Taxes, Inequality and the Size of the Informal Sector

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Abstract

In this note we develop a simple heterogeneous-agent model with incomplete markets to explain the prevalence of a large, low-productivity, informal sector in developing countries. In our model, taxes levied on formal sector agents are used to finance the provision of a productive public infrastructure, which creates a productivity premium from formalization. Our model offers endogenous differentiation of rich and poor countries. Complete formalization is an equilibrium only in countries with the appropriate initial conditions. We discuss existence of this equilibrium and highlight the ambiguous effect of taxes.

Keywords: informal sector, technology adoption, infrastructure, inequality, taxation, development
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1 Introduction

Dualism in the organization of production activities is very pervasive in developing countries, with informal, low-productivity methods of production coexisting with higher-productivity, formal methods. While 17% of the work force in OECD countries operates in the informal sector, this figure, in developing countries, rises to 60% (Ihrig and Moe, 2000). In this note, we ask why such a significant proportion of the economy-wide resources remains trapped in the low-productivity, informal sector. We address the issue of policy responses towards informal organization of production and emphasize the ambiguous effect of taxation.

We do so within a heterogeneous-agent model in which the existence of strategic complementarities generates multiple, Pareto-ranked, equilibrium formal sector sizes. Our model has four main assumptions: (i) the provision of public infrastructure creates a productivity premium from formalization. Formalizing production does not just mean taking an old technology and making it legal, it implies switching from low- to high-productivity technologies to take advantage of the availability of public infrastructures.[1] (ii) The productivity premium from formalization increases with infrastructure quality; (iii) this quality depends on the level of public funds collected from the formal sector; and (iv) markets are incomplete, i.e. agents cannot buy or sell assets in response to exogenous changes in their environment.

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[1] High-productivity technologies rely on mass production, which requires marketing, itself in need of infrastructures for shipping and handling.

Strategic complementarities arise in the model because the tax financing the provision of productivity-enhancing infrastructure is levied on formal sector agents only, which makes the productivity premium from formalization dependent upon the formal sector size. In this context of multiple equilibria, it is well known that banning informality is justifiable on efficiency grounds, unless an equilibrium with complete formalization does not exist. Hence the importance of discussing sufficient conditions for such an equilibrium to exist. In our discussion, we emphasize the interplay between expectations and historical legacies in determining sufficient conditions for an economy to benefit from the enforcement of a ban on informal activities. By combining expectations and historical legacies in this manner, our analysis bridges two strands of the literature on the causes of under-development: a theoretical literature emphasizing coordination failures (Rosenstein-Rodan, 1943; Murphy, Shleifer and Vishny, 1989) and a neo-classical literature (Saint-Paul and Verdier, 1993; Parente and Prescott, 1994 and 1999).[2] Unlike those studies in which rich and poor countries face the same menu of equilibria, our model provides symmetry-breaking between rich and poor countries in the sense of Matsuyama (1996).

We find that an equilibrium with full formalization is unlikely to exist in poor countries. Moreover, reducing the level of the tax financing productive public infrastructure may fail to lead to the emergence of this equilibrium. Unlike in Fortin et al. (1997) and Ihrig and Moe (2000), reducing the cost of formalization may in fact increase the size of the informal sector. In other words, our model elicits the ambivalent role of tax reforms as a policy instrument for eliminating informality.

2 The model

We consider a two-period economy with a single consumption good. The economy is populated by a continuum of two-period lived consumers-entrepreneurs of mass 1, each indexed by θ, the agent's endowment of productive capital. We denote by $\Psi(\theta)$ the measure of agents with endowment smaller than θ. $\Psi(.)$ is strictly increasing and differentiable over the support $[\underline{\theta}, \bar{\theta}]$, where $0 \leq \underline{\theta} < \bar{\theta} < \infty$. One can think of endowments either as human capital (entrepreneurial ability) or physical capital. Agents maximize the present value of their identical, life-time utility through the choice of first-period and second-period consumptions, respectively, c_1 and c_2. This life-time utility is given by $U = u(c_1) + \beta u(c_2)$, where $\beta \in (0,1)$ is a time-discounting factor, and $u(.)$ the periodic utility function, which is strictly increasing, strictly concave, and satisfies Inada conditions.

