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OCCUPATIONAL CHOICE AND INVESTMENTS IN HUMAN CAPITAL IN  
INFORMAL ECONOMIES  
N° 2017/27

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Berniell, L.

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## ABSTRACT

Informality is pervasive in many developing countries and it can affect occupational and educational decisions. Cross-country data shows that the rate of entrepreneurship as well as the gap between the skill premium for entrepreneurs and for workers increase with the size of the informal economy. Also, in countries with larger informal sectors the fraction of high-skilled individuals that choose to be entrepreneurs is larger. To explain these facts, I develop a model economy with human capital investment, occupational choice and an informal sector, where the investment in human capital improves the efficiency of labor as well as managerial skills, and the technology to produce goods exhibits capital-skill complementarity. The model predictions are able to account for the cross-country evidence and also can shed light on the mechanisms at work when the level of informality in the economy increases. In particular, a higher level of informality disincentivizes human capital investments for workers while it incentivizes these investments for the case of some managers, mostly informal but talented.

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# ELECCIÓN OCUPACIONAL E INVERSIONES EN CAPITAL HUMANO EN ECONOMÍAS INFORMALES

Berniell, L.

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## RESUMEN

La informalidad es un rasgo característico en muchos países en desarrollo y puede afectar de manera importante las decisiones laborales y educativas. Datos comparativos entre países indican que la tasa de emprendedurismo así como la brecha entre el retorno a la educación para los empresarios y para los trabajadores aumentan con el tamaño de la economía informal. Además, en los países con sectores informales más grandes la fracción de individuos altamente calificados que eligen ser empresarios es mayor. Para explicar estos hechos este trabajo construye una economía con inversiones en capital humano, elecciones ocupacionales y un sector informal, en la cual la inversión en capital humano mejora la eficiencia de la mano de obra y también las habilidades gerenciales, y además la tecnología para producir bienes muestra complementariedad entre el capital y las habilidades de los trabajadores. Las predicciones del modelo son consistentes con la evidencia comparativa entre países y también señalan los mecanismos que se ponen en funcionamiento cuando aumenta el nivel de informalidad en la economía. En particular, un mayor nivel de informalidad desincentiva las inversiones en capital humano de los trabajadores, mientras que incentiva estas inversiones para el caso de algunos emprendedores, en su mayoría informales pero talentosos.

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# Occupational Choice and Investments in Human Capital in Informal Economies

Lucila Berniell\*

## Abstract

Informality is pervasive in many developing countries and it can affect occupational and educational decisions. Cross country data shows that the rate of entrepreneurship as well as the gap between the skill premium for entrepreneurs and for workers increase with the size of the informal economy. Also, in countries with larger informal sectors the fraction of high-skilled individuals that choose to be entrepreneurs is larger. To explain these facts, I develop a model economy with human capital investment, occupational choice and an informal sector, where the investment in human capital improves the efficiency of labor as well as managerial skills, and the technology to produce goods exhibits capital-skill complementarity. The model predictions are able to account for the cross country evidence and also can shed light on the mechanisms at work when the level of informality in the economy increases. In particular, a higher level of informality disincentivizes human capital investments for workers while it incentivizes these investments for the case of some managers, mostly informal but talented.

**JEL Classification:** E26, O17, L26, J24.

**Keywords:** Informality. Human Capital. Occupational choice. Entrepreneurship.

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# 1 Introduction

Countries differ greatly in their levels of schooling and also in their rates of entrepreneurship. At the same time, the share of the so-called “shadow economy” -informal economic activities- is very large in some countries and very small in others.<sup>1</sup> This paper explores some key channels that connect these three phenomena. In particular, it focuses on assessing whether the extent to which firms can hide from tax authorities -i.e., operate in the informal economy- may affect the incentives of individuals to invest in human capital and also distort their occupational choices.

The cross country data shows that the levels of educational attainment, rates of entrepreneurship and the level of informality are connected. First, across countries there is a positive association between rates of entrepreneurship and the sizes of the informal sector. Second, the difference in the skill premium received by entrepreneurs and workers is negligible for economies with low levels of informality, while it becomes positive and increasing for more informal economies. Third, in more informal economies the fraction of high-skilled individuals that choose to become entrepreneurs is larger. Moreover, the share of the labor force that is skilled and the size of the informal economy are related in a non-linear way: for low levels of informality the share of skilled individuals first decreases but then it rapidly stabilizes for countries with sufficiently large informal sectors.

To account for these facts, I develop an occupational choice model with human capital investment and an informal sector. I adapt Lucas (1978) span-of-control model to a life-cycle economy in which investments in human capital can positively affect the returns to entrepreneurship as well as the efficiency of labor.<sup>2</sup> In addition, the economy features credit constraints which arise as a result of the possibility of hiding the collateral and eluding the fiscal authority, as in Amaral and Quintin (2006).

In the model economy, every period a cohort of measure one of two-period lived agents is born. In the first period, agents split their time between unskilled work and education

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<sup>1</sup>As defined in Schneider et al. (2011), the shadow economy is “*all market-based legal production of goods and services that are deliberately concealed from public authorities...to avoid paying taxes or meeting certain standards or complying with certain administrative procedures*”.

<sup>2</sup>Van der Sluis et al. (2008) and Parker and Van Praag (2006) review the evidence about the effects of education on the returns to entrepreneurship and conclude that there exists a positive association.

(investment in human capital). Agents are heterogeneous in their endowment of innate ability. The production function of human capital combines ability and time spent in education when young. In the second period, agents can supply unskilled or skilled labor. They have the option of becoming entrepreneurs instead of workers, and operate a technology that combines physical capital, skilled and unskilled labor, in which the human capital of the manager plays the role that innate ability plays in Lucas (1978). This technology is also characterized by capital-skill complementarity.

Managers can operate in the formal or the informal sector, and in both sectors they can self-finance part of their physical capital with savings from the first period. In addition, managers can use part of their savings as a collateral to get loans from banks, but they can also choose to default bearing a cost proportional to their income. Given this possibility, there is a cost of enforcing contracts that implies that some agents will end up being credit constrained. In the model, the higher these costs are, the larger will be the number of managers deciding to operate in the informal sector. Therefore, higher costs of contract enforcement is the model's correlate of a more informal economy.

In this model, the link between informality, entrepreneurship, and human capital operates in other dimensions as well. With high costs of enforcing contracts (high informality) entrepreneurs only receive a limited amount of lending from banks, and therefore choose to operate with low amounts of physical capital. Given capital-skill complementarity, this translates into a low demand for skilled labor and into relatively low earnings for skilled workers. As a result, in countries with high informality, workers do not have much incentives to invest in skills. In contrast, the returns to education for entrepreneurs can be high since education enhances the productivity of their operations, which can compensate for the lack of physical capital.

Given a parametrization of this model economy that can generate an equilibrium with a positive mass of individuals choosing each one of the six possible occupations (unskilled workers, skilled workers, informal unskilled managers, informal skilled managers, formal unskilled managers, and formal skilled managers), I analyze theoretically how all these effects interact with one another when the costs of contract enforcement increase. I conclude that the model is able to reproduce the three empirical facts mentioned above.

This work is mainly related to three strands of literature. First, it is related to the literature studying the relationship between occupational choices and informality. In particular, this work is close to Amaral and Quintin (2006), who construct an occupational choice model that is able to describe how skilled and unskilled labor are competitively assorted into formal and informal sectors, without any type of segmentation in the labor markets. However, Amaral and Quintin (2006) do not include the possibility of investment in managerial abilities, which is a key aspect to be considered in order to account for the differential incentives that a higher informality implies for the investments in human capital of managers and workers. This work is also related to the research addressing the effects of market imperfections on occupational choices, for instance the effects of entry costs (Antunes and Cavalcanti, 2007), of taxes on financial intermediaries (Erosa, 2001), of other financial frictions that increase credit costs (Buera et al., 2011), or of size-dependent policies (Guner et al., 2008). However, none of these works analyze human capital investments.

