Taxation Base in Developing Countries*

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Abstract: Informal sectors are larger in developing countries than in rich countries. This is a result of higher fixed costs of entry into the formal economy in developing countries. We show that raising barriers to entry is consistent with a deliberate government policy for raising tax revenue. By generating market power, and hence rents, for the permitted entrants, market entry fees foster the emergence of large taxpayers. The rents can be readily confiscated by the government through entry fees and taxes on profits at a low administrative cost. The relevance of the theory is assessed with a sample of 64 countries. Empirical analysis supports the results of the paper.

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1 Introduction

Tax revenue as a proportion of GDP is typically much lower in developing countries than in rich countries.[1] The difference in tax revenues between the poorest and the richest nations of the world is entirely explained by the weakness of direct taxation in developing countries. For instance direct taxation represents 7% of GDP in Sub-Saharan Africa and 22% in industrial countries. In comparison, indirect taxation in developing countries is roughly 10% of GDP, which is the same level as in industrialized countries. The paper aims to analyse why the direct taxation base is so low in developing countries.

In their survey of taxation and development Burgess and Stern (1993) list many special features of developing countries of particular relevance for tax analysis including the importance of the primary sector, dualism, many small-scale enterprises, weak administrative capabilities and substantial evasion. Such features could be grouped together by the observation that developing countries have large informal sectors that are difficult to tax. For instance Enste and Schneider (2000) estimate in a panel of 76 countries that the average size of the shadow economy is 39% for developing countries. In comparison it is 12% of GDP for OECD countries. Similarly the International Labour Organization (ILO 1999) estimates that urban informal employment absorbs 61% of the urban labor force in Africa, and it absorbed between 40 and 50% in pre-crisis Asia. Finally 80% of new jobs created between 1990-1994 in Latin America were in the informal sector, in Africa it was more than 90% (Kuchta-Helbling 2000). While these special features are widely appreciated in analysis of developing country taxation (see, e.g., Newbery and Stern (1987)), they are usually treated as exogenous constraints on feasible tax policies. This paper differs in treating the relative sizes of the informal and formal sectors as the result of deliberate government policies, and hence endogenous. The endogeneity of market structure also differentiates our paper from standard analyses of taxation with imperfect competition where taxation is used to partially offset oligopoly distortions (see, e.g., Myles (1995) chapter 11). In our model governments cannot raise tax from the perfectly competitive informal sector. The revenue imperative creates an incentive to restrict competition in the formal sector, creating rents that can be appropriated through entry fees and profit taxes. The paper hence combines industrial organization and development economics to analyze the determinants of formal/informal sector formation.

Enste and Schneider's (2000) cross-country study reveals that the increase of the shadow economy in OECD countries is best explained by an increasing burden of direct taxation and social security contributions, combined with rising state regulatory activi-

[1]The tax revenue-GDP ratio for 1995-1997 was 18.2 % for developing countries (based on a sample) and 37.9% for OECD countries (excluding Czech Republic, Hungary, Korea, Mexico, and Poland) (Tanzi and Zee 2000).

ties.[2] If these factors play a role in developing countries, they cannot explain *per se* the size of their shadow economies. Overall taxation and social security contributions are lower in developing countries, so if they were the principal determinants of the shadow economy it should be *smaller* in developing countries than in developed countries. We cannot directly transpose results obtained for developed countries to developing countries. In developing countries taxes, especially direct ones such as income taxes or taxes on profit, are just a small part of the cost of setting up a business. A recent cross-country study of 75 nations by Djankov et al. (2000) indicates that the official cost of setting up a firm entails fees worth at best 1.4% of GDP per capita in Canada and at worst 260% of GDP per capita in Bolivia. The average cost for the panel is 34% of GDP per capita. On top of this official monetary expense the authors show that registering a business can be very complicated and time consuming. In the best case establishing a new firm requires 2 steps and 2 days in Canada, and in the worst case it requires 20 procedures and 82 business days in Bolivia. For the panel on average it involves 10.17 steps and 63.05 business days.[3] The study by Djankov et al. (2000) concludes that firm entry barriers are higher in countries with lower GDP per capita.

We suggest that a major reason why many micro-enterprises stay informal in developing countries is because becoming formal involves large fixed costs, most of them sunk. Official registration is simply beyond the reach of poor entrepreneurs. Since the costs to become formal are largely endogeneous (i.e., the government chooses the level of the registration fees, the complexity and the length of the procedure, and so on), the paper analyses why in equilibrium these costs end up being proportionally higher in poor countries. We show that this is consistent with a deliberate government policy for raising tax revenue. In the formal sector the barriers to entry generate market power for the firms. The rents are confiscated by the government through entry fees and taxes. Entry fees then fill two purposes. As barriers to entry they create market power for firms whose rents are captured by the government. As tax instruments they have low administrative cost. The relevance of the theory is assessed on a sample of 63 countries. The empirical analysis, which studies the determinants of the size of the shadow economy and of taxation revenue as a percentage of GDP, supports the results of the paper.

Section 2 of the paper presents the model. Section 3 studies formation of the direct taxation base in a developing country. Section 4 studies government taxation policy.

[2] In her survey of the literature on informal sector formation Klarita Gerxhani (2001) wrote: "Some of the earliest primary reasons to participate in the underground economy mentioned in the literature are: (1) to evade taxes; (2) to avoid losing government benefits; (3) to circumvent regulations and licensing requirements; (4) a reaction by both firms and individual workers to the labor unions; and (5) the impact of international competition."

[3] These are official time and expense required to establish a new business, they do not include bribes or administrative delays.

Section 5 proposes a preliminary test of the theory based on a sample of 64 countries. Finally, section 6 offers some concluding remarks.

2 The model

In order to get clear cut results, the paper focuses on the industrial organization of constant returns to scale industries. This implies that any market distortion can be ascribed to government policy. This assumption is consistent with existing evidence on manufacturing and services in developing countries, whether they belong to the formal or the informal sector (see Tybout (2000)).[4] For each commodity there are hence two possible production techniques. Production in the traditional sector is denoted t, production in the modern sector is denoted m. Because of the constant returns to scale assumption the cost function of any firm producing traditionally is linear:

$$C^t(q) = c^t q \tag{1}$$

where $q \geq 0$ is the quantity produced by the firm and c^t is the constant marginal cost of producing traditionally. The sector being competitive, in the absence of government intervention the price in the informal sector is equal to the marginal cost: $p^t = c^t$.

Because of the constant returns to scale technology, the production cost function in the modern sector is also linear: $c^m q$. Nevertheless production in the modern sector involves fixed costs of official registration. Let $F \geq 0$ denote the cost to enter the formal sector. It is paid up-front and is sunk. It corresponds to entry fees collected by the government. Its level is exogeneous to the firm. The total cost function of any producer in the modern sector is thus in two parts:

$$C^m(q) = F + c^m q \tag{2}$$

where F is the market entry fee collected by the government, $q \geq 0$ is the quantity produced by the firm and c^m is the constant marginal cost of production in the modern sector.

We assume that everything else being equal, the traditional method of production is less efficient than the modern method.[5]

[4] On small-scale production in developing countries (informal firms are small), Tybout (2000) who surveyed the empirical literature, reports returns to scale very close to unity in all the industries covered by the literature (including India, Indonesia and Africa). Regarding larger firms (at least ten workers) Tybout (2000) also reports constant or mildly increasing returns to scale in the various manufacturing sectors of Latin American, Asian, North African countries and in Africa (i.e., in food, in textiles/garments, in wood products and in metal products).