In period 1, only a cottage-industry, low-productivity technology is available for producing the consumption good. It is assumed, without loss of generality, that an agent θ who uses this technology in absence of public infrastructures can produce θ units of the good. Agents can allocate an exogenously determined sum ϕ from their first-period production/income to contribute to the financing of a productive infrastructure, necessary for the adoption of a high-productivity technology. Formalization in our model is a process of

[2] See Krugman (1991) for a survey of these literatures. Adserà and Ray (1998) have a model in which history favors inertia as a coordination mechanism.

acquiring the right to use a productive, publicly-financed infrastructure. Once the infrastructure is built, in period 2, those who did not contribute can nevertheless use it, but they cannot adopt the high-productivity technology. This corresponds to a scenario where the high-productivity technology is freely distributed only to those who paid the formalization fee. Let α denote the number of agents who elect to formalize. Assuming a balanced budget, the quality of the infrastructure built is given by $X = \alpha\phi$.[3] In period 2, therefore, those who paid the fee operate the high-productivity technology, $y_H = f(X, \theta)$, while the others operate the cottage-industry technology, $y_L = g(X, \theta)$. The functions f and g have the following properties:

A.1 For all $X > 0$, and for all $\theta \in [\underline{\theta}, \bar{\theta}]$, $f_\theta > 0$, $g_\theta > 0$; $f(0, \theta) = 0$, while $g(0, \theta) = \theta$ and $g(X, \theta) > \theta$.

A.2 For all $X > 0$, and for all $\theta \in [\underline{\theta}, \bar{\theta}]$, $f(X, \theta) - g(X, \theta) > 0$; and $f_X - g_X > 0$.

Assumption A.1 implies that infrastructure, while productive in both technologies, is only essential for operating the high-productivity technology. Assumption A.2 states that the availability of infrastructure generates a productivity premium from formalization, since formalization involves the adoption of a more productive technology. This productivity premium is increasing in the quality of infrastructure.

Given $\phi > 0$, agents choose whether or not to go formal by anticipating the effect of this decision on their first- and second-period consumptions. Denote by x each agent's organizational choice: $x = 1$ if the agent goes formal, $x = 0$ otherwise. First- and second-period budget constraints for agent θ are respectively: $c_1 \leq \theta - x\phi$ and $c_2 \leq xf(X, \theta) + (1 - x)g(X, \theta)$. This restricts the value of ϕ to be in $(0, \underline{\theta})$.

Let $V(x; \alpha, \phi, \theta)$ denote the present-value of utility of an agent θ, who takes action $x \in \{0, 1\}$ when $X = \alpha\phi$ is the quality of infrastructure. Given the properties of $u(.)$, budget constraints will be saturated:

$$V(x; \alpha, \phi, \theta) = u(\theta - x\phi) + \beta u\left[xf(X(\alpha, \phi), \theta) + (1 - x)\, g(X(\alpha, \phi), \theta)\right]. \tag{1}$$

Each agent decides on whether or not to formalize production in the second period by comparing $V(1; \alpha, \phi, \theta)$ and $V(0; \alpha, \phi, \theta)$. Let $\mu(\alpha, \phi, \theta)$ denote agent θ's net value from going formal when $X = \alpha\phi$:

$$\mu(\alpha, \phi, \theta) \equiv V(1; \alpha, \phi, \theta) - V(0; \alpha, \phi, \theta) \tag{2}$$

The net value from formalizing depends upon the realized formal sector size, α, implying that there are strategic complementarities between agents' efforts to formalize, as this concept is used in Matsuyama (1996) and Ray (2000). In particular, assuming $X > 0$, if the percentage change in the productivity premium from formalization following a marginal increase in infrastructure quality is sufficiently high, the net value from formalizing can be shown to be increasing in α. In other words, if for all $X > 0$,

$$\frac{f_X - g_X}{g_X} > \frac{u'\left[g(X, \theta)\right] - u'\left[f(X, \theta)\right]}{u'\left[f(X, \theta)\right]}, \tag{3}$$

[3] We assume away the possibility that parts of tax proceeds may be consumed by the government or swallowed up in corruption. We chose to abstract from this aspect which has been treated by Sarte (2000), and highlight the fact that even if the whole tax proceeds were allocated to infrastructures, without any corruption, there would still be a large informal sector in poor countries.

$$\text{then: } \mu_\alpha = \beta\phi\left(u\left[f(X,\theta)\right]f_X - u\left[g(X,\theta)\right]g_X\right) > 0, \tag{4}$$

Because of this interdependence of agents' decisions, each agent must form expectations about others' behavior, when deciding whether or not to go formal. Assuming that indifferent agents choose to formalize, if agent θ predicts that the realized formal sector size will be α^e, he will formalize if and only if $\mu(\alpha^e, \phi, \theta) \geq 0$. He will opt for the status quo otherwise.