Second, this work is also in line with the research analyzing the interplay between education and occupational choices, for instance Poschke (2010), Boháček (2006) or Bhattacharya et al. (2011). Poschke (2010) studies the relationship between educational attainment and the prevalence of low-productivity versus high-productivity entrepreneurship, but his model does not explicitly model human capital investments nor does include an informal sector in order to study its impacts on the relationship between education and entrepreneurship. On the contrary, Boháček (2006) and Bhattacharya et al. (2011) do model investments in human capital, and, of particular interest for the present work, they model the investments for developing managerial skills but not the one made by workers.

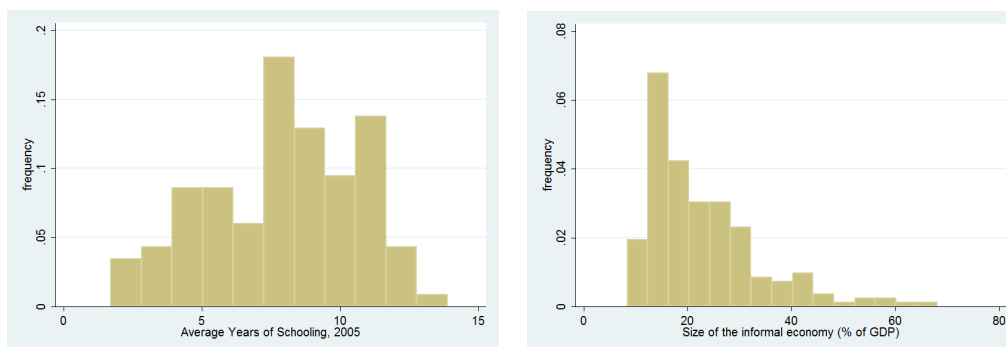
Last, this paper contributes to the rich literature on cross-country differences on educational attainment (Bils and Klenow, 2000, Schoellman, 2008, Córdoba and Ripoll, 2009, Hanushek and Woessmann, 2010, Erosa et al., 2010, Hendricks, 2010) by analyzing a mechanism that produces differential incentives to investing in human capital across occupations.

The rest of the paper is organized as follows. Section 2 describes in detail the empirical facts that motivate the connection between informality, occupational entrepreneurship

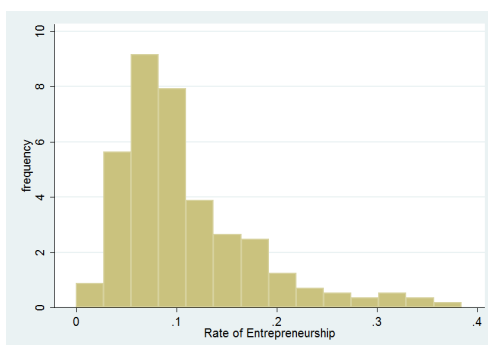
and education. The model economy is presented in Section 3. In Section 4 I provide a characterization of the equilibrium choices in terms of the cutoffs for occupations and educational levels. Section 5 describes what are the effects of an increase in the costs of enforcement and links these effects to the empirical motivation. Section 6 concludes.

## 2 Empirical facts

Across countries in the world, the average years of schooling for the adult population (15+ years old) ranges from about 2 years to more than 12 years (Figure 1(a)). The size of the informal economy also varies significantly (Figure 1(b)), ranging from 8% of GDP for a country like the United States to 60% of GDP for a country like Bolivia (Schneider et al., 2011). Furthermore, Figure 1(c) shows that the rate of entrepreneurship, measured as the business ownership rate, is also very dispersed across countries.



(a) Schooling years, 2005. *Source:* Barro and Lee database. (b) Size of the informal economy (% of GDP), pooled years 2001-2007. *Source:* Schneider et al. (2011).

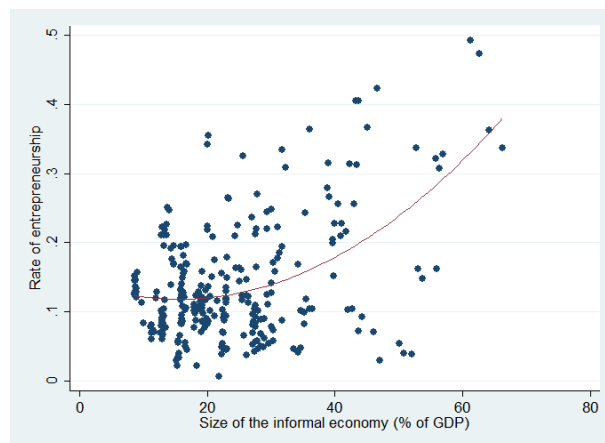


(c) Rate of entrepreneurship, pooled years 2001-2008. *Source:* Global Entrepreneurship Monitor (GEM) Database.

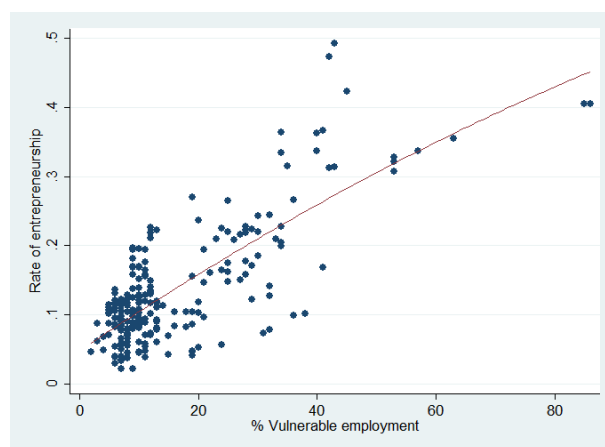
Figure 1: Cross-country distributions of schooling, informality, and entrepreneurship.



This paper explores the connection between these three magnitudes. The main hypothesis is that the level of informality in an economy affects individuals' decisions about human capital investments as well as occupational choices. Cross-country evidence reveals three key facts in line with this hypothesis. First, the business ownership rate is positively correlated with informality, as shown in Figures 2(a) and 2(b).<sup>3</sup>



(a) Business ownership rate and the informal economy.  
Sources: GEM Database and Schneider et al. (2011).



(b) Business ownership rate and vulnerable employment.  
Sources: GEM Database and WB-WDI.

Figure 2: Fact 1 - The rate of entrepreneurship increases with the size of the informal economy.

Second, in countries with small informal sectors the Mincerian returns to education for entrepreneurs and for workers do not differ much, but a gap widens up as the level of

<sup>3</sup>Figures 2(a) and 2(b) only differ in the measure of informality used. The first measure (size of the informal economy) is the share of the GDP produced in the informal sector, and it is taken from Schneider et al. (2011). The second measure is the share of vulnerable employment over total employment, according to the definition in the WDI (World Development Indicators, World Bank).

informality becomes relatively high (Figure 3(a)). This evidence suggests that with high informality the returns to education for entrepreneurs may be larger than for workers, which is the same to say that in such economies there is a wage premium for skilled individuals that choose to be entrepreneurs instead of salaried workers. Another piece of similar evidence is shown in Figure 3(b) which, for a subset of countries (Latin American plus United States), shows that the relationship between this wage premium and the share of the shadow economy is specially present when we compare the wages of skilled informal entrepreneurs to those of skilled formal workers.<sup>4</sup> Since there exists vast evidence suggesting that education increases the returns to entrepreneurship<sup>5</sup>, some entrepreneurs may be more inclined to invest in education as a way to overcome the low productivity of their businesses when informality is high (availability of credit is low). This is as to say that managers invest in their own human capital instead of in physical capital. On the other hand, when informality is very low (and access to credit is broad) investing in education is an attractive alternative for workers due to the relatively higher wages paid to skilled workers.

