Tax Evasion, the Underground Economy and Financial Development

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Abstract

We study the relationship between the underground economy and financial development in a model of tax evasion and bank intermediation. Agents with heterogenous skills seek loans in order to undertake risky investment projects. Asymmetric information between borrowers and lenders implies a menu of loan contracts that induce self-selection in a separating equilibrium. Faced with these contracts, agents choose how much of their income to declare by trading off their incentives to offer collateral against their disincentives to comply with tax obligations. The key implication of the analysis is that the marginal net benefit of income disclosure increases with the level of financial development. Thus, in accordance with empirical observation, we establish the result that the lower is the stage of such development, the higher is the incidence of tax evasion and the greater is the size of the underground economy.

1 Introduction

The underground economy is a pervasive feature of countries throughout the world. In one form or another, and to a lesser or greater degree, it has existed, and continues to exist, in all societies. Its effects on economic and social development can be significant and far-reaching as scarce resources

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are wasted or used inefficiently, as purposeful regulations are circumvented and undermined, and as public finances deteriorate to the detriment of public policy. Of course, the presence of an underground sector is simply a reflection of individuals' incentives to conceal their economic activities, either because these activities would be less rewarding if practised in the formal sector, or else because the activities are illegal to begin with. Understanding what factors might influence such incentives is an important avenue of research which we pursue in this paper.

By its nature, the underground economy is difficult to study empirically. Nevertheless, there has been a good deal of progress on ascertaining data and developing techniques for quantifying its size and importance. Whilst different approaches yield different estimates, the general conclusion is that the extent of informal economic activity is substantial. For example, Schneider and Enste (2002) report that, over the period 1988-2000, the average size of the shadow economy as a proportion of GDP ranged between 14-16 percent in OECD countries; the equivalent numbers for developing countries were much higher at 35-44 percent, and in some cases reached the staggering figure of 70 percent or more.[1]

For the most part, the key factors put forward as influencing underground activity have been related to aspects of public policy and public administration.[2] Included amongst these are the burdens of taxation and social security contributions, the complexity and arbitrariness of the tax system, the extent of bureaucracy and regulations, and the incidence of corruption and rent-seeking (e.g., Friedman *et al.* 2000; Johnson *et al.* 1998a,b; Loayza 1996; Schneider and Enste 2000, 2002; Schneider and Neck 1993).). Without undermining the importance of any of these, our focus in this paper is on another, quite different, factor that has received rather less consideration - namely, the level of financial development. By way of motivating this, we draw attention to two recent studies which suggest that the functioning of financial markets has an important role to play in determining informal behaviour. The first - by Dabla-Norris and Feltenstein (2005) - reports a significant negative correlation between measures of financial development and the size of the shadow economy using aggregate cross-country data. The second - by Straub (2005) - provides evidence of a significant positive effect of credit market efficiency on the degree of business formality using cross-country firm-level data. We obtain similar results from our own investigations, where we plot various

[1] Examples of the latter include Egypt, Thailand and Nigeria, for which the underground economy during 1998-99 was estimated to be 69, 70 and 77 percent of official GDP, respectively.

[2] For a comprehensive discussion of these (and other) factors, see Schneider and Enste (2000).

standard indicators of financial development against the partial residuals of a regression used to estimate other potential determinants of the shadow economy.[3] The plots, shown in Figure 1, reveal persuasively that the effect of financial development on the size of the shadow economy is both strongly and robustly negative.

The objective of the analysis that follows is to provide an explanation for the above observations. We do so within the context of a simple model of tax evasion and financial intermediation. The basic idea is as follows. Suppose that individuals would like to undertake some investment project, but that the cost of doing so is greater than their current income or wealth so that external finance is needed. This finance is acquired from banks according to the terms and conditions of optimal loan contracts. Asymmetric information between borrowers and lenders leads to a menu of such contracts that stipulate not only the rate of interest charged on loans, but also the probability that a loan will be granted (implying the possibility of credit rationing). Faced with these arrangements, an individual puts forward a loan application which requires her to decide how much of her current wealth to declare, or how much of it to conceal, by trading off the costs and benefits of this. Typically, the costs of concealment - meaning the costs of participating in the informal sector - are modelled in terms of exclusion from certain public goods and services (e.g., social infrastructure, property rights and the justice system), together with the possibility of fines, incarceration and other such punishments. In our case the costs are related to the functioing of financial markets. Specifically, the more wealth that an individual hides, the less collateral she has to offer for securing a loan and the worse are the terms and conditions of the loan contract made available to her. Significantly, this deterioration in credit arrangements is more pronounced at lower levels of financial development (as measured by higher costs of financial intermediation). As regards the benefits of concealment, an individual who invests any part of her wealth in the shadow economy enjoys the prospect of avoiding some of her tax obligations. The key implication of our analysis is that the marginal net gain from greater wealth disclosure increases with the level of financial development. Accordingly, we establish the result that the lower is the stage of such development, the higher is the incidence of tax evasion and the greater is the size of the underground economy.