In accordance with the literature on strategic complementarities (e.g. Katz and Shapiro, 1985), we assume that agents have identical expectations of formal sector size, and that, in equilibrium, agents' expectations are fulfilled. A *fulfilled expectations equilibrium* (FEE) is a realized formal sector size α such that (i) agents' expectations are fulfilled (i.e., $\alpha = \alpha^e$), and (ii) all agents' decisions are optimal. The following Proposition characterizes the cut-off agent θ^* in a FEE.

Proposition 1 *Given $X > 0$, if in addition to condition (3) we have:*

$$\frac{f_\theta - g_\theta}{g_\theta} \geq \frac{u'\left[g(X,\theta)\right] - u'\left[f(X,\theta)\right]}{u'\left[f(X,\theta)\right]}, \tag{5}$$

then there exists a continuously differentiable function ρ such that $\theta^* = \rho(\alpha;\phi)$ and $\rho_\alpha < 0$.

Proof. Consider an indifferent agent, i.e., one such that $\mu(\alpha, \phi, \theta) = 0$. Then, by construction,

$$\mu_\theta = u'(\theta - \phi) - u'(\theta) + \beta\left(u'\left[f(X,\theta)\right]f_\theta - u'\left[g(X,\theta)\right]g_\theta\right).$$

Given $X > 0$, the properties of u combined with condition (5) imply that $\mu_\theta > 0$. The Implicit Function Theorem may then be applied to establish the rest of the result. ■

Condition (5) states that the rate at which the productivity premium from formalization increases following an increase in the agent's endowment of the productive asset θ has to be sufficiently high. The property $\rho_\alpha < 0$ implies that the higher the expected formal sector size, the lower the level of capital an agent must be endowed with in order to be indifferent between formalizing or not. Given our normalization of population size and the definition of Ψ, the realized formal sector size is given by:

$$\alpha = 1 - \Psi\left[\rho(\alpha;\phi)\right]. \tag{6}$$

Since, by Proposition 1, $\rho(\alpha;\phi)$ is continuous in α, and Ψ is continuous by assumption, Brouwer's fixed point theorem guarantees existence of a fullfilled expectations equilibrium. Clearly, depending on the functions u, f, g, and Ψ, and on the level of ϕ, the fixed point problem in (6) can admit multiple solutions. In the next section, we characterize the set of equilibria and investigate policy responses to informality, including the role of taxation.

3 Taxes, inequality, and the existence of a full formalization equilibrium

In this section, we want to emphasize three main results. First, there always exists an equilibrium with full informalization. Second, the existence of a full formalization equilibrium crucially depends on the

proportion of agents with endowments below the cut-off value θ^*. Third, lowering taxes may have surprising results on the size of the informal sector.

To understand the structure of equilibria, it is important to note that since by Proposition 1 $\rho(\alpha;\phi)$ is a decreasing function of α, an equilibrium with complete formalization (i.e., $\alpha = 1$) does not exist unless

$$\Psi[\rho(1;\phi)] = 0. \tag{7}$$

When condition (7) is satisfied no agent is better off in the informal sector when he believes all other agents will formalize. As we show below, however, this condition does not warrant uniqueness of equilibrium:

Proposition 2 *Complete informalization ($\alpha = 0$) is always a FEE, while complete formalization ($\alpha = 1$) is a FEE if and only if condition (7) is satisfied.*

Proof. To prove the first claim, suppose that all agents expect nobody to formalize in the second period, i.e., $\alpha^e = 0$. In equilibrium, these expectations will materialize if and only if, for all θ, $\mu(0,\phi,\theta) < 0$, which is true by construction. The proof of the second claim follows from (6). ■

Proposition 2 implies that the existence of the equilibrium with complete informalization is purely driven by expectations, while that of the full formalization equilibrium is driven jointly by expectations and initial conditions. Since from (4), $\mu_\alpha > 0$, it can be shown that the equilibrium with $\alpha = 1$ Pareto-dominates the equilibrium with $\alpha = 0$. In a country in which all benefit from formalizing ($\Psi[\rho(1;\phi)] = 0$), there is a role for the enforcement of a ban against informal activities. This ban will help coordinate decisions towards the Pareto-superior equilibrium. In contrast, in an economy in which a positive segment, $\Psi[\rho(1;\phi)]$, of the population cannot afford to formalize, policies need to first establish the conditions for existence of the full formalization equilibrium by correcting historical legacies. We begin our discussion of history-correcting policies by reassessing the popular issue of tax reform as an instrument for the promotion of formalization.

