%* and *3=100%,* containing reasonably balanced relative frequencies – 28%, 34% and 38% for codes 1, 2 and 3 respectively.[39] Descriptive statistics in Table 1 indicate that standard deviations around the mean value of 2.1 are almost twice as high within countries as between – a pattern similar to the dispersions of other variables varying across firms and countries. More important, since all firms sampled were legally registered, the data imply that simultaneous activity in the official and unofficial economy is a quite common state of affairs.

3.3 Regression Experiments

Table 2 reports four ordered logit regression experiments relevant to the testable implications of the model. All independent variables are in logarithms and so regression coefficients estimate the impact of proportional movements in each variable on the ordered response variables.[40]

Model (1) investigates the determinants of tax toleration summarized by equation (15). All determinants of our survey-based measure of $\underline{t}_{ij}$ are highly significant statistically and have the signs predicted by the underlying theoretical model, with the exception of log Payroll Tax Rate which is correctly signed but has a p-value of 0.07.[41] More important, the probability effects implied by the ordered logit regression coefficients are substantively sizeable. The biggest effects

[38] As with the *irregular 'additional payments'* (bribery) question discussed above, the WBES naturally did not ask managers directly to acknowledge criminal behavior, and for this reason the tax evasion question was phrased with reference to "*the typical firm in your area of activity*". As pointed out before, such questions are commonly interpreted as revealing firms' own-behavior.

[39] The empirical results discussed ahead however were not at all sensitive to this and other ways of organizing the raw tax evasion data.

[40] Regressions based on independent variables expressed in original metrics yield the same pattern of results, although the semi-elasticity log setups in Table 2 delivered slightly better chi square significance statistics for the models entertained. A parallel set of regression experiments that included sector fixed effects was also undertaken to take account of the possibility of correlated errors across firms within a sector (agriculture, manufacturing, construction, services and 'other'). Point estimates and significance levels from those regressions were nearly identical to those reported in Table 2 and are available by request to the authors.

[41] Recall, however, that the model did not make an unambiguous prediction of the sign of a firm's capital stock, $\overline{K}_{ij}$. The significant positive coefficient implies that the indirect effects of $\overline{K}_{ij}$ dominate the direct effects, but this cannot be taken as evidence one way or the other of the model's validity.

are generated by the log Institutional Services variable. Consider, for example, a representative firm experiencing an improvement of institutional services spanning the full range of $\ln B$ (from log 1.0 to log 4.0) when all other variables are equal to their sample means. Standard computations based on the ordered logit coefficient estimates show that this maximal improvement in measured $\ln B_{ij}$ decreases the probability that the firm will have the lowest tax toleration score ($\underline{t}_{ij} = 1$) by 0.53 (from 0.90 to 0.37), and increases the probability it will move into the higher tax toleration categories $\underline{t}_{ij} = 2$, $\underline{t}_{ij} = 3$, and $\underline{t}_{ij} = 4$ by probabilities 0.22, 0.16 and 0.15, respectively. The response of tax toleration to equivalent movements in other variables in model (1) are smaller than the changes induced by shifts in $\ln B$ in monotonic relation to the relative magnitudes of the ordered logit coefficient estimates.

Regression experiments (2)-(4) investigate the determinants of official production and tax compliance as measured by the interview data on the share of total sales reported to tax authorities already discussed. Models (2) and (3) correspond to the reduced form causal relations sketched in equation (16). Model (4) is the structural form. In models (3) and (4) independent variables are interacted with a binary variable LT that isolates firms in which taxes pose at least some obstacle to business operations.[42] We take these firms to be ones in which tax toleration $\underline{t}$ potentially plays a significant role in sectoral production decisions, and among them tax rates and the determinants of tax toleration will likely exhibit comparatively robust effects on the share of output declared officially and subject to taxation.

In reduced form Models (2) and (3) the institutional services regressor, $\ln B_{ij}$, and our crude proxy for bribe price effects of μ_{ij}, S_j and P_j are significant and substantively sizeable. However, the capital stock term $\ln \overline{K}_{ij}$ and the labor tax variables $\ln R^L_{ij}$ and $\ln t^L_j$ are insignificantly different from zero in these test regressions. The results for $\ln \overline{K}_{ij}$, however, say little about the applicability of the model in data because the direct negative and indirect positive effects of capital endowments on a firm's incentive to produce officially probably tend to offset one another in reduced form.

[42] As indicated in the notes to Table 2, LT is a binary value that equals 1 for firms whose managers gave responses *1 ='major obstacle', 2= 'moderate obstacle'* or *3='minor obstacle'* to the "taxes as an obstacle" survey question that we use to measure $\underline{t}_{ij}$. Recall that 91% of the firms in our sample have scores $\underline{t} < 4$ and hence $LT = 1$.