Our analysis complements a small body of other research which suggests various possible connections between the credit market and the shadow econ-

[3] These other factors cover the extent and quality of regulations, the burden of taxation and the quality of governance. A description of the data and methodology is given in Appendix A.

omy. Dabla-Norris and Feltenstein (2005) construct a computable dynamic general equilibrium model for the purpose of estimating the impact of taxes on underground activity (and other macroeconomic phenomena) in Pakistan. Their numerical results indicate that, in the presence of credit market imperfections, an increase in corporate taxation may not only cause firms to operate underground but, in doing so, may also lead to a reduction in the amount of collateral in the formal sector and, with this, a reduction in the volume of loans and subsequent investments in that sector. In a slightly different vein, Straub (2005) develops a model in which agents face a choice of participating in either a formal or informal credit market. It is shown how this choice is influenced by the interaction between the cost of entry into formality and the relative efficiency of formal and informal credit mechanisms. Along related lines, Antunes and Cavalcanti (2007) present a framework in which agents can choose to become either workers or entrepreneurs, with the possibility of practising entrepreneurship in either the formal or informal sector. The analysis demonstrates how the choice of occupation is affected by entry barriers (regulation costs) and credit market imperfections. A common feature of these contributions is that the extent of underground activity is a reflection of individuals' all-or-nothing choice as to whether to participate in the shadow economy. By contrast, our own analysis centres on individuals' incentives to exploit unofficial opportunities whilst still doing business in the formal sector.

The remainder of the paper is organised as follows. Section 2 sets out the basic framework. Section 3 presents the solution to banks' optimal loan contracting problem. Section 4 presents the solution to individuals' optimal tax evasion problem. Section 5 reveals the equilibrium outcomes that transpire from these solutions. Section 6 contains a few concluding remarks.

2 The Basic Set-up

We consider a small open economy in which there is a countably infinite number of agents measuring a size of unit mass. Agents are identical in terms of their preferences, endowments of wealth and production opportunities, but may differ according to their abilities and skills. These attributes, which are bestowed randomly, determine an agent's performance in productive activity that reflects a choice of project, or occupation, which gives access to a technology for generating output. For certain types of project to be undertaken, loans must be acquired from financial intermediaries under the terms and conditions of mutually agreeable loan contracts. Agents are obliged to pay taxes on all sources of income at a rate determined exogenously by the government. There are two main sources of imperfection in the economy - an imperfection in financial markets due to asymmetric information between borrowers and lenders, and an imperfection in governance due to asymmetric information between tax payers and tax collectors. In more detail the model is described as follows.

Agents are risk neutral, deriving linear utility from consumption of various income streams that are realised at the end of the period. One source of income is an initial asset endowment, $A > 0$, that pays a gross rate of return of $\alpha > 1$ with certainty. The value of this asset is private information, as is the income, αA, that it yields.[4] Other sources of income are production (or investment) projects, of which there are two types. The first type involves the use of some basic (traditional) technology in some routine activity that is costless and riskless: this is a safe occupation that requires zero capital outlay and that yields a fixed amount of income with certainty. The second type entails the operation of a more advanced (modern) technology in a more speculative venture that is expected to be more productive but which is also costly and subject to uncertainty: this is a risky occupation that requires K units of capital outlay and that yields a stochastic rate of return. The payoffs from both projects depend on an agent's abilities and skills that are drawn randomly from a known probability distribution which accounts for agent heterogeneity. Specifically, an agent faces the prospect of being either high-skilled (type-H) with probaility $p \in (0, 1)$ or low-skilled (type-L) with probability $1 - p$.[5] The realised distribution of skills is private information to agents. Those who turn out to be high-skilled enjoy a greater expected income from each type of project than those who turn out to be low-skilled: for the safe project, the former produce $s_H > 0$ units of output, whilst the latter produce $s_L \in (0, s_H)$ units; for the risky project, the former earn a rate of return of $\kappa > 1$ with probability $q_H \in (0, 1)$ and a rate of return of zero with probability $1 - q_H$, whilst the latter earn the same returns with alternative probabilities $q_L \in (0, q_H)$ and $1-q_L$. The greater expected income from the risky project is captured by the restriction $q_i\kappa > s_i$ $(i = H, L)$, and the greater productivity of high-skilled agents is reflected in the features $s_H > s_L$ and $q_H\kappa > q_L\kappa$. To save on notation in our subsequent analysis, we normalise $s_L = 0$ and $q_H = 1$.

Since all income is realised at the end of the period, an agent who wishes to take on the risky project must acquire external finance to the tune of K. Such

[4] The assumption that A is the same for all agents is made for simplicity. Our results would not change were we to consider a distribution of A across agents.

[5] An alternative description of events is to assume that agents are endowed with identical abilities, but are randomly allocated projects with different (high and low) risk characteristics.

finance is acquired from competitive financial intermediaries (banks) that have access to a perfectly elastic supply of loanable funds at the exogenous world (gross) interest rate, r. For reasons given below, equilibrium loan contracting involves different types of agent being offered different terms and conditions on borrowing, including different rates of interest on loans. We denote by R_i the gross rate of interest charged to an agent of type-i. With probability q_i, the risky enterprise is successful and the agent pays back her loan to earn a final project income of $(\kappa - R_i)K$. With probability $1 - q_i$, the enterprise fails and the agent goes bankrupt, earning a final project income of zero.