[5] Empirical studies show that production in the informal sector is more labor intensive than production in the formal sector and that it involves small size units.

A1 $$c^t \geq c^m.$$

Informal producers are indeed constrained in their technological choice because of their lack of education, savings, social network, and access to essential infrastructure.[6] It is for instance difficult for them to enforce contracts. This is not an issue for services such as car washing or fruit selling, but is a major drawback for sophisticated commodities such as medicine, computers or cars which require a warranty or a certification process. This raises the issue of why informal production is so widespread in developing countries. Imperfection in credit markets is the usual explanation.[7] In contrast in our model entrepreneurs are blocked out of the formal sector by the entry fees. To make this point clear we assume perfect credit markets (i.e., every profitable project gets financed).

On the consumers' side, we consider a linear specification of demand. To test the robustness of the results and their empirical relevance we also consider in footnotes a Cobb-Douglas specification. The two specifications lead to the same qualitative results. Under the linear specification the inverse demand function is:

$$p(Q) = A - BQ. \tag{3}$$

Term A is a scale parameter that indicates the depth of the market. It can be thought of as reflecting the size of the population. If A is small it implies that even if the commodity is free, the demand for the commodity is small. On the other hand, B measures the price responsiveness to supply. The lower it is the higher is the price in equilibrium. It can be thought of as inversely related to the wealth of the population. The quantity elasticity of price, $\epsilon_{q,p} = -\frac{BQ}{A-BQ}$, decreases in absolute value with A and increases with B.[8]

We assume that the commodities produced by the formal and the informal sector are homogeneous products. This implies that in equilibrium we cannot have the coexistence of formal and informal production. Consumers purchase the commodity from the cheapest producer. That is, they purchase from the informal sector if the price is strictly lower in the informal sector, and from the formal sector otherwise. This is of course a simplification. In practice commodities are differentiated so that traditional and modern production techniques might coexist.[9] We avoid the technicalities of a differentiation model by focusing on homogeneous products.

[6] "Infrastructure" is interpreted broadly to include legal institutions essential for property rights.

[7] Even if returns to scale are close to unity in services and manufacturing, modern production technologies generally require an initial investment in capital.

[8] In the Cobb-Douglas specification the demand is $D(p) = \frac{aM}{p}$ where $p \geq 0$ is the price, a is the Cobb-Douglas coefficient and M is consumers wealth (i.e., aM is proportional to GDP). The inverse demand function is $P(Q) = \frac{aM}{Q}$. Then $\epsilon_{q,p} = -1$.

[9] This is for instance the case with occidental pharmaceutical and traditional medicine. However they may be considered as different products.

3 Market equilibrium

We study now the incentive an individual firm might have to operate formally. To enter the formal sector the firm first incurs the fixed cost F, and next pays taxes on profit. Since F is an entry fee, it is not tax deductible. To keep the analysis simple we focus on linear taxes on variable profit.[10] The taxation rate is denoted t. In contrast the firms in the informal sector do not pay entry fees or taxes.

Since F has to be sunk before production and exchange can take place, the net profit of each firm must be large enough to cover F. We hence model competition among firms in the formal sector as a generalized Cournot competition.[11] Let $Q_{-j} = \sum_{h \neq j} q_h$ denote total production excluding that of firm j. The firm $j(= 1, .., N)$ chooses q_j to maximize $\Pi_j(q_j, Q^*_{-j}) = (1-t)\Big(P(q_j + Q^*_{-j})q_j - c^m q_j\Big) - F$. It is easy to check that since the firms' cost are symmetric, the equilibrium is symmetric. That is $q_j = Q/N \ \forall j = 1, ..., N$. The first order condition is $\frac{P(Q)-c^m}{P(Q)} = \frac{-P'(Q)Q}{NP(Q)}$. The Lerner index is equal to the quantity elasticity of the price divided by N. For $N = 1$ we get the traditional monopoly solution, for $N = 2$ the Cournot duopoly solution, and for $N \to \infty$ the competitive outcome Q^*. Under the linear specification of the model the competitive outcome is $Q^* = \frac{A-c^m}{B}$ and the first order condition yields:[12]

$$Q(N) = \frac{N}{1+N} Q^*. \tag{4}$$

We compute next firms' per capita profit assuming that consumers decide to purchase from the formal sector (i.e. assuming $p^t \geq p^m$). The profit of a firm depends on the total number of firms in competition: $\Pi(N) = (1-t)\frac{Q(N)}{N}(P(Q(N)) - c^m) - F$. Substituting the value of (4) into this expression yields: $\Pi(N) = \frac{1-t}{B}\Big(\frac{A-c^m}{N+1}\Big)^2 - F$. Under the perfect credit market assumption an equilibrium in the formal sector is then a maximal number of firms N (i.e., a maximal integer) such that they all break even. That is, the maximal integer N such that $\frac{1-t}{B}\Big(\frac{A-c^m}{N+1}\Big)^2 \geq F$. We deduce that

$$N = \text{INT}\Big\{\Big(\frac{1-t}{BF}\Big)^{0.5}(A - c^m) - 1\Big\}, \tag{5}$$

where $INT(x)$ denotes the integer part of x. Even if the market is *a priori* competitive, because of the entry fee, it becomes oligopolistic with N producers. From equations (4) and (5) we compute the price that emerges under the assumption that at the equilibrium production occurs in the formal sector (i.e., $p^m = A - BQ(N)$):

$$p^m = c^m + \Big(\frac{F}{1-t}B\Big)^{0.5}. \tag{6}$$

[10] In developing countries among income taxes there is more reliance on company taxes and less on personal taxes.

[11] For more on this point see for instance Tirole (1988)

[12] The Cobb-Douglas specification yields $Q(N) = \frac{N-1}{N}Q^*$, where $Q^* = \frac{aM}{c^m}$.

The price exceeds the marginal cost by a factor $(\frac{F}{1-t}B)^{0.5}$ which increases with the fixed cost, the tax rate and the demand parameter B. This is rather intuitive. If the fixed cost is high, or if the tax rate is high, the firms need a large mark-up to break even.[13]

By virtue of equation (5), if A is too small, or B too large (i.e., the consumers are few or poor), or alternatively, if the tax rate t, or the fixed cost F are too large, no formal production can emerge in this sector. To be more specific if $A < c^m + 2(\frac{F}{1-t}B)^{0.5}$ then $N = 0$. In this case the only way to produce the commodity is informally. The price in the informal sector is $p = c^t$. There is an equilibrium in the informal sector if $A > c^t$. We deduce that if in the linear case $A < \min\left\{c^m + 2(\frac{F}{1-t}B)^{0.5}, c^t\right\}$ no production takes place. In contrast if A is large enough there is production at the equilibrium. The production is organized formally if $p^m \leq p^t$, which is equivalent to $c^m + \left(\frac{F}{1-t}B\right)^{0.5} \leq c^t$. Production is informal otherwise. The next proposition characterizes the equilibrium market structure.[14]

Proposition 1 *The equilibrium is:*

- no production if $A - c^m < \min\left\{c^t - c^m, 2(\frac{F}{1-t}B)^{0.5}\right\}$,