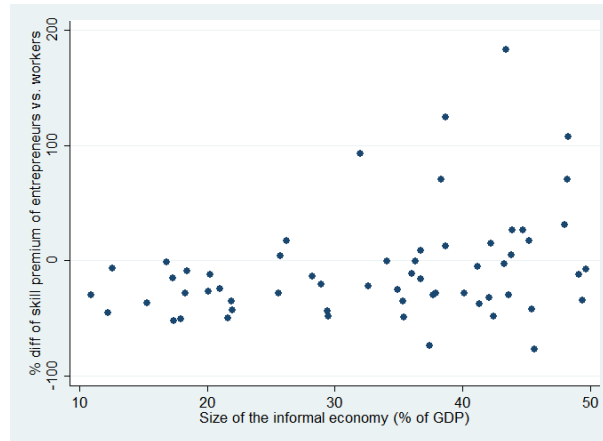
Third, in countries with relatively large informal sectors, a larger fraction of skilled individuals choose to be entrepreneurs. This fact is shown in Table 1, where the mean ratio of skilled entrepreneurs to skilled labor force is higher for countries with a larger informal sector. Figure 4 presents the distributions of this ratio for countries with very low and very high shares of the informal economy, and shows that for the former group skilled entrepreneurs are as frequent as skilled individuals in the labor force (distributions is highly concentrated around the number 1, left panel), while for the latter group of countries (right panel in Figure 4) this figure shows that skilled entrepreneurs are more frequent than skilled persons in the labor force (the distribution is biased towards numbers greater than 1).

These facts suggest that the returns for skilled informal entrepreneurs increase with

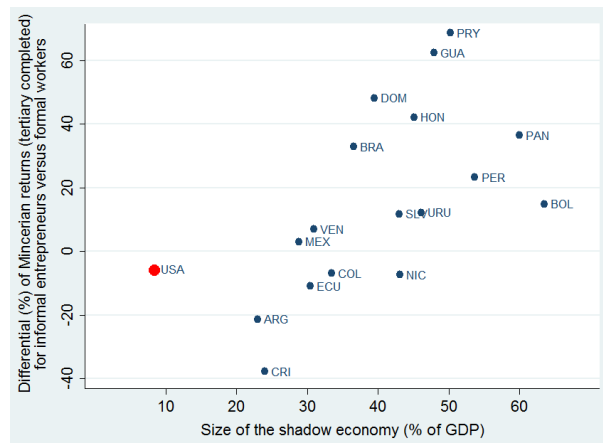
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<sup>4</sup>The definition of informality used is based on the productive characteristics of the occupations, according to which informal workers or entrepreneurs are those individuals who work in firms with less than five employees, irrespective of whether they contribute to social security systems, which corresponds to a more legalistic definition of informality. However, both ways of defining informality produce measures that are very much correlated.

<sup>5</sup>Parker (2004), Hartog et al. (2010) and Block et al. (2011) present evidence showing how education affects the returns to entrepreneurship.



(a) Mincerian returns (%) to education (more than high school) for entrepreneurs minus those returns but for workers, as a function of the size of the informal economy. *Sources:* Household surveys for 88 countries, and Schneider et al. (2011).



(b) Mincerian returns (tertiary education completed) for **informal** entrepreneurs (less than 5 employees) minus Mincerian returns for **formal** workers (in firms with 5+ employees), as a function of the size of the informal economy. *Sources:* SEDLAC and Gluzmann et al. (2011), and Schneider et al. (2011).

Figure 3: Fact 2 - Differences in skill premium (Mincerian returns) by occupations as a function of the size of the informal economy

the extent of informality in the economy (fact 2). They also suggest that not only more business start up when informality is high (fact 1), but also that some of these business are run by skilled individuals, generating the fact that skills are more concentrated among entrepreneurs the larger is the size of the informal economy (fact 3). Hence, pervasive informality in the economy may induce some individuals to invest in human capital in order not to become salaried workers in the formal sector, but to run their own business probably

Table 1: Distribution of skilled individuals across occupations, for very low-informality and very high-informality countries.

| Group of countries    | Description  | Ratio: $\frac{\% \text{ of skilled entrepreneurs}}{\% \text{ of skilled labor force}}$ |      |      |
|-----------------------|--|--|------|------|
|                       |  | Min  | Max  | Mean |
| Very low-informality  | Countries in the bottom 25% of the distribution of sizes of informal economy | 0.59   | 1.42 | 1.02 |
| Very high-informality | Countries in the top 25% of the distribution of sizes of informal economy    | 0.58   | 1.69 | 1.12 |

Sources: GEM database and Schneider et al. (2011).

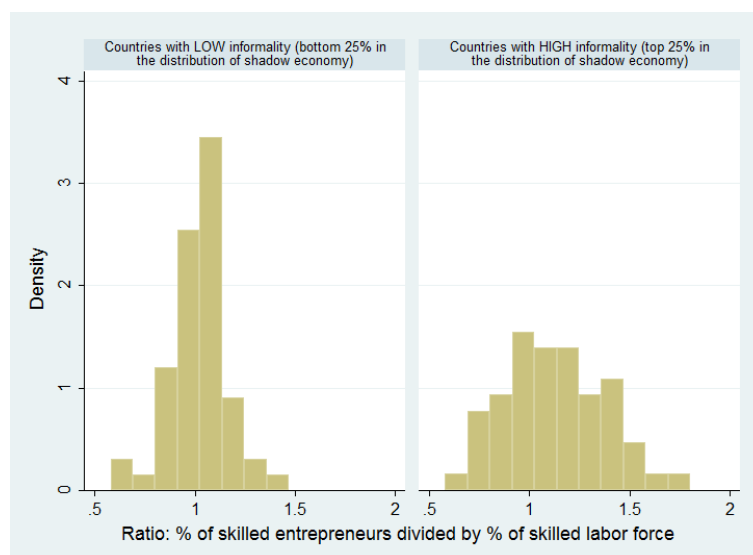
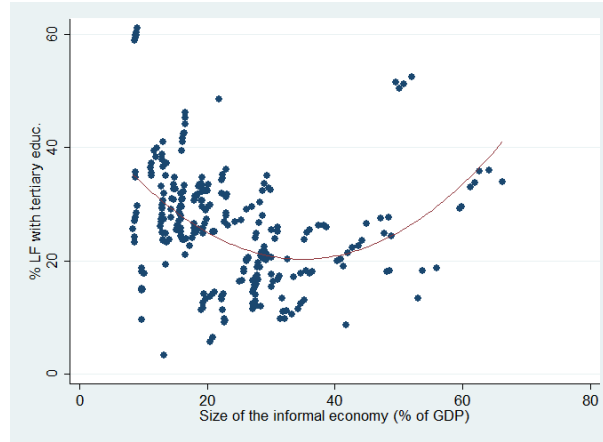
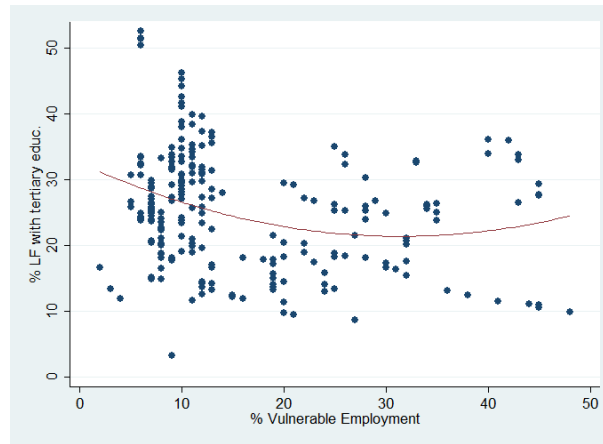


Figure 4: Fact 3 - Concentration of skills by occupation in countries with very low or very high levels of informality. *Sources:* GEM Database and Schneider et al. (2011).

in the informal sector. As a result of this mechanism, the share of skilled individuals do not fall as much as it would otherwise. As shown in Figures 5(a) and 5(b), the correlation between the share of the labor force with post-secondary education (skilled) and the size of the informal economy appears to be indeed non-linear: the share of the skilled workforce first declines and then it rapidly stabilizes, or even raises, as the level of informality increases.



(a) Years of schooling and Informal Economy. *Sources:* World Bank EdStats and Schneider et al. (2011).



(b) Education and Vulnerable Employment. *Sources:* World Bank EdStats and World Bank WDI.

Figure 5: Educational attainment of the labor force and the size of the informal sector.

### 3 The Economy

Consider the following model populated by agents who live for two periods. The time is discrete and every period a new cohort of measure one of two-period lived agents is born. Agents are heterogeneous in their endowment of innate ability, denoted by  $z \in [0, 1]$ , which is distributed according to  $\Gamma(z)$ . There are three factors of production: skilled and unskilled labor  $-l_s$  and  $l_u$ , that receive salaries  $w_s$  and  $w_u$  in competitive labor markets- and capital  $k$ .