Agents are obliged to pay taxes on all of their incomes at the proportional rate $t \in (0, 1)$. The government is able to observe the incomes from projects, but not the income from the asset endowment (since the value of the asset is known only to agents). As such, an agent may seek to evade part of her tax liabilities by misreporting her initial wealth. We denote by $\gamma \in [0, 1]$ the fraction of this wealth that an agent declares, the remaining fraction, $1 - \gamma$, being undeclared. By behaving in this way, the agent makes public that she has $\gamma\alpha A$ amount of asset income on which she is liable to pay tax. The agent's motivation for declaring at least some of her wealth is that she can use this as collateral for securung a loan to run the risky project. We assume that the agent can successfully conceal the undeclared fraction of her wealth by investing it in the hidden (or shadow) economy at a black market gross rate of return of $\rho \geq \alpha$. The final income from doing this is $(1 - \gamma)\rho A$ on which the agent does not pay any tax.[6]

This completes our description of the environment. Decision making takes place as follows. Prior to realising their skills and project returns, agents choose how much of their intial wealth to declare so as to maximise their expected utility, subject to the financial contracts offered by intermediaries. Subsequently, the distribution of skills is revealed privately to agents who then apply for loans. Given this private information, together with the part disclosure of wealth, intermediaries set the terms and conditions of contracts in agents' best interests, whilst ensuring that appropriate constraints on behaviour are observed. Out of their realised final incomes, agents pay off any loans and tax liabilities before consuming the remainder. The equilibrium outcomes that transpire from these decisions are determined by solving

[6] According to this description of events, an agent's subterfuge in disposing of her undeclared income allows her to evade taxes with complete confidence of impunity. This feature is merely a simplification, though it is probably near the mark for many developing countries, where the will and wherewithal to fight such practices are relatively weak. It is straightforward to show that our results would not change if one was to assume that agents face a risk of being caught as a consequence of some imprecise government monitoring.

backwards through the sequence of events - a matter to which we now turn.

3 Financial Contracts

The precise functioning of the credit market is as follows. At the beginning of the period, lenders are approached by prospective borrowers with a request for funding to undertake risky investment projects. A contract is offered, acceptance of which implies a binding agreement that commits a lender to making a loan of size of K, and a borrower to making a subsequent repayment of this loan. A lender's information at this stage includes an agent's declared value of her initial wealth, γA, together with the corresponding future income, $\gamma\alpha A$. Importantly, it does not include separate observations of γ and A, meaning that the lender is unaware of the agent's true wealth status and must therefore design a contract based only on what has actually been declared. Other information available to lenders includes the *ex ante* distribution of borrower types, p, the income from a borrower's outside opportunity, s_i, the expected income from project investment, $q_i\kappa K$ and the cost of funds, r.

In practice, banks and other financial institutions incur various costs in conducting their operations, such as transactions costs associated with the management of asset portfolios and the provision of liquidity services, and agency costs associated with the processing of information, and the screening and monitoring of borrowers (e.g., Diamond 1984; Fama 1980; Gurley and Shaw 1960). For the purposes of the present analysis, we consolidate these into a single composite cost of intermediation, denoted by $\delta > 0$, which serves as our indicator of financial development. Two empirical measures of intermediation costs are banks' overhead expenditures as a proportion of total assets and banks' net interest rate margin (defined as the difference between the interest income and interest cost per unit of interest-bearing loans).[7] It is well-documented that both measures tend to be higher in lower states of financial development, as typified by the predominance of banks that operate on a relativley small scale, that hold relatively small amounts of capital and that are subject to relatively tight regulations (e.g., Demigurc-Kunt *et al.* 2003). Accordingly, we interpret lower values of δ as corresponding to improvements in the efficiency of the financial system.

We assume that financial intermediaries operate in a competitive environment, and that the terms and conditions of available loan contracts are

[7]The former of these is considered to be a more direct measure since the latter, as well as reflecting overhead costs, might incorporate other factor, such as regulatory and institutional hurdles in transferring loanable funds to borrowers.

public knowledge. As such, an intermediary is approached by an agent only if the contract that it offers is not dominated by the contracts offered by its competitors. In equilibrium the profits of intermediaries are driven to zero.

The design of financial contracts is made complicated by the fact that intermediaries are unable to observe the true skill characteristics of agents. From the perspective of lenders, low-skilled agents are more risky than high-skilled agents. We assume that the population of the former is sufficiently large as to prevent intermediaries from pooling clients together and offering a single contract. Instead, banks must design contracts in such a way that induces self-selection by clients. The possibility of doing this arises from the fact that the different borrower types receive different payoffs from their outside opportunity of running the safe project. This feature means that the indifference curves of high-skilled and low-skilled agents satisfy the single crossing property which enables intermediaries to distinguish the two types by offering a menu of contracts that encourages self-selection in a separating equilibrium (e.g., Bencivenga and Smith 1993; Bose and Cothren 1996).[8] As indicated above, one difference between these contracts is the rate of interest on loans. Another difference is the probability that a loan will actually be granted as banks may be induced to ration credit by turning down some loan applications. We denote by $\pi_i \in (0, 1)$ the probability that an agent of type-i will be approved credit, $1 - \pi_i$ being the probability that she will be denied such funds. In the event of the former, banks incur the cost of intermediation, δ, and earn an income that depends on whether or not the risky project succeeds: if so (i.e., with probability q_i), a bank is paid back in full, receiving R_iK in loan repayment; if not (i.e., with probability $1 - q_i$), the bank recovers part of its loss by appropriating a borrower's collateral, $\gamma\alpha A$.

The solution to the contracting problem is stated as follows.

Proposition 1 *Assume that $(\kappa - R_H)K > s_H$. Then the equilibrium separating contracts are characterised by*

$$R_H = \frac{rK + \delta}{K}, \quad \pi_H = \frac{(q_L\kappa - r)K - \delta + (1 - q_L)\gamma\alpha A}{q_L[(\kappa - r)K - \delta]}, \tag{1}$$

$$R_L = \frac{rK + \delta - (1 - q_L)\gamma\alpha A}{q_LK}, \quad \pi_L = 1. \tag{2}$$

Proof. See Appendix B. ■

[8] As shown by Rothschild and Stiglitz (1976), this is the only equilibrium under the circumstances that we have described.