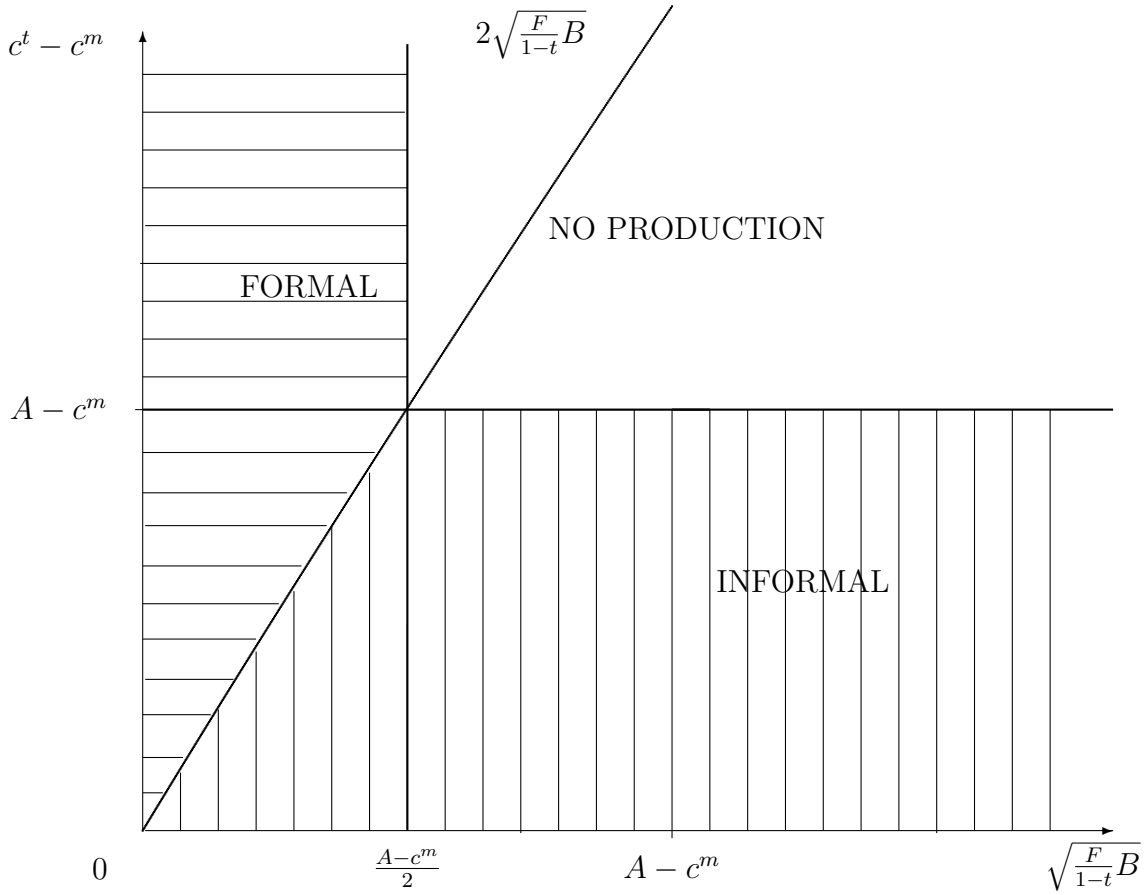
- a competitive informal sector with price equilibrium $p = c^t$, *if* $c^t - c^m < \min\left\{A - c^m, 2(\frac{F}{1-t}B)^{0.5}\right\}$,

- an oligopolistic formal sector with N firms, defined by equation (5), and price equilibrium $p^m = c^m + \left(\frac{F}{1-t}B\right)^{0.5}$ *otherwise.*

Figure 1 illustrates Proposition 1.

[13] In the Cobb-Douglas case we get $N = \left(\frac{1-t}{F}aM\right)^{0.5}$ and $p = \frac{\left((1-t)aM\right)^{0.5}}{\left((1-t)aM\right)^{0.5} - \left(F\right)^{0.5}}\ c^m$.

[14] With a Cobb-Douglas specification, the "no production" area disappears because, whatever the price of the commodity, the consumers always devote a fraction a of their revenue to the consumption of the commodity. The market equilibrium is: an oligopolistic formal sector with N firms and price p defined in the preceding footnote if $\left(\frac{aM(1-t)}{F}\right)^{0.5} \geq \min\{\frac{c^t}{c^t - c^m}, 1\}$, and a competitive informal sector with price equilibrium $p = c^t$ otherwise.



[Figure 1]

Proposition 1 implies that if F is small (i.e., close to 0) the traditional technique of production disappears. The market equilibrium is production in the modern sector. On the other hand, where barriers to entry are higher there should be a segmentation between formal and informal sectors based on type of business or industry. Then the sector is organized formally if the difference in productivity between the traditional and modern methods of production is large enough. That is if $c^t - c^m$ is large enough, which corresponds to a large value on the vertical axis in figure 1. Otherwise it is not worthwhile for private entrepreneurs to bear the fixed cost F and pay taxes. In other words the model predicts that the formal sector should include commodities or services that cannot efficiently be produced in a traditional way. In contrast business that can efficiently be run with traditional production techniques have strong incentives to remain informal.

Empirically the division between the formal and informal sectors tends to be product based. For instance a study conducted in 1996 in the urban area of Dakar in Senegal concluded that 665135 people were working in the informal sector. Among these 61% were in the production of goods (bakery employed 65% of the workers in this category), 20% in trade (more than 50% selling fruits and vegetables, fish or clothes and shoes), and 13% in the production of services (20% mechanics, 18% hairdressers, 18% refrigerator repairers, 15% car washers). In contrast the formal private sector employed 68803 people, 62% worked in industry, 18.2% in services (a majority in telecommunication and transport), 12.5% in trade (a majority in wholesale) and 7.3% in construction.[15]

From proposition 1, demand parameter B plays a role in the segmentation between the formal and informal sectors. The higher B is, the more likely it is that the good will be produced informally. This corresponds to large value on the horizontal axis in figure 1. A poor population is characterized by a high B. We deduce from proposition 1 that for a given level of the fixed and variable costs, a rich population purchases in the formal sector and a poor one in the informal sector.[16] Everything else being equal, richer nations should have smaller informal sectors. Proposition 1 also illuminates the role played by the fixed cost F in the emergence of an informal economy. Everything else being equal, countries with larger Fs have larger informal sectors. The model predicts that the size of the shadow economy decreases with GDP per capita and with population size; it increases with market entry sunk costs.

The cross-country study by Djankov et al. (2000) shows that market entry barriers are higher in countries with lower GDP per capita. This helps us to understand the difference in production organization *across* countries. The informal sector is larger in developing countries because the consumers are poor and the barriers to market entry are high. The wealth effect and the barriers to entry effect reinforce each other. The government cannot influence in the short run the nation's wealth. The fact that a country is rich or poor is a constraint. This implies that there is a part of the shadow economy that is incompressible in developing countries. On the other hand, the barriers to market entry are chosen by the government. These are largely endogeneous. What might explain that governments in poor countries choose to restrict further entry to their formal economies? The next section studies this problem.