Each individual is endowed with one unit of time that can be offered in the market for unskilled workers, both when young and when old. In the first period, agents can also split their unit of time between unskilled work and education (investment in human

capital). I denote by  $t_e \in \{t_e^U, t_e^S\}$ , with  $t_e^U < t_e^S$ , the fraction of time devoted to education when young. To simplify notation, and as a normalization, I let  $t_e^U = 0$ , while  $0 < t_e^S \leq 1$  represents the fraction of one model-period that needs to be allocated to the formation of skills.<sup>6</sup> That is,  $(1 - t_e^S)$  is the quantity of unskilled labor supplied by a young agent that decided to invest in human capital. Next period this individual will have  $\tilde{z}$  units of human capital, which is formed according to

$$\tilde{z} = \tilde{z}(t_e, z) = z^{\theta(\frac{1}{\theta} - t_e)}, \quad (1)$$

where  $0 < \theta < \frac{1}{t_e^S}$  is a parameter that guarantees that this technology is: increasing in  $z$  and  $t_e$ ; concave in  $z$ ;  $\tilde{z}(0, z) = z$  and  $\tilde{z}(t_e, 0) = 0$ ,  $\forall z$  and  $\forall t_e$ ; and bounded such that  $\tilde{z} \in [0, 1]$ .<sup>7</sup>

In the second period, agents can be workers or become entrepreneurs (managers), and their amount of human capital  $\tilde{z}$  can then be allocated to two alternative uses: managerial ability, denoted by  $m$ , or units of skilled labor,  $l_s$ . The agent that did not invest in skills when young and continues as a worker when old supplies her unit of labor  $l_u = 1$  in the unskilled labor market in the second period of her life, as she did in the first one.

All production is carried out by entrepreneurs, who operate a technology

$$y = m^\gamma F(k, l_u, l_s)^{1-\gamma}, \quad (2)$$

that exhibits capital-skill complementarity, and in which  $F(k, l_u, l_s)$  has constant returns to scale.<sup>8</sup> The share of the profits that goes to the manager is  $\gamma$ . Capital depreciates entirely from one period to the next.

There can be unskilled managers (with  $m = z$ , because they had chosen  $t_e = 0$ ) as well as skilled ones (with  $m = z^{\theta(\frac{1}{\theta} - t_e)} > z \forall z$ , because they chose  $t_e = t_e^S$  when young). The interpretation of these modeling choices indicates that managerial ability can be increased

<sup>6</sup>For instance, for a model economy with a period-length of 20 years (in which agents are born at age 20) the value  $t_e^S$  can be set to 1/4, which is the average time invested in post-secondary education (5 years).

<sup>7</sup>As described next, investing in skills in the first period is costly not only due to the forgone income when young, but also due to a direct cost  $c$  per unit of time spent to education.

<sup>8</sup>For instance, the production technology can take the form of a nested CES with perfect capital-skill complementarity:  $y = m^\gamma F(k, l_u, l_s)^{1-\gamma} = m^\gamma [\min\{bl_s, k\}]^{\alpha(1-\gamma)} l_u^{(1-\alpha)(1-\gamma)}$ .

by investing time in education, and that innate ability  $z$  also intervenes in its formation. Moreover, managerial ability increases the productivity of the firm.<sup>9</sup>

The entrepreneurs (or managers) can act in the formal or the informal sector of the economy. In both sectors managers can self-finance part of the physical capital with savings from the first period, but they can also borrow money from a financial intermediary in order to rent the capital they need to run their businesses. In the formal sector, profits are taxed at  $\tau > 0$ .<sup>10</sup> In the informal sector, managers do not pay taxes. The financial intermediary lends at rate  $r$ , which is exogenously given, and formal managers can choose to default bearing a cost proportional to their income ( $\eta$ ). Informal managers can easily hide any collateral from the intermediary, that is, they do not face a cost  $\eta$  in case of defaulting. Preferences are such that  $U(c_1, c_2) = \log c_1 + \beta \log c_2$ , where  $\beta \in (0, 1)$  and  $\beta(1 + r) \leq 1$ .

For a given level of managerial ability  $m$ , and a given demand for capital  $k$ , the profits of entrepreneurs before paying taxes are

$$\Pi(k, m) = \max_{l_u, l_s \geq 0} m^\gamma F(k, l_u, l_s)^{1-\gamma} - (1+r)k - w_s l_s - w_u l_u.$$

In a world with perfect contract enforcement ( $\eta = 1$ ) formal managers would employ the uniquely defined optimal level of physical capital  $k^*(m) = \arg \max_{k \geq 0} \Pi(k, m)$ . However, here managers have the option to default and credit contracts must be self-enforcing (as in Amaral and Quintin, 2006). Therefore, the net profits of managers are

$$\begin{aligned} W(a, m; \eta, \tau) &= \max_{s \leq a, d \geq 0} (1 - \tau)\Pi(s + d, m) & (3) \\ \text{s.t. } (1 - \tau)\Pi(s + d, m) + a(1 + r) &\geq (1 - \eta)(1 - \tau)[\Pi(s + d, m) + (s + d)(1 + r)] \\ &+ (a - s)(1 + r), \end{aligned}$$

where  $d$  is the loan obtained from the financial intermediary and  $s$  is the collateral used to obtain that loan, which has to be lower than the savings from the first period ( $a$ ). The solution to this maximization problem has to satisfy the incentive compatibility constraint

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<sup>9</sup>Evidence supporting this assumption can be found in Van der Sluis et al. (2008).

<sup>10</sup>The proceeds from taxation are dissipated.

that says that the contract has to be such that the intermediary will only lend an amount  $d$  that makes default sub-optimal. The left-hand side of this constraint is exactly equal to the net income of the manager if she repays. The right-hand side is her net income in the case of defaulting, where the manager saves the principal plus the interest that otherwise would have gone to the intermediary. I denote by  $s(a, m; \eta, \tau)$ ,  $d(a, m; \eta, \tau)$ ,  $l_u^d(a, m; \eta, \tau)$ ,  $l_s^d(a, m; \eta, \tau)$  the solutions to the problem of a manager with savings  $a$  and managerial skills  $m$ . Entrepreneurs choose the formal sector when their access to outside financing is sufficient to offset the fact that they become subject to taxation, that is, when  $W(a, m; 0, 0) \leq W(a, m; \eta, \tau)$ .

### 3.1 Individuals' choices

The individual with ability  $z$  solves the following problem of maximizing her lifetime utility by solving

$$V(z) = \max_{a \geq 0, t_e \in \{t_e^U, t_e^S\}, \phi_w \in \{0, 1\}, \phi_f \in \{0, 1\}} \log(c_1) + \beta \log(c_2), \quad (4)$$

subject to

$$c_1 = (1 - t_e)w_u - ct_e - a,$$

$$c_2 = a(1 + r) + \phi_w \left[ \left(1 - \frac{t_e}{t_e^S}\right) w_u + \frac{t_e}{t_e^S} w_s \tilde{z}(z, t_e) \right] + (1 - \phi_w) [\phi_f W(a, \tilde{z}(z, t_e); \eta, \tau) + (1 - \phi_f) W(a, \tilde{z}(z, t_e); 0, 0)],$$

$$\text{and } \tilde{z} = z^{\theta(\frac{1}{\theta} - t_e)}.$$

Note that in the second period she has her asset income,  $a(1 + r)$ , and if the agent chooses to be unskilled, i.e.  $t_e = t_e^U = 0$ , and decides to be a worker, i.e.  $\phi_w = 1$ , then she also earns  $w_u$ . If she decides to be a manager, she uses her  $\tilde{z} = z$  units of skills to run a firm. The firm can be formal, and in this case the manager earns  $W(a, \tilde{z}(z, t_e); \eta, \tau)$ . If the firm is informal, on the other hand, the net profit of the manager is given by  $W(a, \tilde{z}(z, t_e); 0, 0)$ . For an agent who decides to become skilled, the second period income is  $w_s \tilde{z}(z, t_e)$  if she decides to be a worker. If a skilled agent decides to work as a manager, she uses her



managerial ability  $\tilde{z}(z, t_e^S) > z$  either as a formal or as an informal manager.