The above results have some straightforward intuition. As already mentioned, any contract that yields positive profits to lenders cannot survive in a competitive equilibrium. An intermediary's expected income from lending to an agent of type-i is $q_i R_i K + (1 - q_i)\gamma\alpha A$: that is, with probability q_i, the risky project is successful and the agent pays back $R_i K$ in interest income, whilst with probability $1 - q_i$, the project fails and the agent hands over all of her collateral, $\gamma\alpha A$. The intermediary's total cost of lending is the cost of borrowing funds, rK, plus the cost of intermediation, δ. Equating expected income and costs gives the zero profit condition, from which we deduce the expressions for R_i (recalling that $q_H = 1$). Note that $R_H < R_L$ if $\gamma\alpha A < rK + \delta$, a condition that we assume to be satisfied (otherwise the analysis would be trivial as intermediaries would face no risk in lending). As regards the determination of π_i, intermediaries induce separation of low-skilled and high-skilled agents by offering the former their first-best contract (whereby each one of them is granted a loan with certainty) and presenting the latter with a distorted contract (whereby a fraction of them are credit rationed).[9] That separation is achieved at the expense of high-quality clients follows simply from the incentive compatibility condition and is a standard result in the adverse selection literature.

An important implication of the above results is the following.

Corollary 1 *The probability that a high-skilled agent will be given a loan is greater the lower is the cost of financial intermediation and the higher is the agent's declared value of wealth*

Formally, $\frac{\partial \pi_H}{\partial \delta} < 0$ and $\frac{\partial \pi_H}{\partial \gamma} > 0$. The reason is that, as the cost of intermediation declines, or as the declared value of wealth increases, the interest rate charged to low-skilled agents falls by more than the interest rate charged to high-skilled agents; this makes the contract offered to the latter less attractive to the former and thereby provides an opportunity for intermediaries to reduce the incidence of credit rationing whilst maintaining incentive compatibility.

4 Tax Evasion

The foregoing analysis reveals how the equilibrium arrangements for borrowing and lending are influenced by the declared asset position of agents. The greater is the initial wealth that agents reveal, the greater is the collateral

[9] The same parameter restriction as before, $\gamma\alpha A < rK + \delta$, ensures that $\pi_H \in (0, 1)$.

that can be used as security against a loan and the better are the terms and conditions of loan contracts. At the same time, revealing more wealth means that agents expose themselves to a higher burden of taxation. An agent's disclosure (or concealment) of her wealth status is therefore a decision that involves optimising a trade-off. The agent solves this problem with the knowledge of the contracts on offer, but without the knowledge of which contract she will actually be presented with as her skill type is not realised until subsequently.

The circumstances facing agents are summarised as follows. Each agent pays the same tax rate, t, on all sources of income, except the income from undeclared wealth. With probability π_i, an agent of type-i acquires a loan to run the risky project. The project succeeds with probability q_i and fails with probability $1 - q_i$. In the event of the former, the agent earns a net disposable income of $(1-t)(\kappa - R_i)K$ from the project, plus a net disposable income of $(1 - t)\gamma\alpha A$ from her declared asset endowment, plus an income of $(1 - \gamma)\rho A$ from her undeclared endowment. In the event of the latter, the agent earns only the last of these incomes, $(1 - \gamma)\rho A$. With probability $1 - \pi_i$, an agent of type-i is denied a loan. In this case the agent receives an after-tax income of $(1 - t)s_i$ from running the safe project, plus an after-tax income of $(1 - t)\gamma\alpha A$ from her reported wealth, plus an income of $(1 - \gamma)\rho A$ from her unreported wealth. Collecting terms together and setting $\pi_L = 1$ (along with $a_L = 0$ and $q_H = 1$), we may write the expected utility of a high-skilled and a low-skilled agent as

$$E(U_H) = (1 - t)[\pi_H(\kappa - R_H)K + (1 - \pi_H)s_H + \gamma\alpha A] + (1 - \gamma)\rho A, \quad (3)$$

$$E(U_L) = (1 - t)[q_L(\kappa - R_L)K + \gamma\alpha A] + (1 - \gamma)\rho A. \quad (4)$$

An agent's choice of how much of her initial wealth to declare is a choice of the value of γ. As indicated above, this decision is made prior to the agent realising her skills, but in the knowldge of the contracts that will be available. Since the probability that an agent will turn out to be high-skilled (low-skilled) is p $(1-p)$, γ is chosen so as to maximise $U = pE(U_H)+(1-p)E(U_L)$, given that R_i and π_i are determined according to (1) and (2). Appropriate substitution allows us to re-state this problem as

$$\max_{\gamma} U = (1 - t)\{p[\pi_H((\kappa - r)K - \delta - s_H) + s_H] + (1 - p)[(q_L\kappa - r)K - \delta] + \gamma\alpha A\} + (1 - \gamma)\rho A. \quad (5)$$

The behaviour of an agent is straightforward to deduce and we summarise it as follows.