[15] www.tpsnet.org/informel.htm (April 2004)

[16] We also deduce from proposition 1 that if A is small, which indicates that the demand is not great (i.e. even if it is free consumers don't consume much of it), the market disappears. The no production area decreases with A. This result is not robust to the introduction of the Cobb-Douglas specification because the consumers devote a% of their revenue to the purchase of the commodity, independently of the price p.

4 Government policy

The government collects entry fees, NF, and taxes on profit, $Nt\Pi(N)$, from the formal sector. Assuming firms produce formally (i.e., assuming $2(\frac{F}{1-t}B)^{0.5} \leq \min\left\{A - c^m, c^t - c^m\right\}$), the total government tax revenue from the industry is:

$$R = tQ(p^m - c^m) + NF. \tag{7}$$

Neglecting the integer part problem, we substitute the real value of N defined by equation (5), p^m defined by (6), and Q defined by (4), in (7) yielding:

$$R = \left(\frac{F}{1-t}\right)\left\{\left(\frac{1-t}{BF}\right)^{0.5}(A - c^m) - 1\right\}. \tag{8}$$

The government is utilitarian. It maximises a weighted sum of consumers' surplus, firms' profit, and tax revenue. Under our equilibrium assumptions the firms profit, $(1-t)(p^m - c^m)q$, is approximately F, so that the firms' net profit is approximately zero. The consumers' surplus is defined as: $S(Q) = \int_0^Q P(q)dq - QP(Q)$. Under the linear specification we deduce that $S(Q) = \frac{B}{2}Q^2$. Substituting the real value of N in (4) we deduce that

$$Q = \frac{A-c^m}{B} - \left(\frac{F}{B(1-t)}\right)^{0.5}. \tag{9}$$

The government's utilitarian objective function is:

$$\underset{(F,t)}{\text{Max}}\, W(F,t) = \tfrac{1}{2}BQ^2 + \lambda R, \tag{10}$$

where λ reflects the weight the government puts on tax revenue with respect to consumers' surplus. Everything else being equal this weight decreases with the availability of alternative sources of financing and with the government budget constraint. Most developing countries run large public deficits. They have few sources for government financing. For instance in 1999 the 41 Heavily Indebted Poor Countries (HIPC) had external debt averaging 57 percent of GDP and other developing countries had debt averaging 36 percent of GDP. It seems unlikely that governments of poor countries put a big weight on consumers' surplus relative to tax revenue. They are more concerned with paying the interest on the debt (to be able to borrow more), and the civil servants' wages, especially the wages of the police and the army to avoid military coups. On the other hand, they also need to pay attention to the price of essential commodities such as staple foods to avoid civil rebellion. This naturally leads governments of poor countries to weight differently consumers' surplus and market entry fees depending on the sector at hand.[17] In a partial equilibrium

[17]It is worth noting that it is also the case in rich countries where "luxury" goods are more heavily taxed than basic goods. This implies that governments of rich countries weight taxes and consumer surplus differently in different sectors.

perspective the weight λ reflects how the government trades off the consumer surplus and the tax revenue. By letting λ vary in $[0, +\infty)$, the government objective function varies from pure consumers' surplus maximization (i.e., $\lambda = 0$), to tax revenue maximisation (i.e., $\lambda = +\infty$). Another interpretation of λ is that it reflects the weight a corrupt government puts on firms' rent that it captures. Indeed poor countries are generally more corrupt than rich countries and simultaneously their barriers to entry are higher. It seems natural to conclude that barriers to entry are higher because of corruption (see Djankov et al (2002)). However this is not the logic followed here.[18] In the empirical part of the paper we try to assess the relevance of the different interpretations of λ.

The government chooses (F, t) to maximise (10). Let $x = \frac{F}{1-t}$. It is clear from equations (8) and (9) that the government's objective function depends on x only. Conditionally on $F > 0$, it is equivalent in terms of tax revenue to raise an entry fee or to tax profit. However, the two tax instruments do not play symmetric roles. If at the optimum $x > 0$, necessarily $F > 0$. Indeed, setting $F > 0$ creates an oligopolistic situation; the firms make rents that are confiscated by taxes. In contrast when $F = 0$ the market is competitive and the firms do not make rents so that $R = 0$.[19] Since in terms of collection costs it is cheaper to raise F than to tax profit (it is paid up front and does not require a detailed follow up of firms' profit), the market entry fee fills two purposes: first of all it is a tax instrument with low administrative cost, secondly it constitutes a barrier to market entry fostering the emergence of large tax payers.

Since the way the government draws its resources does not play a role in the analysis below we do not consider administrative costs.[20] The government chooses the optimal x, independently of the way the tax rate t and the entry fee F enter x. Optimizing (10) with respect to x yields the following result.

Proposition 2 *If $\lambda \leq 1$ there is no entry fee, $\frac{F}{1-t} = 0$, and the market is competitive. If $\lambda > 1$, the government's optimal taxation policy is to set*

$$\frac{F}{1-t} = \Big(\frac{\lambda - 1}{2\lambda - 1}\Big)^2 \frac{(A - c^m)^2}{B}, \tag{11}$$

which yields a formal oligopolistic market structure with

$$N = INT\Big\{\frac{\lambda}{\lambda - 1}\Big\}. \tag{12}$$

[18] In our view corruption is a consequence of poverty (though obviously it does not help growth). Underpaid and poorly trained civil servants take bribes to compensate for their low wages (see Auriol (2003)). The main concern of the government of a poor country is to secure a revenue to maintain itself.

[19] With competitive industries the only way to draw a revenue for the government is by taxing labor and capital. This requires detailed accounts for the firms and numerous and well trained tax inspectors. The inherent administrative costs and literacy and technical requirements explain why developing economies' administrations do not tax labor and capital provided to informal firms.

[20] If we add them the optimal taxation scheme is to set $t = 0$ and to tax solely through F.

Proof: Differentiating (10) with respect to $x = \frac{F}{1-t}$ and setting the derivative equal to zero yields (11) if $\lambda \geq 1$. Substituting (11) into equation (5) we get (12). If $\lambda \leq 1$ (10) is decreasing in $x = \frac{F}{1-t}$. This yields $F = 0$, and $N = +\infty$.

Proposition 2 implies that in sectors where the government puts more weight on consumers' surplus than on tax revenue it chooses, with the crude instruments considered here, a policy of zero taxation. For instance it is likely that in developing countries the government puts a higher weight on consumers' surplus in sectors such as staple foods production and distribution, than in sectors such as telecommunication services. We thus expect less taxation for essential consumption commodities than for sophisticated ones. We also deduce from Proposition 2 that the optimal entry fees increase with λ so that the total number of firms in the formal sector decreases with λ. This implies that countries that are more prone to public finance difficulties should restrict more the entry to their formal economy (i.e., choose higher entry fees). In the limit (i.e., when $\lambda \to +\infty$) the government puts no weight on consumers' surplus; it seeks the maximal tax revenue. Optimizing R with respect to $x = \frac{F}{1-t}$ (or equivalently letting λ go to $+\infty$ in equation 11) yields: $\frac{F}{1-t} = \frac{\left(A-c^m\right)^2}{4B}$. Substituting this expression into equation (5) we get $N = 1$. In other words a government which tries to maximize tax revenue will choose a monopoly structure. Indeed industry profit is maximal with a monopoly (i.e., $\Pi(1) = \frac{(A-c^m)^2}{4B} \geq N\Pi(N)\ \forall N \geq 1$). To maximize its revenue the government creates a (legal) monopoly whose profit is confiscated through entry fees and/or taxes. The model then implies that higher barriers to entry in the market imply higher rents for the industry which are captured by the government through the entry fees. In the next section we aim to test the empirical relevance of such conclusions.