The solution to this problem gives the agent's decision on how much to save (i.e.,  $a(z; \eta, \tau)$ ), the amount of time spent investing in her human capital when young (i.e.,  $t_e(z; \eta, \tau) \in \{0, t_e^S\}$ ), her occupation when old (i.e.,  $\phi_w \in \{0, 1\}$ ), and, if she chooses to be a manager, the sector in which to operate (i.e.,  $\phi_f \in \{0, 1\}$ ).<sup>11</sup>

### 3.2 Labor markets

In each period, the aggregate demand for skilled labor is given by

$$\begin{aligned} L_s^d(w_s, w_u; \eta, \tau) &= \int_{z \in [0,1]} l_s^d(a(z), m(z, t_e(z)); \eta, \tau) [1 - \phi_w(z)] \phi_f(z) \Gamma(z) dz \\ &+ \int_{z \in [0,1]} l_s^d(a(z), m(z, t_e(z)); 0, 0) [1 - \phi_w(z)] [1 - \phi_f(z)] \Gamma(z) dz. \end{aligned} \quad (5)$$

Similarly, the aggregate demand for unskilled labor is

$$\begin{aligned} L_u^d(w_s, w_u; \eta, \tau) &= \int_{z \in [0,1]} l_u^d(a(z), m(z, t_e(z)); \eta, \tau) [1 - \phi_w(z)] \phi_f(z) \Gamma(z) dz \\ &+ \int_{z \in [0,1]} l_u^d(a(z), m(z, t_e(z)); 0, 0) [1 - \phi_w(z)] [1 - \phi_f(z)] \Gamma(z) dz. \end{aligned} \quad (6)$$

In each period, the aggregate supply of skilled labor is

$$L_s^s(w_s, w_u; \eta, \tau) = \int_{z \in [0,1]} \tilde{z}(z, t_e(z)) \frac{t_e(z)}{t_e^S} \phi_w(z) \Gamma(z) dz. \quad (7)$$

The aggregate supply of unskilled labor is

$$\begin{aligned} L_u^s(w_s, w_u; \eta, \tau) &= \int_{z \in [0,1]} \left[ (1 - t_e^S) \frac{t_e(z)}{t_e^S} + (1 - \frac{t_e(z)}{t_e^S}) \right] \Gamma(z) dz \\ &+ \int_{z \in [0,1]} \phi_w(z) (1 - \frac{t_e(z)}{t_e^S}) \Gamma(z) dz. \end{aligned} \quad (8)$$

---

<sup>11</sup>We focus on equilibria in which wages are constant over time (denoted by  $w_s$  and  $w_u$ ).

### 3.3 Equilibrium

Given  $\eta, \tau$ , and  $\Gamma$ , a steady state equilibrium for this economy is a pair  $\{w_s, w_u\}$  of wage rates and a list of policies for each  $z$ -type agent such that: (i) policies are optimal for all agents (they solve the problem stated in (4)); and (ii) labor markets for both types of labor clear, that is

$$L_s^d(w_s, w_u; \eta, \tau) = L_s^s(w_s, w_u; \eta, \tau),$$

and

$$L_u^d(w_s, w_u; \eta, \tau) = L_u^s(w_s, w_u; \eta, \tau).$$

## 4 Characterization of the equilibrium

This section is intended to explore the main features of an equilibrium for the model economy described above. To do so, we first inspect the main features of the demand for credit in this model economy, and then the key aspects regarding occupational and educational choices.

It is important to note that in the model economy, and for the existence of an equilibrium with positive production, there has to be some agents who choose to be workers and some others who choose to be entrepreneurs. Furthermore, given the technology to produce goods, in the equilibrium there must be skilled and unskilled workers supplying labor to entrepreneurs. Needless to say, the exact equilibrium occupational choices for each ability level will depend on the values of the parameters values of the parameters characterizing preferences (basically  $\beta$ ), the technology for producing goods ( $\gamma, \alpha$  and  $b$ )<sup>12</sup>, the technology for human capital formation ( $t_e^S, \theta$ , and the direct costs of education,  $c$ ), and those shaping the distribution of innate ability ( $\mu_z$  and  $\sigma_z$ ).<sup>13</sup> However, any quantitative version of this economy that tries to resemble key aspects of the data -in which both formal and informal sectors exist and in which both type of managers can be either skilled

<sup>12</sup>Where  $b$  is the technical coefficient in a nested CES with perfect capital-skill complementarity:  $y = m^\gamma [\min\{bl_s, k\}]^{\alpha(1-\gamma)} l_u^{(1-\alpha)(1-\gamma)}$ .

<sup>13</sup>Occupational choices will of course also depend on the exact functional forms of preferences and technologies. The key technological assumption for the results is that there is a sufficiently high degree of capital-skill complementarity in the production function of goods.

or unskilled-, will need a set of parameter values that not only produces an equilibrium with six types of occupations (unskilled workers, skilled workers, informal unskilled managers, informal skilled managers, formal unskilled managers, and formal skilled managers) but also satisfies the allocation of credit and the order of the cutoffs that are described next.

#### 4.1 The demand for credit

In order to characterize the demand for credit, first note that the incentive compatibility constraint can be written as

$$\eta(1 - \tau)\Pi(s + d, m) + s(1 + r)[\tau + \eta * (1 - \tau)] \geq d(1 - \eta)(1 - \tau)(1 + r), \quad (9)$$

which allows us to show that  $s(a, m; \eta, \tau) = a$ , i.e., those managers that can access to credit will pledge all their savings as the collateral for the loan.<sup>14</sup> It is also immediate from inequality (9) that this incentive compatibility constraint will be binding at the optimum.<sup>15</sup> Figure 6 illustrates this result.

On the other hand, the amount of credit that a manager is able to get from the intermediary depends on her level of human capital (which affects the overall productivity of the firm she runs), as well as on the costs of contract enforcement ( $\eta$ ).<sup>16</sup> In particular, the amount of loans demanded (and granted) for a manager with savings  $a < k^*(m)$  (i.e., constrained) is increasing in  $m$  and  $\eta$ . These results are shown in Figures 7(a) and 7(b).<sup>17</sup>

<sup>14</sup>In the inequality (9) it is easy to see that the left-hand side is increasing in  $s$  while the right-hand side is a linear function of  $d$ , given the parameters. In addition, since the objective function is also increasing in  $s$ , the constraint  $s \leq a$  in the individual's maximization problem will be binding at the optimum.

<sup>15</sup>The LHS in (9) is a linear increasing and concave function of  $d$ , given  $a$ ,  $m$  and the parameters  $\tau, \eta$ . The RHS is increasing in  $d$  up to the level of optimal use of capital,  $k^*(m)$  -which results from solving the unconstrained version of the maximization problem in (3)-, and for all  $d > k^*(m)$  the RHS is constant. Since the objective function is also increasing in  $d$ , the demand for loans  $d(a, h; \eta, \tau)$  can be found in the intersection between the LHS and the RHS.

<sup>16</sup>Of course, the amount of credit that the intermediary is willing to lend to the entrepreneur will also depend on her savings, because this affects the amount of resources that can be used as a collateral. Note that the result stating that  $s(a, h; \eta, \tau) = a$ , together with the fact that the LHS in (9) is increasing in  $s$  for all possible values of  $d$ , produce this result.

<sup>17</sup>For the first of these results, notice that a manager with a high  $m$  runs more efficiently her business compared to a manager with low levels of managerial skills. This higher productivity or profitability makes more reliable the promise of repayment and, as consequence, the intermediary can lend a higher amount to the more skilled manager (Figure 7(a)). Second, an improvement in the enforcement of credit contracts (higher  $\eta$ ) increases the loan  $d$ , because even in case of default lenders can regain a larger share of the loan, as shown in Figure 7(b).