Proposition 2 *Let* $F(\delta) \equiv (1-t)p[(\kappa - r)K - \delta - s_H]\frac{\partial \pi_H}{\partial \gamma}$ *and* $G(\rho) \equiv [\rho - (1-t)\alpha]A$*. Then assuming that* $\alpha A < rK + \delta$*, an agent will optimally choose* $\gamma = 1$ *if* $F(\delta) > G(\rho)$ *and* $\gamma = 0$ *if* $F(\delta) < G(\rho)$*.*

Proof. See Appendix B. ■

As before, the above results have a straightforward intuition. By declaring more wealth (i.e., by increasing γ), an agent incurs both a gain and a loss. The former is captured by the term $F(\delta)$ and represents the marginal benefit of putting up more collateral, which is the benefit from the reduction in risk faced by lenders and the consequent improvement in the terms and conditions of the loan contract. The latter is given by the term $G(\rho)$ and corresponds to the marginal cost of investing more wealth in the formal sector, which is the cost of both a higher burden of taxation and the foregone interest income from the informal sector. Depending on which is greater, the agent will set γ at either its maximum or minimum value, implying either full or zero disclosure of her asset endowment and therefore either full or zero compliance with her tax obligations on asset income.[10]

In presenting the above results we have singled out two key parameters that may influence an agent's behaviour - namely, the cost of financial intermediation, δ, and the return on underground investment, ρ. These are seen to impact on the expected gains and losses from the disclosure of wealth. In particular, we make the following observation.

Corollary 2 *The marginal benefit (cost) to an agent of disclosing more wealth is higher the lower (higher) is the cost of financial intermediation (return on underground investment).*

Formally, $F'(\delta) < 0$ and $G'(\rho) > 0$. The effect of δ is explained by the fact that a lower cost of intermediation makes the terms and conditions of loan contracts more attractive to agents. For those who turn out to be high-skilled, there is a greater incentive to put up more collateral (i.e., to declare more wealth) and thereby improve the chances of acquiring a loan. The effect of ρ is simply that a higher return from investing in the informal sector means a higher opportunity cost of investing in the formal sector. The incenive to do the former (i.e., to conceal more wealth) is therefore greater.

[10] As shown in the Appendix, for the case in which $D(\delta) > [\rho - (1-t)\alpha]A$, U is linearly increasing (decreasing) in γ up to (beyond) $\gamma_{\max} = \frac{rK+\delta}{\alpha A}$. The restriction $\alpha A < rK + \delta$ means that $\gamma_{\max} > 1$ which is not a feasible choice since agents would be claiming to have more wealth than A - a claim that they would need to substantiate (but never could) when putting up collateral.

5 Aggregate Outcomes

The results obtained above establish conditions under which an individual agent will seek to evade some of her tax obligations. These conditions depend on economy-wide factors that are relevant to all agents. One of these - the cost of intermediation - provides a measure of financial development. For the purposes of the present paper, we treat this as exogenous since our principal focus is on the causal role played by financial markets in governing events elsewhere in the economy. By contrast, the other economy-wide factor - the return on underground investment - is an outcome that we treat as being determined endogenously on the basis of the aggregate behaviour of individuals. The effect of this is to introduce important interactions which the following analysis intends to reveal.

A plausible assumption is that the rate of return earned in the informal sector is a decreasing function of the total volume of funds channelled into that sector. One justification for this is simply the existence of diminishing returns to informal productive activity: as more resources are devoted to such activity, the marginal gains from it decline. An alternative, more elaborate, motivation is as follows. Suppose that agents' subterfuge in concealing their income requires assistance from some other individuals who specialise in this type of practice. These individuals are experts at directing funds into areas where they are difficult to trace by the government, such as the underground economy and overseas bank accounts. In return for this service an agent must pay a commission which increases with the total amount of funds being laundered because of the greater difficulty and greater costs of doing this. As before, the agent's net return on her own hidden income is lower the larger is the total amount of such income.

We capture the above ideas by specifying the black market rate of return to be a decreasing function of the total volume of undeclared wealth. Denoting by $\mu \in [0, 1]$ the fraction of agents who set $\gamma = 0$, the value of this wealth is μA and the black market return is posited as $\rho = \widehat{\rho}(\mu)$, where $\widehat{\rho}'(\mu) < 0$. Given this, together with our previous results, we now proceed to determine the equilibrium outcomes in the economy.

We begin by defining $\rho_0 = \widehat{\rho}(0)$ and $\rho_1 = \widehat{\rho}(1)$, which are the respective rates of return in the informal sector when every agent and no agent discloses her initial wealth. Evidently, $\rho_0 > \rho_1$. The corresponding marginal costs of disclosure are $G(\rho_0)$ and $G(\rho_1)$, where $G(\rho_0) > G(\rho_1)$. Since the marginal benefit of disclosure, $F(\delta)$, is a monotonically decreasing function, we may deduce that, for each ρ_i $(i = 0, 1)$, there is a unique δ_i such that $F(\delta_i) = G(\rho_i)$, $F(\delta) > G(\rho_i)$ for all $\delta < \delta_i$ and $F(\delta) < G(\rho_i)$ for all $\delta > \delta_i$. Evidently, $\delta_0 < \delta_1$. These critical, or threshold, levels of financial development represent boundaries between regions where the incentive to conceal wealth and evade taxes is either present or absent. We are now in a position to establish our main result which we illustrate in Figure 2.

Proposition 3 *The equilibrium fraction of tax-evading agents is given by the following: (i)* $\mu = 1$ *for* $\delta > \delta_1$*; (ii)* $\mu = 0$ *for* $\delta < \delta_0$*; and (iii)* $\mu = \widehat{\mu}(\delta) \in (0, 1)$ *for* $\delta \in (\delta_0, \delta_1)$*, where* $\widehat{\mu}'(\delta) > 0$*.*

Proof. See Appendix B. ■

Based on the above, we are led to distinguish between three types of regime for an economy: the first - a low financial development regime - is one in which the incidence of tax evasion is always at its maximum ($\mu = 1$) for any given value of δ above the higher threshold value, δ_1; the second - a high financial development regime - is one in which the incidence of tax evasion is always at its minimum ($\mu = 0$) for any given value of δ below the lower threshold value, δ_0. And the third - an intermediate financial development regime - is one in which the incidence of tax evasion is somewhere in between its maximum and minimum ($\mu \in (0, 1)$), and decreases monotonically as δ decreases within the interval of the thresholds from δ_1 to δ_0. The intuition is as follows.