5 An empirical assessment of the theory

We deduce from the preceding analysis at least two testable conclusions that contrast with former results obtained in the literature focused on rich countries. The first result concerns the size of the shadow economy. According to our analysis the size of the shadow economy in developing countries is explained by the weakness of demand and the existence of barriers to entry in formal markets. The second result concerns government policy. According to our analysis governments in developing countries use barriers to entry in formal sectors to create market power for firms whose profits are confiscated by entry fees and taxes. If this analysis is correct, we should empirically observe a positive relationship between a country's barriers to entry and government tax revenue. To be more specific we would like to test the following hypotheses.

H1: In developing countries the size of the shadow economy decreases with GNP per capita and population size and increases with the fixed cost of market entry.

H2: In developing countries tax revenue increases, everything else being equal, with the fixed cost of market entry.

To obtain an indication of the empirical relevance of the model we have assembled a cross-country data set. It includes both advanced and developing economies. However because of many missing data the final sample includes 53 countries in the first set of regressions (assessment of H1), and 64 countries in the second set of regressions (assessment of H2). The data are available on the publisher's web site. Data descriptions and the regression results are presented in the Appendices.

The first dependent variable, denoted $SHADOW$, is an indicator of the size of the shadow economy. It is drawn from the working paper of Djankov et al. (2000), and represents the size of the shadow economy as a percentage of GDP.[21] The explanatory variables include GNP, the 1996 GNP per capita (World Bank 1998), and POP, the population size expressed in millions of citizens (source the Europa World Year Book 1995). More importantly they include the variable $SUNKCOST$, drawn from the working paper of Djankov et al. (2000), which measures the cost of entering the formal economy. $SUNKCOST$ is the cost, expressed as a percentage of GDP per capita, of establishing a company with no special legal complications and with startup capital of ten times GDP per capita. The figures include official fees, costs of forms, photocopies, stamp duty, legal charges etc., and exclude bribes and the opportunity cost of entrepreneurs' time.[22]

We first run a regression with GNP, POP and $SUNKCOST$ as explanatory variables.[23] The estimated equation fits the data satisfactorily, with an adjusted R^2 of 0.57.[24]

$$\begin{array}{rccccc} SHADOW = & 28.05 & -0.0006\,GNP & -0.007\,POP + & 15.15\,SUNKCOST. \\ & (11.22) & (-6.23) & (-2.15) & (4.01) \end{array}$$

[21] Djankov et al. (2000) calculate $SHADOW$ averaging over all estimates of the size of the shadow economy for any given country reported in Enste and Schneider (2000), supplemented by four studies covering additional countries.

[22] In the published version of the paper, Djankov et al. (2002), the data on entry costs were updated to 1999. Since the theory says that $SUNKCOST$ determines $SHADOW$, it is preferable to use $SUNKCOST$ data as close as possible in time to the $SHADOW$ data. The more recent data are not appropriate since they date from 6 to 9 years after the $SHADOW$ data. One might think that it does not matter whether $SUNKCOST$ data are from 1997 or 1999 but the 1999 data are quite different from the 1997 data. The coefficient of correlation between $SUNKCOST$ 1997 Djankov et al. (2000) and $SUNKCOST$ 1999 Djankov et al. (2002) is a low 0.65. This is strange because there has been no sign of a worldwide reform of market entry fees. This probably signals a data quality problem.

[23] See Appendix B, column (1).

[24] In contrast when we run it without $SUNKCOST$ the adjusted R^2 falls to 0.41. Regressing $SHADOW$ on a constant and $SUNKCOST$ gives an adjusted R^2 of 0.32

In this and the following regressions, t-statistics are in parentheses. The coefficients of the explanatory variables are significantly different from zero. As predicted by the theory the coefficients of GNP and POP are negative, and the coefficient of $SUNKCOST$ is positive. The result is robust to the introduction of many controls (see Appendix B for details). The only other significant variables are $TRANS$, a dummy that signals a transition economy and $OECD$ a dummy that signals a member of the OECD organization. The regression equation with these controls is:[25]

$$\begin{array}{rcccccc} SHADOW = & 32.90 & -0.0005\,GNP & -0.01 & POP + & 13.71 & SUNKCOST \\ & (8.55) & (-4.22) & (-2.75) & & (4.02) & \end{array}$$

$$\begin{array}{cccc} -5.82 & TRANS & -7.19 & OECD. \\ (-1.96) & & (-3.35) & \end{array}$$

The coefficients on the introduced variables are negative. OECD and transition economies have smaller shadow economies than their other characteristics would otherwise suggest.[26] The result of the estimation is satisfactory, with an adjusted R^2 of 0.65. A concern with the independent variable $SUNKCOST$ is endogenity. One can argue that $SHADOW$, the size of the shadow economy, influences $SUNKCOST$, the level of the entry fees on market. For instance a larger shadow economy might lead to higher entry fees in an attempt to compensate for the narrowness of the taxation base. This concern is not borne out when we test for endogeneity.[27]

We conclude the sensitivity analysis by running a regression with only developing countries (i.e., 29 countries that have a 1996 GNP per capita below \$10,000).[28] The coefficient of $SUNKCOST$ remains significant with similar magnitude. In contrast when we run a regression with developed economies only (i.e., with GNP per capita above \$10,000), the coefficient of $SUNKCOST$ becomes insignificant. The theoretical predictions of the model are corroborated by the available data: $SUNKCOST$ does significantly influence $SHADOW$ in developing countries. Indeed the impact of market entry fees on the emergence of the shadow economy seems quite large. Based on our estimates an increase of

[25] See Appendix B column (3).

[26] This points to the structural differences between OECD, transition economies and other economies. That is, transition economies used to be centralized and under public ownership. Similarly OECD countries have powerful governments. With each citizen recorded from birth to death, it is difficult for individuals or firms to go undetected.

[27] Appendix B column (2) reports a Two-Stage Least Squares estimation with the instruments *PERCENTPROT*, the percentage of protestants in the total population, *COMLAW*, a dummy that equals 1 if a country has a common law system (both variables are from Treisman 2000), and *AFRICA*, a geographical dummy that equals 1 if a country is on the African continent (these exogeneous variables are quite good predictors of $SUNKCOST$). Based on a Hausman test we do not reject the null hypothesis of exogeneity.

[28] See Appendix B column (4).

1% of the entry fees (in terms of per capita GDP) raises the size of the shadow economy by roughly 14%.