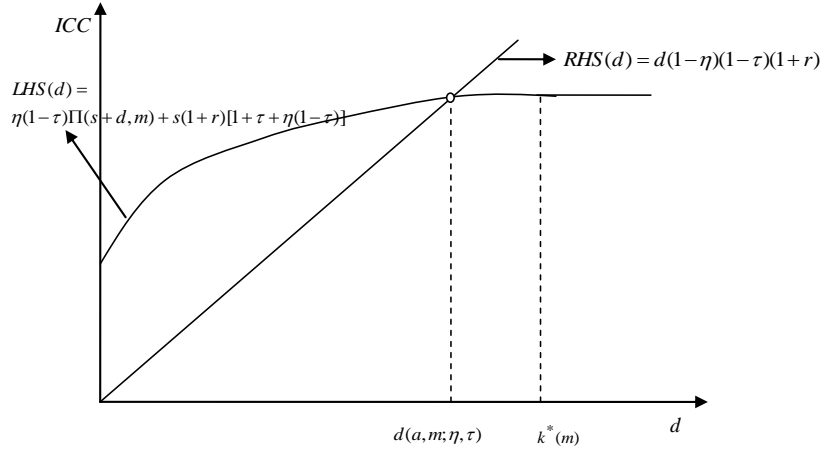


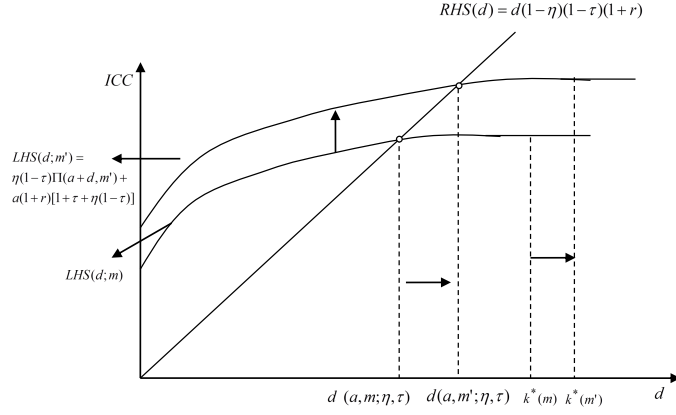
Figure 6: The incentive compatibility constraint (ICC) and the demand for loans.

Finally, in the model economy while formal entrepreneurs are able to borrow from financial intermediaries, informal managers are not able to do so. This result follows from the fact that for informal managers  $\eta = \tau = 0$ . As a result, the constraint (3) becomes  $0 \geq d(1+r)$ . Therefore, informal managers must self-finance the physical capital they use in their operations with their savings from the first period.

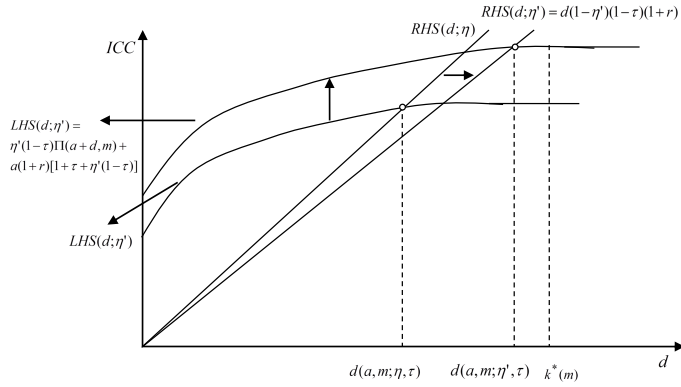
## 4.2 Occupational and educational choices

Given a set of parameter values that produce an equilibrium with a positive mass of individuals choosing each one of the six possible occupations, the order of the cutoffs over the support of innate ability ( $z \in [0, 1]$ ) can be characterized. First note that given that the equilibrium requires the use of at least some amount of unskilled labor, and because the value for unskilled workers is independent of  $z$ , it has to be that the less talented individuals choose to be unskilled workers. Furthermore, since  $m$  and  $k$  are complementary, managers with the highest levels of managerial ability will choose the formal sector to operate their businesses. Finally, for any  $z$  higher than the cutoff from which entrepreneurs switch from the formal to the informal sector, all managers will also be formal, that is, managers will not revert their sector decision.<sup>18</sup> On the other hand, individuals that were born with

<sup>18</sup>If a manager of ability  $z$  accepts to pay taxes in exchange of getting access to the credit market, then a manager with a higher ability ( $z' > z$ ) will also prefer to do so, because of the complementarity between ability and physical capital.



(a) Loan increasing in  $m$  ( $m' > m$ ).



(b) Loan increasing in  $\eta$  ( $\eta' > \eta$ ).

Figure 7: Characterization of the demand for loans.

very high levels of ability (those with  $z \rightarrow 1$ ) will choose not to invest in their own human capital, i.e., they will choose to be formal unskilled managers.<sup>19</sup> Hence, it is possible to characterize the occupations in the lower tail (unskilled worker) and in the upper tail (formal unskilled manager) of the distribution of innate ability.

For the rest of the occupations, it is important to note that skilled informal managers need to be abler than unskilled informal managers. Since acquiring education is costly,

<sup>19</sup>This is a result of the shape of the technology for human capital formation (stated in equation (1)), in which for  $z \rightarrow 1$  the contribution of education to increase  $m$  is close to zero. Anecdotally, one can think in Bill Gates or Steve Jobs as two examples of highly productive and formal entrepreneurs that are college dropouts.

only abler individuals among informal managers will find profitable to invest in their own human capital.<sup>20</sup> As a result, we end up with four possible configurations of the occupational cutoffs. In these four cases the bottom part of the distribution of  $z$  is occupied by unskilled workers, while in the top there are unskilled formal managers. Each case differs in where the mass of agents that choose to be skilled workers is located. The first case is represented in Figure 8, and the other three cases can be found in Figures 11, 14, and 17 in the Appendix.<sup>21</sup>

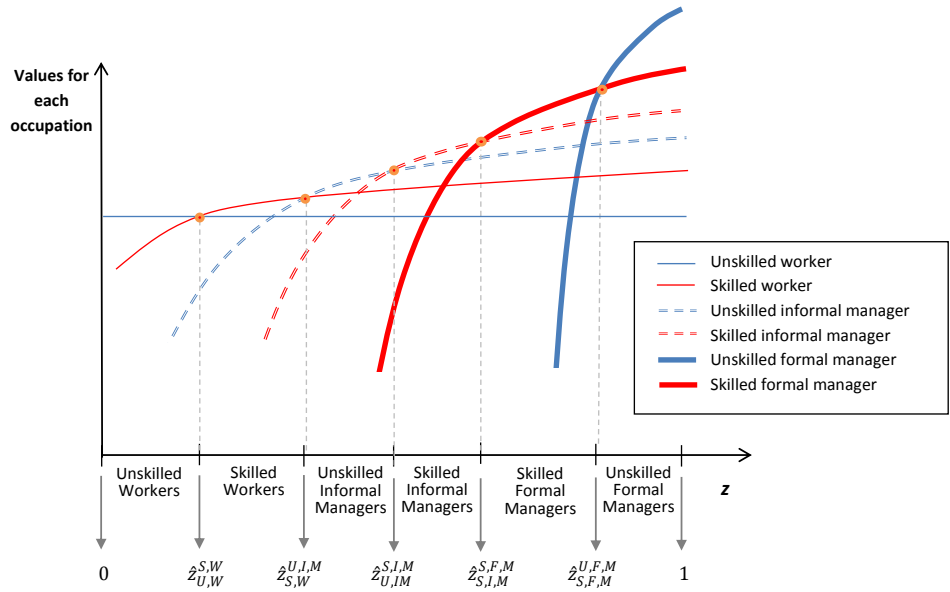


Figure 8: One plausible configuration of occupational, educational, and sector choices along the support of  $z$ .

<sup>20</sup>This is true as long as informal managers are not too able, that is, as long as they lie in the “middle” of the support for innate ability. This condition is likely to be fulfilled because both types of formal managers (skilled and unskilled) have higher levels of innate ability  $z$ , and therefore they lie closer to 1 in the support of  $z$ .