3.1 The ambiguous role of taxes

In this subsection, we are interested in the response of $\Psi[\rho(1;\phi)]$ to changes in ϕ. Since Ψ is strictly increasing, this response is determined by $\partial\rho(1;\phi)/\partial\phi$. In particular, unless $\partial\rho(1;\phi)/\partial\phi > 0$, reducing the level of formal sector taxes may raise the number of agents who are better off operating in the informal sector. Since $\mu_\theta > 0$ by condition (5), the Implicit function theorem may be applied to establish that $\partial\rho(1;\phi)/\partial\phi = -\mu_\phi/\mu_\theta$, where $\mu_\phi = \beta[u'[f(\phi,\theta)]f_X - u'[g(\phi,\theta)]g_X] - u'[\theta-\phi]$. All that matters for determining the sign of $\partial\rho(1;\phi)/\partial\phi$ is to understand how the net value from formalizing changes with ϕ. In the next proposition, we establish existence of a positive threshold ϕ^* below which the proportion of agents better off in the informal sector rises as taxes are lowered. For simplicity, we restrict ourselves to constant returns technologies with respect to infrastructures.

Proposition 3 *Let f and g be such that $f_{XX} = g_{XX} = 0$ and condition (5) hold. If $\forall\ \theta \in [\underline{\theta},\bar{\theta}]$ and $\phi \in (0,\underline{\theta})$,*

$$g_X(\phi,\theta) > \left(\frac{u''[\theta-\phi]}{\beta u''[g(\phi,\theta)]}\right)^{\frac{1}{2}} \tag{8}$$

then there exists $\phi^* \in (0,\underline{\theta})$ *such that* $\partial\rho(1;\phi)/\partial\phi < 0$ *for all* $\phi < \phi^*$*, and* $\partial\rho(1;\phi)/\partial\phi \geq 0$ *for all* $\phi \geq \phi^*$*, where* ϕ^* *is solution to* $\beta u'[f(\phi,\theta)] f_X(\phi,\theta) = u'[\theta-\phi] + \beta u'[g(X,\theta)] g_X(\phi,\theta)$.

Proof. It suffices to show that $\mu_\phi < 0$ whenever $\phi < \phi^*$, and $\mu_\phi \geq 0$ otherwise. Note that when condition (8) holds, the functions $L(\phi) = \beta u'[f(\phi,\theta)] f_X(\phi,\theta)$ and $R(\phi) = u'[\theta-\phi] + \beta u'[g(X,\theta)] g_X(\phi,\theta)$ are respectively decreasing and increasing functions of ϕ in the interval $(0,\underline{\theta})$. Next, note that one can always choose f, g, u, and $\underline{\theta}$ such $L(\phi^*) - R(\phi^*) \equiv 0$ for $\phi^* \in (0,\underline{\theta})$. Hence, by the properties of L and R, $\mu_\phi = L(\phi) - R(\phi) < 0 \ (\geq 0)$ for all $\phi < \phi^* \ (\phi \geq \phi^*)$. ■

Condition (8) states that the contribution of infrastructure to production in the informal sector is high enough that it makes free-riding on infrastructures attractive. In such case, Proposition 3 implies that reducing the formalization fee can in fact increase the proportion of agents who are better off in the informal sector, thus precluding the existence of a full formalization equilibrium. This result contradicts what is predicted from models that ignore the circularity between the quality of infrastructure and the size of the formal sector (e.g. Fortin et al., 1997 and Ihrig and Moe, 2000). Given the ambiguous role of taxes, policies that target the distribution of productive capital, if feasible, may be interesting alternatives to tax reforms.