We now turn to the evaluation of H2. Our purpose is to check whether, everything else being equal, countries that have higher entry barriers to their markets also have larger fiscal revenues. The dependent variable is a logistic transformation of $TAXREV$, central government tax revenue as a percentage of 1996 GDP (source World Bank 1998 and 2001 or IMF 2002 web site). The transformation ensures that out-of-sample fitted values for $TAXREV$ lie in the range 0 to 100%. Except where indicated, our results are qualitatively similar when the dependent variable is $TAXREV$. $TAXREV$ comprises all compulsory, unrequited, non-repayable receipts collected by central governments for public purpose. Clearly $TAXREV$, which includes both direct and indirect taxation revenues, is influenced by many variables other than $SUNKCOST$. Actually the correlation coefficient between $TAXREV$ and $SUNKCOST$ is low and negative (i.e, -0.22).[29] Nevertheless the theory predicts that once we control for other relevant variables $TAXREV$ should be positively related to $SUNKCOST$. We hence ran different linear regressions with potential explanatory variables. The final variables were selected after some experimentation to achieve the best overall fit for the regression.[30] The main result regarding H2 is summarized by the following regression. The coefficients are all significant at the 2% level.

$$\begin{array}{lllllllll} log(\frac{TAXREV}{100-TAXREV}) = & -3.89 & + 0.09 & log(SUNKCOST) + & 0.31 & log(GNP) + & 0.41 & DEM46 \\ & (-13.12) & (2.54) & & (8.55) & & (4.17) & \end{array}$$

$$\begin{array}{llllllll} -1.49 & DENSITY & -0.06 & LAND + & 0.51 & AFRICA + & 0.74 & TRANS. \\ (-6.38) & & (-4.55) & & (3.88) & & (6.37) & \end{array}$$

The result of the estimation is satisfactory, with an adjusted R^2 of 0.72. Based on the White test for heteroskedasticity we do not reject the null hypothesis of homoskedasticity at the 5% level.

As explained in the introduction rich countries tax proportionally more than poor countries. Unsurprisingly the coefficient of the variable GNP is positive. This reflects the structural differences in tax revenue collection between poor and rich economies. It is also unsurprising, in light of the H1 regressions, to find that the coefficient of the dummy variable $TRANS$ is positive. Because of the former centralisation, transition economies collect more tax revenue than their other characteristics would otherwise suggest. The coefficient of the variable $LAND$, land area in millions of square kilometers (Europa

[29] See also Appendix C column (1).
[30] See Appendix C column (2).

World Year Book 1995), is negative which is also intuitive. It seems natural that large countries have proportionally smaller tax revenue because of higher collection cost.[31] In contrast, it is less clear why the coefficient of the variable $DENSITY$, population per square kilometer divided by 10,000 (Europa World Year Book 1995), is negative. One possible explanation is that it is easier to escape taxation in highly populated areas. The coefficient of $DEM46$, a dummy that equals 1 for countries that have experienced 46 years of continuous democracy (source Treisman 2000), is positive. Countries with a long history of democracy tax more than countries without such an experience. We conclude that it is easier to tax when the government is legitimate because with democratically elected representatives it is always possible to sanction poor performance by not reelecting them. Another surprising result emerged by adding $AFRICA$, a geographical dummy which equals 1 if a country is on the African continent. Its coefficient is *positive*. Everything else being equal, being on the African continent increases tax revenue. This could be because, more than other countries, African countries use entry fees. Certainly much of the variation in $SUNKCOST$ can be explained by the $AFRICA$ dummy.[32]

Finally, and more importantly, the $SUNKCOST$ coefficient is positive and significant at the 2% level. In other words, higher entry fees imply higher tax revenue for the government. This is robust to the introduction of many controls. (See Appendix C, columns (3), (4) and commentary for details.) Higher barriers to entry imply higher fiscal revenue, everything else being equal. The impact of $SUNKCOST$ on total tax revenue is positive but small. According to our estimations the elasticity is $\epsilon_{T,K} = 0.09 \times \frac{100-TAXREV}{100}$: on average a 1% increase of the $SUNKCOST$ increases total tax revenue by 0.07% in developing countries (per capita income less than \$10,000) and by 0.06% in rich countries.

A competing theory to ours is that the size of the shadow economy is relatively rigid in the short run and that it influences negatively the total tax revenue. Economies with large informal sectors should tax less than economies with small informal sectors. This view is supported by the fact that the coefficient of correlation between the two variable is -0.44. However our theoretical analysis suggests that the size of the shadow economy is an endogenous variable which depends on demand and market entry fees. In other words, $SHADOW$ and $TAXREV$ are simultaneously determined by $SUNKCOST$. To

[31] One might suspect that this result comes from the fact that larger countries are more likely to have a federal structure, and that central government tax revenue is proportionally lower in federal countries. However, this intuition is not supported by the empirical analysis. In the regressions we ran the coefficient of the dummy $FEDERAL$ was never significant.

[32] A regression of $SUNKCOST$ on a constant and the $AFRICA$ dummy has an adjusted R^2 of 0.39. Another possible explanation could be that official GNP is systematically underestimated. Underestimation of GDP remains, especially in the measurement of women's contribution to GDP, through their informal activities. (see Charmes 2000). This leaves open the question why GNP would be underestimated more in Africa than elsewhere.

check this point we run a Two-Stage Least Squares estimation.[33] Based on the preceding empirical analysis the instruments for $SHADOW$ are the variables POP and $OECD$. We reject the null hypothesis of exogeneity using a Hausman test. As predicted by the theory the coefficient of $SHADOW$ becomes insignificant and negative once we control for the endogeneity problem.

Our regression includes both advanced and developing countries. This a concern because they do not have identical fiscal systems. In particular rich countries have more efficient tax administrations and do not rely on $SUNKCOST$ for fiscal purposes.[34] We next run a regression with developing countries only: the sample includes 41 countries that have a 1996 GNP per capita below $10,000. The regression does not include $DEM46$, $DENSITY$, or $AFRICA$.[35] The coefficients are all significant at the 1% level with the exception of GNP which is significant at the 5% level.[36]

$$\begin{aligned} log(\tfrac{TAXREV}{100-TAXREV}) = & \underset{(-6.95)}{-2.92} + \underset{(3.52)}{0.17}\ log(SUNKCOST) + \underset{(3.32)}{0.21}\ log(GNP) \\ & \underset{(-4.44)}{-0.05}\ LAND + \underset{(4.95)}{0.64}\ TRANS. \end{aligned}$$

The adjusted R^2 is 0.54, and the global F-statistic is a significant 12.92. Based on the White test statistic, we do not reject the null hypothesis of homoskedasticity. The sign of the coefficients do not change. As predicted by theory the impact of $SUNKCOST$ is stronger. A one percent increase in $SUNKCOST$ raises tax revenue by 0.13 percent.

The empirical results support the theoretical conclusions of the paper. Despite the good fit of our regression we would like to stress that the above tests are still very much preliminary. In particular the sample size is small, and some crucial data, such as '$SHADOW$' or '$SUNKCOST$' are difficult to collect in practice. The quality of our data set should be seen as poor. Measurement errors are known to lead to inconsistent and biased estimates. Conclusions from this study need to be qualified by this provision.

[33] See Appendix C column (5).

[34] Running a regression with only rich countries, the only significant variables from the list in Appendix C, column (2) are $DEM46$, $LAND$ and $DENSITY$. A regression with just these variables and a constant, restricted to rich countries, has an adjusted R^2 of 0.68, with 24 observations.

[35] See Appendix C for discussion.

[36] See Appendix C column (6). Columns (7)-(9) present alternative specifications.

6 Conclusion

The size of the shadow economy in developing countries is explained by the weakness of demand and by the existence of barriers to market entry. It seems that African countries make particular use of entry fees. Restricting official market entry is a deliberate policy. We have argued that this is consistent with a benevolent government's policy for raising revenue. Our empirical results support our argument: higher entry fees are associated with larger informal sectors and with higher tax revenues.