<sup>21</sup>The notation used for the cutoffs identifies with a subscript the previous occupation and with a superscript the following occupation in the support of  $z$ . In Case 1 the order of the cutoffs is:  $\hat{z}_{U,W}^{S,W}$ ,  $\hat{z}_{S,W}^{U,I,M}$ ,  $\hat{z}_{U,I,M}^{S,I,M}$ ,  $\hat{z}_{S,I,M}^{S,F,M}$ , and  $\hat{z}_{S,F,M}^{U,F,M}$ . In Case 2, the order is:  $\hat{z}_{U,W}^{U,I,M}$ ,  $\hat{z}_{U,I,M}^{S,W}$ ,  $\hat{z}_{S,W}^{S,I,M}$ ,  $\hat{z}_{S,I,M}^{S,F,M}$ , and  $\hat{z}_{S,F,M}^{U,F,M}$ . In Case 3 the order is:  $\hat{z}_{U,W}^{U,I,M}$ ,  $\hat{z}_{U,I,M}^{S,I,M}$ ,  $\hat{z}_{S,I,M}^{S,W}$ ,  $\hat{z}_{S,W}^{S,F,M}$ , and  $\hat{z}_{S,F,M}^{U,F,M}$ . Last, in Case 4 the order is:  $\hat{z}_{U,W}^{U,I,M}$ ,  $\hat{z}_{U,I,M}^{S,I,M}$ ,  $\hat{z}_{S,I,M}^{S,F,M}$ , and  $\hat{z}_{S,F,M}^{S,W}$ .

## 5 The effects of higher costs of contract enforcement

We are now ready to analyze the effects of higher contract enforcement costs. When the cost of enforcing contracts is higher, the demand for credit of formal managers is lower (see Figure 7(b)), so is the use of capital in their operations. However, the use of capital of informal managers is not directly affected, since they self-finance the amount they pay for the services of physical capital. Therefore, through this channel, a moderate increase in the cost of enforcing contracts (lower  $\eta$ ) will induce a fall in the value obtained by formal managers, and at the same time this will first leave unaffected the values obtained by informal managers (both skilled and unskilled).<sup>22</sup> Moreover, since formal managers use more intensively skilled labor -due to capital-skill complementarity in the production function-, in a scenario with higher costs of contract enforcement the demand for skilled labor will be reduced, which in equilibrium will imply lower relative earnings for skilled versus unskilled workers. These two are the key mechanisms at work when  $\eta$  falls, and they are illustrated in Figure 9 as movements in the values of formal managers and skilled workers. Of course, these are the first effects that are triggered, and in the general equilibrium the values for the rest of occupations will also be affected. However, the changes in the values of formal managers and skilled workers are of first order and will likely quantitatively dominate. In addition, the key results obtained below regarding changes in occupations and educational attainment of  $z$ -type agents will be preserved when adding these subsequent -general equilibrium- changes in the values of other occupations.<sup>23</sup>

As shown in Figures 9 and 10<sup>24</sup>, these key movements of the value functions produced by a higher cost of enforcing contracts (lower  $\eta$ ) will increase the number of entrepreneurs acting in the informal sector.<sup>25</sup> Hence, in the model economy there is a direct mapping between the cost of contract enforcement and the number of informal entrepreneurs.

<sup>22</sup>Notice for instance that  $W(a(z), m(z); \eta, \tau)$  is increasing in  $\eta$  (see Figure 7(b)) while  $W(a(z), m(z); 0, 0)$  is independent of  $\eta$ .

<sup>23</sup>For instance, the values of informal managers are likely to be improved due to the lower  $w_s$  paid to skilled workers.

<sup>24</sup>Notice that these figures omit considering the underlying distribution of  $z$ -types, which is needed to properly count the shares of individuals who choose one or the other occupation or educational level. One way to easily incorporate in these Figures the distribution of  $z$  is to assume a uniform distribution. But the results hold true for other well-behaved (unimodal) distributions as well.

<sup>25</sup>While  $\hat{z}_{S,W}^{U,I,M}$  is reduced,  $\hat{z}_{S,I,M}^{S,F,M}$  is increased, leading to this result.

Moreover, the cutoff for becoming an entrepreneur will decrease (lower  $\hat{z}_{S,W}^{U,I,M}$ ) when  $\eta$  is lower, i.e., when the level of informality in the economy raises. As a result, in an economy with equilibrium cutoffs as those in Figure 8, an increase in the costs of contract enforcement will induce not only a larger proportion of informal entrepreneurs, but also a larger number of entrepreneurs, amplifying the rate of entrepreneurship in the economy. This observation is consistent with the empirical fact 1 (Figure 2) that shows that countries with larger informal sectors also have larger shares of their labor force in entrepreneurial activities.

Furthermore, note that since there is no reason to think that the value obtained by skilled informal entrepreneurs will be lower if  $\eta$  falls (in fact, this value is likely to increase due to lower salaries paid to skilled labor), their skill premium will not be negatively affected. Since the salaries of skilled workers are now relatively lower because they are less demanded, then the difference in the skill premium of entrepreneurs and of workers changes, favoring more the entrepreneurs the lower is  $\eta$ . This result is consistent with the empirical fact 2 (Figure 3(b)) that shows that the gap between the premium received by skilled informal entrepreneurs and skilled workers is increasing with the importance of the informal sector in the economies.

A final remark about the effects of a lower value for parameter  $\eta$  is in order. As it was stated above, when costs of enforcing contracts increase less individuals choose to be skilled workers. The opposite occurs with the number of individuals who choose to be skilled informal managers. Moreover, the aggregate number of skilled managers, either formal or informal, does not decrease when  $\eta$  is reduced. Therefore, the share of skilled individuals that choose to become entrepreneurs in this economy increases when the enforcement of contracts becomes more costly. This result is related to the empirical fact 3 (skills are relatively more concentrated among entrepreneurs the more informal the economies are), which is shown in Table 1 and Figure 4.

Analyzing the effects of higher costs of enforcing contracts for the other three possible configurations of the occupational cutoffs produces similar results, which are detailed in the Appendix (Figures 12, 15, and 18).



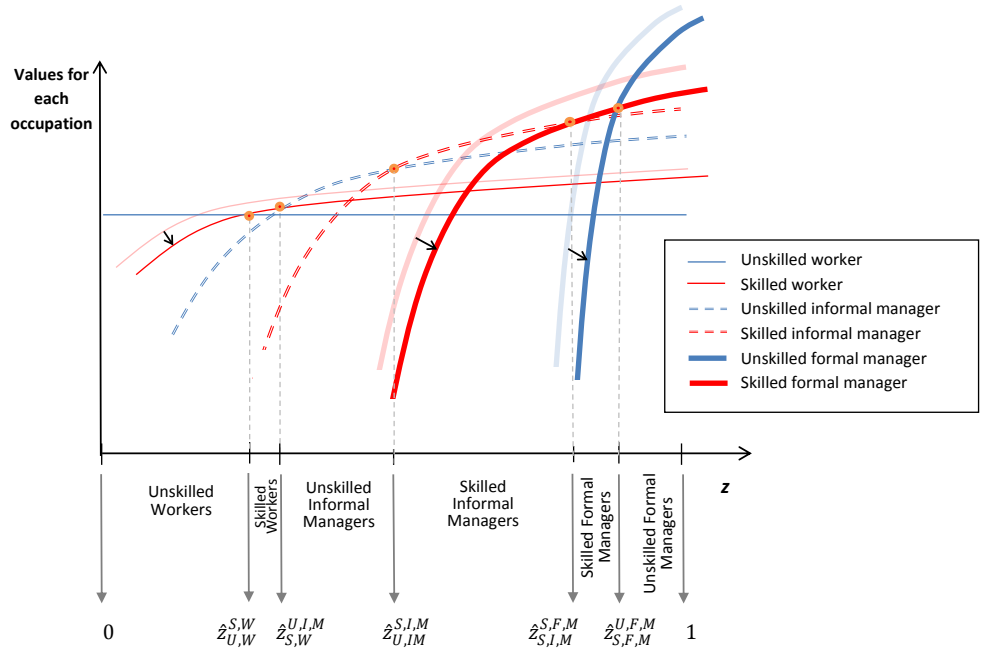


Figure 9: Changes of the cutoffs for occupational, educational, and sector choices along the support of  $z$  for higher costs of enforcing contracts (a lower  $\eta$ ).