Each agent chooses to disclose or conceal her initial wealth according to whether $F(\delta) > G(\rho)$ or $F(\delta) < G(\rho)$. Whichever of these conditions holds depends on the level of financial development and the return on undergound investment: the higher is the former (i.e., the smaller is δ) the better are the terms and conditions of loan contracts (an inducement to disclosure), whilst the higher is the latter (i.e., the greater is ρ) the more attractive is participation in the informal sector (an inducement to concealment). For any $\delta > \delta_1$, we have $F(\delta) < G(\rho_1) < G(\rho_0)$. In this case the level of financial development is so low that it never pays an agent to declare her wealth, even if she is faced with the lowest possible return on underground investment as a result of all other agents concealing their wealth. As such, each and every agent chooses to evade taxes in a unique equilibrium from which there is no incentive to deviate. Conversely, for any $\delta < \delta_0$, we have $F(\delta) > G(\rho_0) > G(\rho_1)$. In this instance the level of financial development is so high that an agent is always better off by declaring her wealth, even if she could earn the the highest possible return in the informal sector due to all other agents declaring their wealth. Consequently, the only equilibrium from which defection will not occur is one in which each and every agent chooses not to evade taxes. Contrasting these scenarios is the case of $\delta \in (\delta_0, \delta_1)$, for which we have $G(\rho_1) < F(\delta) < G(\rho_0)$. In this intermediate range of financial development the benefits from declaring and concealing wealth exactly offset each other in an equilibrium where some agents evade taxes and others do not. The fraction of tax evaders is the value of μ that satisfies $F(\delta) = G(\rho)$, where $\rho = \widehat{\rho}(\mu)$. Were this condition not to be satisfied, then some agents would be either declaring wealth when they would do better to conceal it ($F(\delta) < G(\rho)$) or concealing wealth when they would do better to declare it ($F(\delta) > G(\rho)$), in which case the number of tax evaders would either rise or fall until ρ reaches a value such that the condition is established. In this way, lower values of δ lead to lower values of μ so as to preserve the marginal agent's indifference between compliance and non-compliance in tax regulations.

In summary, our analysis is able to explain the observed negative relationship between the level of financial development and the incidence of tax evasion. When the former is sufficiently low or sufficiently high, the latter is at its maximum or at its minimum; when the former is somewhere in between, the latter is somewhere in between and decreases monotonically as the efficiency of financial markets improves. To the extent that financial development occurs endogenously as the economy, in general, develops, tax evasion may be a temporary phenomenon that a government might be willing to live with, especially if the costs of mitigating it are high. On the other hand, an economy that staggers in its process of development may find itself permanently deprived of tax revenues that could otherwise be put to good causes. According to our analysis, financial development serves to combat the incentives to engage in tax evasion only above some threshold level: if this threshold is not reached, then the underground economy will continue to thrive against a backdrop of financial repression.

6 Conclusions

The existence of a shadow economy has potentially serious implications for economic performance and public policy. Activities conducted in this sector are neither protected nor regulated in the same way that applies to activities in the formal sector. Growth prospects can be compromised by encumbrances to doing business due to the lack of social infrastructure. Public finances can suffer as the tax base shrinks, thus weakening the government's capacity to generate revenue. And policy makers' assessments and recommendations can be prone to greater error because of the poorer quality of official statistics. For these and other reasons, the size of the informal sector is a matter of non-trivial concern and an important task is to understand what factors might influence it.

Informality in an economy is a reflection of individuals' incentives to conceal their activities or circumstances. This may take various forms, ranging from full participation in the underground sector (e.g., working exclusively in the shadow labour market) to more subtle clandestine practices (e.g., misreporting income and hiding invesments). In this paper we have focused on the latter by considering a situation in which individuals may choose to conceal their true wealth status for the purpose of tax evasion. Our central concern has been to study how the temptation to engage in such behaviour might be influenced by conditions in financial markets from which individuals acquire loans to undertake business ventures. The crux of our analysis is that, in the presence of financial market imperfections (i.e., asymmetric information), the amount of wealth disclosed by an individual affects the terms and conditions of the loan contract that is offered. At the same time, the marginal benefit of disclosure increases with improvements in the functioning of financial markets, as represented by a lower cost of financial intermediation. In spite of its simplicity, the model produces a rich variety of outcomes as a result of the mutual interaction between individual decision making and the aggregate economic environment. In particular, we are led to distinguish between three types of financial development regime with the implication that the fraction of tax-evading agents declines as the economy moves from a low, through an intermediate, to a high development regime. This negative relationship between the incidence of tax evasion (or size of the underground sector) and the level of financial development accords well with empirical evidence.

Appendix A

Figure 1 is based on a regression using annual data for 114 countries (including both developed and developing countries) over the period 1999-2005. The regression equation is specified as

$$SE_{it} = \beta_0 + \beta_1 RF_{it} + \beta_2 RQ_{it} + \beta_3 TB_{it} + \beta_4 PC_{it} + \beta_5 RW_{it} + \varepsilon_{it},$$

where the notation and data are summarised as follows:

- SE - shadow economy, measured by the average size of the underground economy as a percentage of GDP (source: Schneider 2007);
- RF - regulatory freedom, measured by the average scores on the regulatory freedom index (source: Heritage Foundation Freedom in the World Indicators);
- RQ - regulatory quality, measured by the average scores on the regulatory quality index (source: World Bank Governance Indicators);
- TB - tax burden, measured by the average scores on the fiscal freedom index (source: Heritage Foundation Freedom in the World Indicators);
- PC - public sector corruption, measured by the average scores on the corruption perception index (source: Transparency International);
- RW - rule of law, measured by the average scores on the rule of law index (source: World Bank Governance Indicator).
- i - country index.