Market entry fees involved in officially establishing a new business block out small entrepreneurs and foster the emergence of large taxpayers. Based on our estimations a 1% increase of the entry sunk cost increases the informal sector by 15%. Hence a few taxpayers account for a large proportion of total tax collection in developing countries. For instance Baer (2002) reports that 0.4% of tax payers account for 61% of total domestic tax collection in Kenya and 57% in Colombia. Recognizing this phenomenon, the IMF has encouraged the establishment of large taxpayer units (LTUs). By concentrating scarce tax administration resources where they are most productive, LTUs permit the adoption of more sophisticated taxation instruments.

The chosen entry barriers may well be optimal in terms of governments' short time horizons, but they come with considerable costs. Firms in the formal sector are given market power to raise prices above marginal costs. This reduces exchange and consumer surplus in the formal economy. Keeping firms in the informal sector exposes them to weakened property rights and hence increased risks. Taxing some sectors and not others distorts resource allocation. Eliminating such inefficiencies could provide a significant impetus to growth, and simultaneously tax collection, in the medium to long term.

An effort to broaden the tax base is a typical element of tax reform in developing countries (Burgess and Stern (1993)). Our analysis suggests that tax reformers could widen their area of interest beyond the standard tax parameters. By reducing market entry fees developing countries could enlarge their formal sectors and hence the tax base. A policy of reducing entry fees to enlarge the tax base probably needs to proceed gradually, to create the administrative resources necessary to deal with a broader tax base. Alternative revenue raising mechanisms will also play a role. The widespread introduction of VATs in recent years (Ebrill et al (2002)) presents developing country governments with a new instrument of commodity taxation, which may be more effective at raising revenue in competitive sectors than profits taxes. If so, the relative importance of profits taxes may diminish, and the introduction of VATs could be the spur for a lowering of entry fees. We leave this conjecture as a subject for further research.

Finally, it would seem possible for imaginative governments to establish additional mechanisms to enlarge the tax base by encouraging the formal sector. For example, by creating a special status for small entrepreneurs (e.g., without limited liability) associated with discounted entry fees and some benefits (for example, easier access to micro-credit or to electricity connection) governments of poor countries may increase their taxation bases. The idea would be to use second degree discrimination to encourage small entrepreneurs to register under the status created for them without having larger firms doing the same. LTUs could be key actors in this reform by their monitoring of large taxpayers.

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Appendices

A The Data

The two dependents variables are:

- $SHADOW$: the size of the shadow economy as a percentage of GDP (varying time periods 1990-1993) based on averaging of different studies (Djankov et al. 2000). The data are available at: http://post.economics.harvard.edu/faculty/laporta/papers.html (April 2004).

- $TAXREV$: central government tax revenue as a percentage of GDP. It comprises all compulsory, unrequited, non-repayable receipts collected by central governments for public purpose. It includes both direct and indirect taxation revenues. The tax revenue data are for the year 1996 (source World Bank 1998), with the exception of Malawi which is for year 1990, Ghana and Paraguay for the year 1993, Tanzania for the year 1995/96, Bosnia, Kazakhstan, Macedonia, Bangladesh for the year 1997 (source IMF web site 2002), Azerbaijan, Guinea, Zimbabwe which are for the year 1998 (Source World Bank 2001),

and Brazil, Japan, Slovak Republic, Iceland, Hungary, and Slovenia, which are from the World Competitiveness Yearbook (Garelli 2001) for the year 1999.

The explanatory variables include:

- $AFRICA$: dummy that equals 1 if the country is on the African continent.

- AGR: agriculture value added as a percentage of GDP 1996 (for Benin and Chile by default 1970) (World Bank 1998).

- $COMLAW$: dummy that equals 1 if the country has a common law system (Treisman 2000).

- $DEM46$: dummy that equals 1 if the country has been democratic in all 46 years (1950-1995) (Treisman 2000).

- $DENSITY$: population per square kilometer, divided by 10,000. (World Bank 1998, except Bosnia-Herzegovina, Fiji, France, Guyana, Iceland and Ireland which are from the Europe World Year Book 1995.)

- DEV: dummy that equals 1 if the country has per capita GNP greater than $10,000 (1996 USD) (World Bank 1998).

- $FEDERAL$: dummy that equals 1 if the country has a federal structure (Treisman 2000).

- $FORMBRITCOL$: dummy that equals 1 if the country is a former British colony or is the UK (Treisman 2000).

-$FREEOPEN$: measure of free trade openness (Barro and Lee 1994, available at www.nber.org/ftp/barro.lee).

- GNP: GNP per capita in dollars 1996 (World Bank 1998).

- $HIPC$: a dummy that equals 1 if a country was classified as a heavily indebted poor country by the IMF and the World Bank in May 2001.

- $LAND$: 1995 land area in millions of square kilometers (World Bank 1998) (with the exception of Estonia, Finland, Guatemala, Hungary, and Indonesia, source Europa World Year Book 1995)

- $MAT1$: fuels, minerals and metals as share of 1993 merchandise exports. Missing data replaced by 1978/1979 values. (Treisman 2000)

- $OECD$: dummy that equals 1 if a country belongs to the OECD organization.

- POP: country population in millions (source the Europa World Year Book 1995).

- $SUNKCOST$: direct cost as a fraction of 1997 GDP per capita associated with meeting government requirements to open a new business (Djankov et al. 2000). The 'standard' company considered across all countries has an initial startup capital of 10 times average per capita income, and is established in the capital city. In the published version of the paper (Djankov et al. 2002) the data are for 1999 and are different. The coefficient of correlation between the two data sets is 0.65.

- $TRANS$: dummy that equals 1 if the country is in transition.

- $TISCORE$: 1996 Transparency International scores, by default Transparency International score 1998 (Transparency International web site 2000: www.transparency.org).

- $TIMECOST$: minimum time, in days, required to meet government requirements for establishing a new company, when there are no special legal complications. The same 'standard' company considered for $SUNKCOST$ is used to ensure comparability across countries. (Djankov et al. 2000).

B Assessment of H1

Dependent Variable: SHADOW

	(1)	(2)	(3)	(4)
Constant	28.05	27.08	32.90	30.89
	(11.22)***	(7.62)***	(8.55)***	(7.84)***
GNP	-0.0006	-0.0006	-0.0005	-1.23×10^{-3}
	(-6.23)***	(-4.82)***	(-4.22)***	(-1.70)*
POP	-0.007	-0.006	-0.01	0.01
	(-2.15)**	(-1.70)*	(-2.75)***	(-2.53)**
SUNKCOST	15.15	17.25	13.71	14.63
	(4.01)***	(2.31)**	(4.02)***	(3.69)***
TRANS			-5.82	
			(-1.96)*	
OECD			-7.19	
			(-3.35)***	
No. Obs.	53	47	53	29
Adjusted R^2	0.58	0.58	0.65	0.26

Columns (1), (3) and (4) were estimated by ordinary least squares. Column (2) was estimated by two stage least squares, using PERCENTPROT, COMLAW and AFRICA as instruments for SUNKCOST. Column (4) is estimated for a restricted sample, with developing countries only. White heteroskedastic-consistent standard errors are used to calculate t-statistics, which are reported in parentheses. Significance is denoted by *** (1%); ** (5%); * (10%).