3.2 The role of inequality

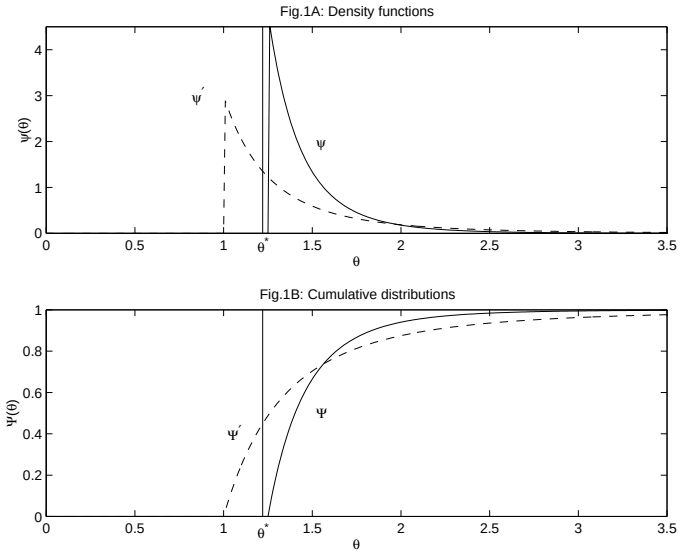
For a given tax ϕ, condition (7) is more likely to be violated in poor countries than in rich countries. Take two countries with asset distributions identical in all respects but their mean, with condition (7) satisfied in the first one but not in the second. Then, necessarily the second country is the one with lowest mean asset. Of course, two countries with identical *per capita* asset levels may find themselves with asymmetries in their menus of equilibria. Then, it must be that the one for which full formalization is not an equilibrium is more unequal than the other. We illustrate this by solving a numerical example, where θ follows a Pareto distribution $\psi(\theta)$ with cumulative distribution $\Psi(\theta) = 1-(\theta_0/\theta)^\gamma$ when $\theta > \theta_0$, and 0 otherwise. In Figure 1, we consider two distributions ψ and ψ' with parameters (θ_0,γ) respectively $(1,3)$ and $(1.25,6)$.[4] We assume that distribution ψ satisfies condition (7) — all agents have endowments higher than θ^* — so that a full formalization equilibrium exists. Increasing inequality through a mean-preserving spread of ψ, we find a positive number of agents better off not formalizing. The full formalization equilibrium has vanished.

The asset distribution is in fact a fundamental source of symmetry-breaking, whether by its first or its second moment. In absence of a massive inflow of assets from abroad, the second moment might be a good target for a correcting policy. Although redistribution of physical capital, or subsidized education fall outside of the scope of our model, these are policies that would go in the direction of reducing inequality.

In countries in which education resources are unequally distributed, for example, a condition like (7) is

[4] It can easily be verified that ψ' is a mean-preserving spread of ψ with variance multiplied by a factor of 8.

Figure 1: Mean-preserving spread



likely to be violated. In African countries, ethnic divisions are known to diverge resources away from the education needs of the majority of the population (Easterly, 2000), thus making informal, low-productivity activities more attractive to this majority. A policy that would help achieve complete formalization is one that first corrects history by improving access to quality education. Once history is corrected so that an equilibrium with complete formalization exists, a ban on informal activities is Pareto-improving. This, of course, is easier said than done. The correcting policy may not itself be Pareto-improving. Agents in the upper tail of the asset distribution may prefer the status quo to a combination of the correcting policy and the subsequent move towards full formalization. In particular, if ethnic divisions are the key determinant of inequality, correcting policies are likely doomed to upset.

Given that much of illegal labor and child labor take place in the informal sector, our results are clearly linked to the discussion on the desirability of bans on these types of work (Basu and Van, 1998; Dessy and Pallage, 2001). Since most illegal labor is typically driven by poverty, if condition (7) is not satisfied, then such bans, without correcting policies, will likely not be Pareto improvements.

4 Final discussion

We have worked throughout under the assumption of no-enforcement, therefore focusing on self-enforcing equilibria. We believe this assumption is not unreasonable for countries in which 60% of the labor force belongs to the informal sector. Banning informality in this context is a challenge to which few governments would survive. In richer countries, in which everyone can afford to go formal, once we abstract from moral hazard issues as we do in this paper, enforcement does not pose much difficulty. Our results, however, show that bans in that case are in effect self-enforcing. The role of a ban, when it is imposed, is that of a signal

pointing to the relevant focal point.

What this note has achieved is a "big push" theory based on a move towards formalization in a model in which differences in the behaviors of countries' arise endogenously. The "big push," or the absence of it, is not due to expectations only, but depends on the existence of an equilibrium towards which to "push."

As for a reduction in the tax burden, its effects are ambiguous. Our results therefore suggest that caution is needed when using such simple-minded policy, often recommended in the literature as the solution to informalization.

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