The residuals from the above regression are plotted against the following indicators of financial development:

- Domestic credit to the private sector, measured by the average overall amount of domestic credit provided to private borrowers as a percentage of GDP (source: World Bank Development Indicators).
- Domestic credit provided by the banking sector, measured by the average overall amount of domestic credit provided by private deposit institutions as a percentage of GDP (source: World Bank Development Indicators).

- Liquid liabilities (M3), measured by the average amount of outstanding liquid liabilities of the banking system as a percentage of GDP (source: World Bank Development Indicators).

Appendix B

Proof of Proposition 1

As indicated in the text, financial intermediaries earn zero profit from each type of loan contract. This condition, which amounts to $q_i R_i K + (1 - q_i)\gamma\alpha A = rK + \delta$ (where $q_H = 1$), delivers the expression for each of the contractual interest rates, R_i. An agent of type-i derives an expected utility of $V_i(C_i) = [q_i \pi_i(\kappa - R_i)K + (1 - \pi_i)s_i](1 - t)$ from the contract offer of $C_i = \{R_i, \pi_i\}$ (where $q_H = 1$ and $s_L = 0$). The first term in $[\cdot]$ gives the net payoff from the risky project, $(\kappa - R_i)K$, when a loan is granted (which occurs with probability π_i) and when the project is successful (which occurs with probability q_i). The second term in $[\cdot]$ gives the payoff from the safe project, s_i, when a loan is not granted (which occurs with probability $1 - \pi_i$). In each case the agent pays taxes, t, on her income. Let C_i^F denote the first-best contract that an agent of type-i would receive under full information. For each of these contracts, $\pi_i = 1$ and R_i is determined as above. Since $R_H < R_L$ (under our assumption that $\gamma w < rK + \delta$), then $V_L(C_H^F) > V_L(C_L^F)$ and $V_H(C_H^F) > V_H(C_L^F)$. Suppose that lenders were to offer C_i^F in the presence of asymmetric information (as exists in our model). Clearly, there would be no incentive for high-skilled agents to reject C_H^F in favour of C_L^F by pretending to be low-skilled agents. Thus, in order to induce self-selection, lenders do not need to distort the contract for the low-skilled types, but are able to offer this group its first-best choices of R_L and π_L (as summarised in (2)). Given this, then the contract for the high-skilled group is determined by solving the following problem:

$$\max_{\pi_H} \; V_H(C_H) = [\pi_H(\kappa - R_H)K + (1 - \pi_H)s_H](1 - t), \tag{B1}$$

$$\text{s.t. } q_L(\kappa - R_L)K(1 - t) \geq \pi_H q_L(\kappa - R_H)K(1 - t), \tag{B2}$$

$$0 \leq \pi_H \leq 1. \tag{B3}$$

The constraint in (A2) is the incentive compatibility condition for high-skilled agents. Assuming that $(\kappa - R_H)K > s_H$, it is straightforward see that this constraint is binding: since $V_H(C_H)$ is strictly increasing in π_H, intermediaries will set this probability at the highest possible value, which is the value that makes (A2) hold with equality, given the setting of each R_i. High-skilled agents are therefore offered a distorted combination of R_H and π_H (as summarised in (1)).

Proof of Proposition 2

It follows from (5) that

$$\begin{aligned}\frac{\partial U}{\partial \gamma} &= (1-t)p[(\kappa - r)K - \delta - s_H]\frac{\partial \pi_H}{\partial \gamma} - [\rho + (1-t)\alpha]A \\ &= F(\delta) - G(\rho). \end{aligned} \tag{B4}$$

The result in (1) implies that $\pi_H \in (0,1)$, $\frac{\partial \pi_H}{\partial \gamma} > 0$ and $F(\delta) > 0$ for all γ up to $\gamma_{\max} = \frac{rK+\delta}{\alpha A}$, at which point and beyond $\pi_H = 1$ and $\frac{\partial \pi_H}{\partial \gamma} = F(\delta) = 0$. Assume that $\alpha A < rK + \delta$, implying $\gamma_{\max} > 1$. For the case in which $F(\delta) > G(\rho)$, $\frac{\partial U}{\partial \gamma} > 0$ for $\gamma < \gamma_{\max}$ and $\frac{\partial U}{\partial \gamma} < 0$ for $\gamma > \gamma_{\max}$, so that the agent will set $\gamma = 1$, its maximum value. For the case in which $F(\delta) < G(\rho)$, $\frac{\partial U}{\partial \gamma} < 0$ for all γ, implying that the agent will set $\gamma = 0$, its minimum value.