Other variables tested as controls in the regression of column (1) include: AGR; $LAND$; $TISCORE$; and $TIMECOST$. Intuition suggests that countries characterized by

large agricultural sectors, large territory (because of the cost of controlling it), high level of corruption or long administrative procedures have large informal sectors. We also tested $TAXREV$, the tax revenue as a percentage of GDP, which is generally used to proxy the taxation burden. None of these variables had coefficients significantly different from zero.

C Assessment of H2

Dependent Variable: $log(\frac{TAXREV}{100-TAXREV})$

	(1)	(2)	(3)	(4)	(5)
Constant	-0.41	-3.89	-3.34	-3.10	-4.15
	(-13.12)***	(-13.12)***	(-3.98)***	(-4.17)***	(-5.48)***
log(SUNKCOST)	-0.10	0.09	0.08	0.08	0.10
	(-2.62)***	(2.54)**	(1.88)*	(2.19)**	(2.09)**
log(GNP)		0.31	0.24	0.23	0.34
		(8.54)***	(2.68)**	(3.50)***	(6.45)***
DEM46		0.41	0.44	0.43	0.41
		(4.17)***	(2.88)***	(3.31)***	(2.82)***
TRANS		0.74	0.74	0.82	0.81
		(6.37)***	(6.59)***	(8.32)***	(4.64)***
AFRICA		0.51	0.56	0.42	0.54
		(3.88)***	(3.66)***	(2.89)***	(4.40)***
LAND		-0.06	-0.05	-0.06	-0.06
		(-4.55)***	(-1.34)	(-4.66)***	(-4.32)***
DENSITY		-1.49	-1.42	-1.45	-1.50
		(-6.37)***	(-2.95)***	(-5.19)***	(-4.21)***
TISCORE			2.14×10^{-3}	-0.03	
			(0.06)	(-0.61)	
TIMECOST			1.08×10^{-3}	-1.98×10^{-5}	
			(0.78)	(-0.02)	
SHADOW					-0.001
					(-0.12)
OECD			0.11		
			(0.72)		
MAT1			-1.95×10^{-3}		
			(-0.91)		
FEDERAL			-0.15		
			(-0.97)		
COMLAW			-0.11		
			(-0.72)		
FORMBRITCOL			0.22		
			(1.44)		
HIPC			-0.31		
			(-1.45)		
(TIMECOST×			-1.47×10^{-3}		
SUNKCOST)			(-1.60)		
No. Obs.	64	64	52	57	52
Adjusted R^2	0.05	0.72	0.73	0.74	0.73

Columns (1)–(4) were estimated by ordinary least squares. Column (5) was estimated by two stage least squares using POP and OECD as instruments for SHADOW. White heteroskedastic-consistent standard errors are used to calculate t-statistics, which are reported in parentheses. Significance is denoted by *** (1%); ** (5%); * (10%).

Column (1) shows a simple relationship between $SUNKCOST$ and $TAXREV$, which, in light of the adjusted R^2, is mis-specified. Column (2) presents the principal regression. Column (3) presents additional variables included as controls in the regression of column (2). The coefficient of $SUNKCOST$ remains significant at the 10% level whether these variables (with the exception of $TIMECOST$) are added simultaneously, individually or in partial combination as in column (4). None of the additional variables has a coefficient that is significantly different from zero whether we include them separately or simultaneously. The coefficient of $SUNKCOST$ is insignificant if the variable for interaction with $TIMECOST$ in column (3) is dropped, which may be explained by the high correlation between these two variables. Column (5) presents the two stage least squares regression discussed in the main text.

Since there exists a positive correlation between an economy's exposure to international trade and the size of the government (see Rodrik 1998, and Alesina-Wacziarg 1998), $TAXREV$ could presumably be positively related to $FREEOPEN$, a measure of free trade openness (source Barro-Lee 1994). If $FREEOPEN$ is added to the regression of column (2), whether individually or with other controls, the coefficient on $FREEOPEN$ is not significant. Adding $FREEOPEN$ renders the coefficient on $SUNKCOST$ insignificant, but the regression has little relevance for our purposes since the sample for which data on both $SUNKCOST$ and $FREEOPEN$ are available is excessively weighted toward rich countries (49% of the countries have per capita GNP $>$ \$10,000), and has no transitional economies.

Developing Countries Only

Dependent Variable	$log(\frac{TAXREV}{100-TAXREV})$			TAXREV
	(6)	(7)	(8)	(9)
Constant	-2.92	-3.99	-0.51	8.55
	(-6.95)***	(-7.60)***	(-0.63)	(4.41)***
log(SUNKCOST)	0.17	0.09	0.12	10.74
	(3.52)***	(1.52)	(2.26)**	(2.41)**
log(GNP)	0.21	0.31	-0.01	1.85×10^{-3}
	(3.32)***	(4.74)***	(-0.13)	(2.68)**
TRANS	0.64	0.75	0.76	13.23
	(4.95)***	(6.27)***	(8.89)***	(6.00)***
LAND	-0.05	-0.04	-0.29	-0.82
	(-4.44)***	(-3.03)***	(-1.92)*	(-4.40)***
DENSITY		5.95		-1.42
		(0.40)		(-2.95)***
AFRICA		0.55		9.62
		(3.21)***		(3.01)***
(AFRICA×				-11.69
SUNKCOST				(-2.18)**
DEM46		0.10		
		(0.27)		
TISCORE			-0.13	2.14×10^{-3}
			(-2.97)***	(0.06)
No. Obs.	41	41	34	41
Adjusted R^2	0.54	0.60	0.68	0.59

All columns were estimated by ordinary least squares. White heteroskedastic-consistent standard errors are used to calculate t-statistics, which are reported in parentheses. Significance is denoted by *** (1%); ** (5%); * (10%).

Column (6) reproduces the main regression in column (2), but with a sample of only developing countries, and with the variables $DENSITY$, $DEM46$, and $AFRICA$ omitted. The coefficients on $DENSITY$ and $DEM46$ were not significant in the reduced sample. If the $AFRICA$ dummy is included the coefficient on $SUNKCOST$ remains positive but is insignificant. The coefficient on $SUNKCOST$ is positive but weakly significant (12% level) if we include $AFRICA * SUNKCOST$ (see column (7)). However, if we run the same regression with $TAXREV$ as the dependent variable, both $AFRICA$ and $SUNKCOST$ coefficients are positive and significant, and the cross term is negative and significant (see column (9)). This negative sign means that being on the African continent and having large entry fees is bad for tax revenue. As noted in the main text, the $AFRICA$ dummy captures much of the variation in $SUNKCOST$. African countries seem to place particular reliance on entry fees and the rents of associated market power.

Column (8) is a variation of column (6), addressing the suggestion of Djankov et al. (2002) that entry fees are imposed to provide opportunities for corrupt rent extraction. The GNP variable is insignificant. This is unsurprising since $TISCORE$ and GNP are highly correlated. The model fit is satisfactory, but $TISCORE$ is endogeneous: when tax revenue is low corruption is high because public wages are low (see Auriol 2004). This endogeneity may help to explain why the coefficient on $TISCORE$ is not significant in column (9). Controlling for endogeneity would require a different theoretical framework. For present purposes, the important point is that the coefficient on $SUNKCOST$ is positive and significant.