Table 2: Regressions

Dependent Variable:	**Tax Toleration** (1=Major Obstacle to 4=No Obstacle), $\underline{t}_{ij}$	**Tax Compliance** (1 if $\left(\frac{y_o}{y_o+y_u}\right)_{ij}$<60% to 3 if $\left(\frac{y_o}{y_o+y_u}\right)_{ij}$=100%)		
Model:	(1)	(2)	(3)	(4)
		All Firms	Firms with $\underline{t} < 4$	
log Institutional Services, $\ln B_{ij}$	1.973 (0.247|0.000)	0.741 (0.174|0.000)	0.732 (0.153|0.000)	
log Payroll Tax Rate, $\ln t_j^L$	-0.389 (0.214|0.069)	0.009 (0.182|0.959)	0.006 (0.162|0.970)	
log Labor Regulations, $\ln R_{ij}^L$	0.703 (0.218|0.001)	-0.084 (0.090|0.350)	-0.107 (0.089|0.232)	
log Top Corporate Tax Rate, $\ln t_j^F$		-0.331 (0.364|0.364)	-0.598 (0.183|0.001)	-0.289 (0.100|0.004)
log Regulations on Official Activity, $\ln R_{ij}^F$		0.031 (0.174|0.861)	-0.002 (0.170|0.992)	0.451 (0.172|0.009)
log Infrequency of Bribes, $\ln\{\mu, S, P\}_{ij}$	0.352 (0.116|0.002)	0.757 (0.104|0.000)	0.716 (0.108|0.000)	
log Fixed Assets, $\ln\overline{K}_{ij}$	0.103 (0.031|0.001)	0.022 (0.020|0.280)	0.023 (0.020|0.250)	
log Tax Toleration, $\ln\underline{t}_{ij}$				0.311 (0.118|0.009)
Wald χ^2 (p-value)	79.58 (0.000)	79. 43 (0.000)	79.23 (0.000)	15.02 (0.002)
N Firms	3818	3818	3818	3818
N Countries	54	54	54	54

Notes: Index i denotes firms and j denotes countries. Estimation Method is Ordered Logit with Robust Standard Errors. In models (3) and (4) independent variables are interacted with a "lower tax tolerance" dummy variable LT, where LT=1 if $\underline{t}$< 4 and LT=0 if $\underline{t}$= 4. In parentheses (standard error|p-value). Recall that the Regulations variables R_{ij}^L and R_{ij}^F are scored 1=Major Obstacle to 4=No Obstacle and are therefore expected to have signs opposite to those of the corresponding conventional tax rate variables.

As expected, Model (3) delivers results most consistent with the underlying theoretical model. The regressors $\ln B_{ij}$, $\ln t_j$ and $\ln\{\mu_{ij}, S_j, P_j\}$ are all highly significant, correctly signed and exert sizeable impact on tax compliance. For instance, the ordered logit coefficient estimates imply that an improvement in log Institutional Services spanning its full range raises the probability that a firm will comply fully with the tax code and declare all sales officially by 0.23, while the probability that less than 60% of sales will be officially declared declines by 0.20 when other variables are at mean values.[43]

The theoretical structure summarized in equation (16) asserts that a firm's threshold of tax toleration $\underline{t}_{ij}$ encapsulates the effects of the institutional environment, bureaucratic incentives to engage in corruption, and other independent variables in Model (1) on a firm's incentive to remain in the official taxed economy, as opposed to producing underground. Model (4) estimates directly this structure when the dependent variable is again the share of total sales reported officially and subject to taxation. As implied by the model, the estimates show that when both $\ln \underline{t}_{ij}$ and the profit tax variables $\ln t_j^F$ and $\ln R_{ij}^F$ are included in the ordered logit regression, increases in log tax toleration positively affect the firm's official output share, and movements in the log tax variables imposing higher costs on the firm negatively affect the official output share.

The regression evidence in Table 2 clearly documents important correlations among statutory tax rates and survey perceptions of tax toleration, tax compliance, regulatory burdens and institutional benefits among managers of private sector firms. Moreover, taken together the empirical results conform well to our theoretical framework for analyzing how quality of governance affects the propensity of profit maximizing firms to remain in the official taxed economy, as opposed to evading taxes by producing in the underground economy. Indeed the correspondence of theory and evidence appears particularly strong in view of the substantial errors of measurement in variables available for calibration of the model's underlying concepts.