Proof of Proposition 3

Suppose, first, that $\delta > \delta_1$. Then $F(\delta) < G(\rho_1) < G(\rho_0)$, implying that it pays each agent to set $\gamma = 0$, irrespective of what other agents are doing. That $\mu = 1$ (i.e., all agents set $\gamma = 0$) is the unique equilibrium outcome follows from the fact that no agent has an incentive to deviate from this, whilst each agent has an incentive to deviate from $\mu = 0$ (i.e., the case in which all agents set $\gamma = 1$). Next, suppose that $\delta < \delta_0$. In this instance $F(\delta) > G(\rho_0) > G(\rho_1)$ so that it now pays each agent to set $\gamma = 1$, irrespective of what others are doing. As before, that $\mu = 0$ (i.e., all agents set $\gamma = 1$) is the unique equilibrium outcome follows from the fact that no agent has an incentive to deviate from this, whilst each agent has an incentive to deviate from $\mu = 1$ (i.e., the case in which all agents set $\gamma = 0$). Finally, suppose that $\delta \in (\delta_0, \delta_1)$. Then $G(\rho_1) < F(\delta) < G(\rho_0)$, implying that each agent will set either $\gamma = 0$ or $\gamma = 1$, depending on what others are doing. That neither $\mu = 1$ nor $\mu = 0$ is an equilibrium outcome follows from the fact that agents have an incentive to deviate in each case - that is, to set $\gamma = 1$ in the first case and $\gamma = 0$ in the second. Consider, however, a $\mu \in (0,1)$ such that $\rho_0 > \widehat{\rho}(\mu) > \rho_1$ and $G(\rho_0) > G[\widehat{\rho}(\mu)] > G(\rho_1)$. Then there exists a unique value of this μ which supports an equilibrium with $F(\delta) = G[\widehat{\rho}(\mu)]$. Since $F'(\delta) < 0$ and $G'[\widehat{\rho}(\mu)]\widehat{\rho}'(\mu) < 0$, then this μ is an increasing function of δ, or $\mu = \widehat{\mu}(\delta)$ where $\widehat{\mu}'(\delta) > 0$.

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Figure 1
Shadow Economy Regression Residuals Against Financial Development Indicators

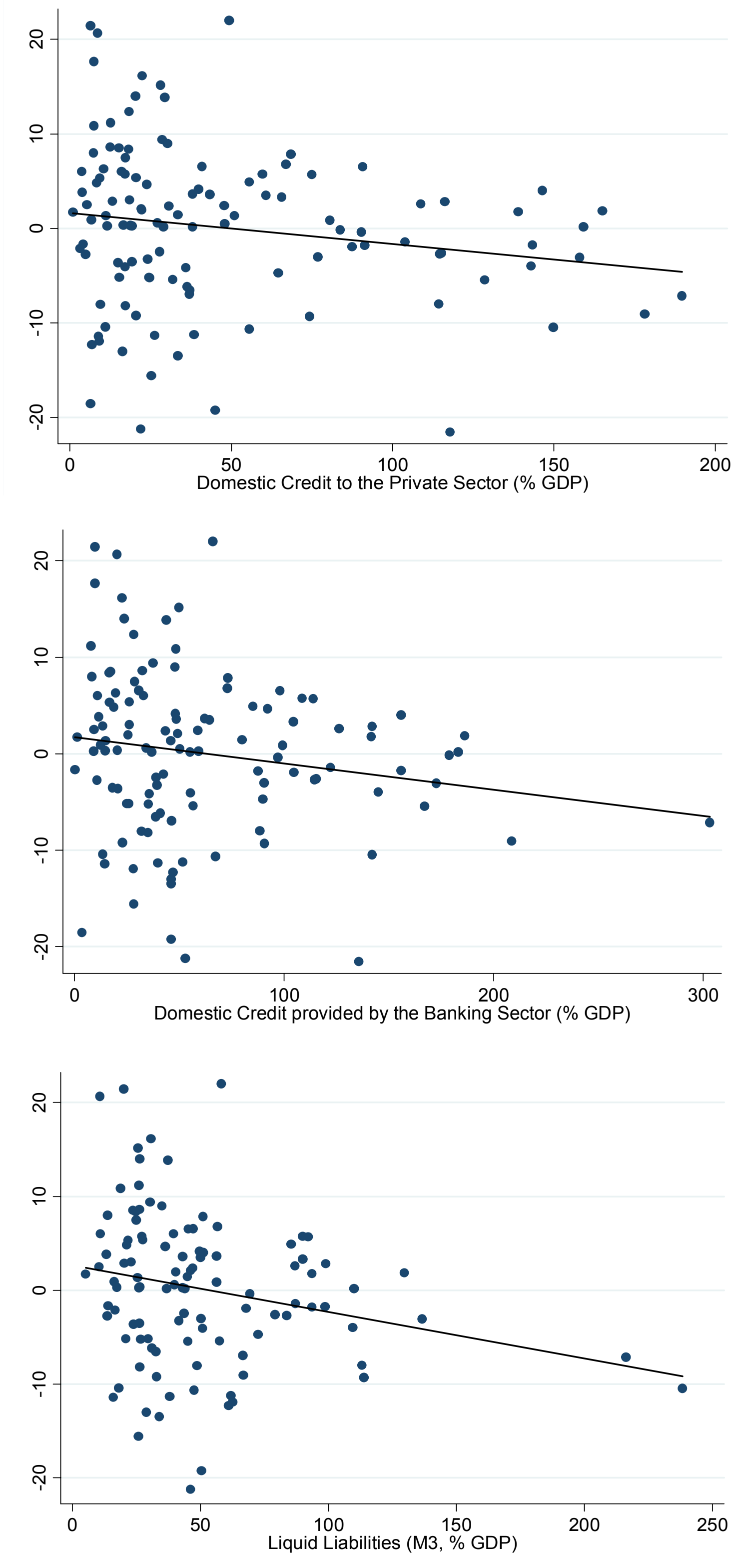

Figure 2
Equilibrium Tax Evasion