[43] Although the model pertains to individual enterprises and not national aggregates, averaging the survey variables within countries yields qualitatively similar relationships. Across N=54 country averages the correlation of the institutional services and tax toleration variables is .63 and between institutional services and reported sales it is .49.

4 Concluding Observations

The central implication of theoretical and empirical results in this paper is that markets for corruption arise and big migrations out of legal production into the underground economy occur when large numbers of firms perceive taxes as not "worth paying" – an unfortunate circumstance that we summarized in terms of profit taxes imposed on producers in the official economy relative to firms' thresholds of tax toleration. Tax toleration is driven by firm-specific appraisals of the availability, quality and usefulness of government services supporting official activities, by taxes and regulations on officially employed labor, by the compensation of enforcement authorities, and by the effectiveness of detection and punishment of bureaucratic malfeasance. Because most of those determinants differ across firms, tax toleration and tax compliance vary among producers facing the same rates of conventional profit taxation and operating in the same national political-institutional environment.

Firms without much intrinsic need of formal institutional services will likely always be tempted to produce unofficially and evade taxation unless tax rates are negligible or corruption prices are extremely high. The latter would tend to be the case when enforcement authorities are handsomely compensated, when they stand high chances of being caught selling corruption, and when they are stringently penalized for any malfeasance discovered. Though government policy clearly can affect such supply-of-corruption variables, it can do little to influence the appetite for tax evasion among firms that inherently have little or no interest in official institutional services, no matter how well tuned and accessible those services might be. Yet such firms are likely to be small (and in many cases single-person operations, like the home cleaning help engaged unofficially by many readers of this paper) and at the margins of many economies.

Most big players in an economy potentially take great productive benefit of formal institutional services, and their propensity to remain in the official, tax-paying sector can therefore be influenced by government efforts to build and sustain institutions of quality. Firms with substantial intrinsic need of services will tend to develop high tax toleration, if appropriate institutions are in place. Government fiscal policy is then less constrained – with high tax toleration, relatively high taxes on official productive activity may be imposed without great fear of inducing a mass exodus of

tax-paying producers into the black economy.

Heterogeneity of tax toleration among firms has implications for the aggregate effects of policies targeted on the scale of the shadow economy and tax evasion. Depending on how many and to what extent firms within a country have incentive to produce underground and evade taxation, policies regarding profit taxation and the employment conditions of enforcement bureaucrats may create trade-offs between containment of tax evasion and the overall level of economic activity. For instance, strengthening incentives of enforcement officials to remain honest reduces bureaucratic corruption and unofficial economic activity at the cost of depressing total output among evading firms, without affecting the productive activity of non-evading firms. If the economy is dominated by firms with low thresholds of tax toleration, then higher bureaucratic salaries and better corruption detection mechanisms may yield only modest expansions of official production and contractions of total output. Casual observation of the situation in many developing countries, and some developed ones too, suggests that stamping out unofficial economic activity would on the whole depress aggregate income and economic wellbeing.

The likely effects of policies addressing tax evasion by lowering profit tax rates are more ambiguous. In developing countries, where many firms are likely to be small and heavily involved in the unofficial sector, reduction of profit tax rates will help reduce underground production, raise tax compliance and increase national output. Profit taxation policy, however, exerts less impact in countries where many firms operate on the border of their tax tolerance, in the sense that their tax toleration threshold is lower than but close to the statutory tax rate. In such cases the first-order effects of reductions to profit tax rates would tend to shrink aggregate income.

Our model implies, however, that the trade-off of a smaller underground economy at the cost of lower aggregate output does not arise with policies that affect institutional services and taxes and regulations on officially employed labor. Such policies influence all firms in the economy because they affect the productivity and profitability of factors deployed in official production. Improved institutional benefits, for example, have the advantage of giving tax-evading firms incentive to reduce their unofficial operations, while also inducing higher levels of output among all firms in the economy,

regardless of their location on the continuum of tax compliance. This theoretical implication may help explain the strong positive correlation between indicators of institutional quality and estimated levels of total and official aggregate national output reported in many macro-level empirical studies.

Our firm-level analysis rightly treated institutional benefits and taxes as unconnected outside variables because any particular firm would correctly perceive a choice to evade taxes and regulations by producing unofficially as having negligible impact on the government's resources and its capacity to deliver services from which it might profit. However in the macro political economy those variables are intimately connected, if only because public institutions of high quality require commensurately large investments of public revenue raised by taxation.[44] In principle a virtuous circle is possible in which high taxes and high tax compliance coexist amicably because important producers are anchored firmly in the official economy, supplying the tax revenues required to build and sustain well functioning institutions that underpin high toleration of taxation.

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