## 6 Conclusions

Informality is pervasive in many developing countries, and its effects range from harming credit, reducing the stock of available physical capital, segmenting labor markets, depriving large shares of population from labor rights, and, as shown in this paper, to also affect the incentives to invest in human capital across different occupations, as well as occupational choices themselves. In the current paper, the key mechanism producing these effects is also related to the impact of informality on the extent of financial intermediation and, as a result, on the use of capital in the production of goods and services.

This paper offers an analytical framework that is able to connect different empirical facts that *a priori* seem unrelated. In particular, these facts show a strong link between the extent of informal activities, the rate of entrepreneurship, and the distribution of educational attainment across occupations. More informal economies not only have more entrepreneurs (many of them are the so called 'subsistent' entrepreneurs), but are also characterized for paying relatively more to skilled entrepreneurs than to skilled workers,

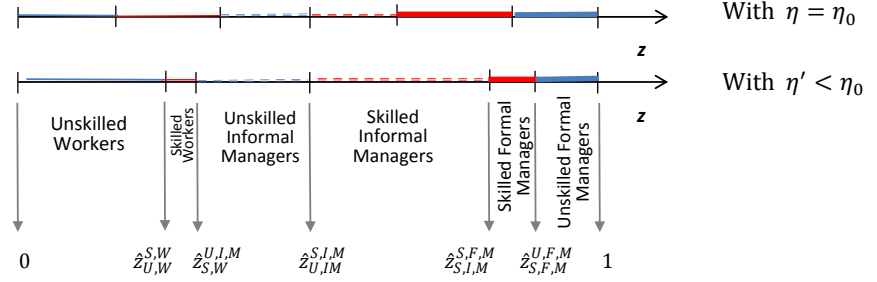


Figure 10: Occupational cutoffs for two values of  $\eta$  ( $\eta_0$  and  $\eta'$ , with  $\eta_0 > \eta'$ ).

as compared with more formal economies. Also, in informal (less developed) economies the relatively scarce stock of skills is more concentrated among entrepreneurs. The model presented here links all these facts to the idea that the higher are the costs of enforcing contracts -in particular, credit contracts- the higher will be the extent of the informal economy, and there will exist more incentives to becoming an entrepreneur instead of a worker and to invest in human capital only if you are an entrepreneur and not so much if you are a worker.

The mechanisms at work start to operate through financial intermediation. When the costs of enforcing contracts are higher, financial intermediaries are reluctant to lend much money, and formal entrepreneurs (who are not excluded from the credit market) are more financially constrained and, therefore, less capable of hiring physical capital to operate their businesses. Since the technology features capital-skill complementarity, this implies that formal entrepreneurs will demand less skilled workers, who in the new equilibrium for the labor market will be paid lower salaries. On the other hand, these changes in the market for credit will not impact directly those entrepreneurs acting in the informal sector, since they were already excluded from the possibility of being externally financed. However, some entrepreneurs will now not only be more inclined to act in the informal sector, but to also to invest 'in themselves'. That is, some individuals who otherwise

would have chosen to be formal entrepreneurs, under higher costs of enforcing contracts will choose to act informally and also to spend time and other resources in the formation of their own human capital, as way to overcome the lack of physical capital. This happens because in the model economy the investments in human capital increase managerial skills, which improve the overall efficiency of the productive unit.

Therefore, more informality implies a different distribution of skills across occupations and sectors of activity, because it incentivizes investments in human capital of some managers, but it causes the opposite effect for workers. Importantly, informality affects crucially the occupational choices of individuals, making some of them to change their decision regarding being a worker or an entrepreneur, and also regarding in which sector of the economy to operate for the case of entrepreneurs.

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## 7 Appendix

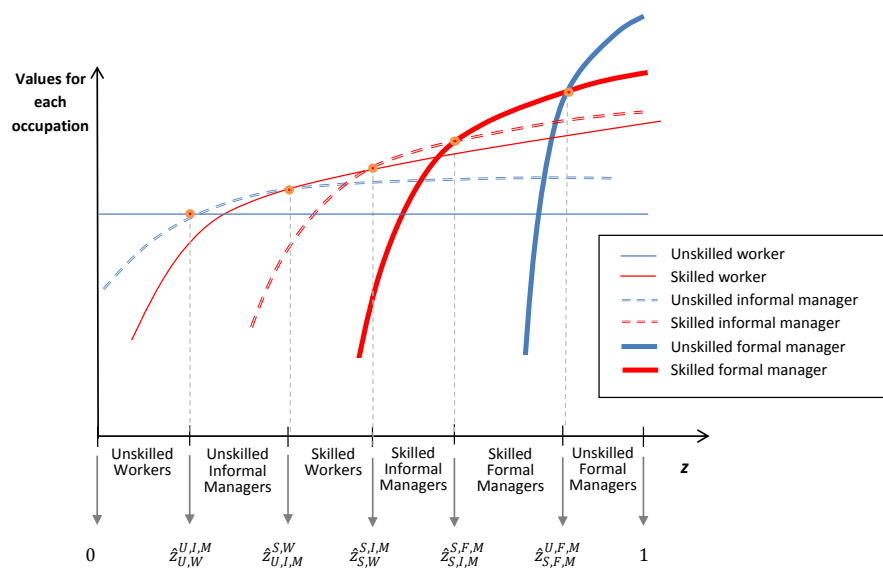


Figure 11: Case 2: Cutoffs for occupational, educational, and sector choices along the support of  $z$ .

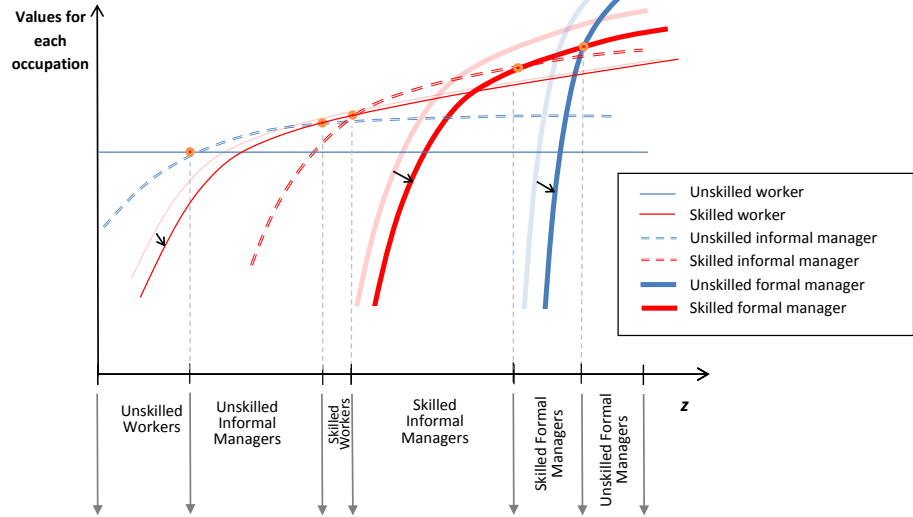


Figure 12: Case 2: Changes of the cutoffs for occupational, educational, and sector choices along the support of  $z$  for higher costs of enforcing contracts (a lower  $\eta$ ).

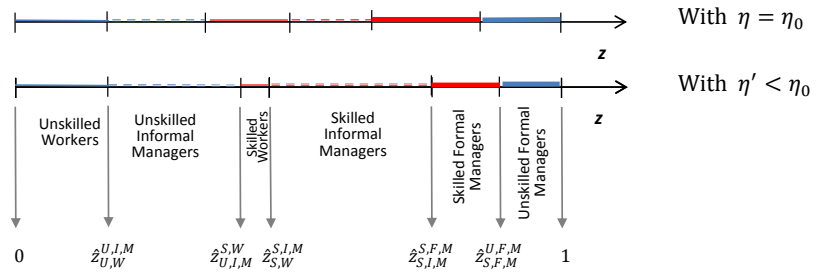


Figure 13: Case 2: Occupational cutoffs for two values of  $\eta$  ( $\eta_0$  and  $\eta'$ , with  $\eta_0 > \eta'$ ).



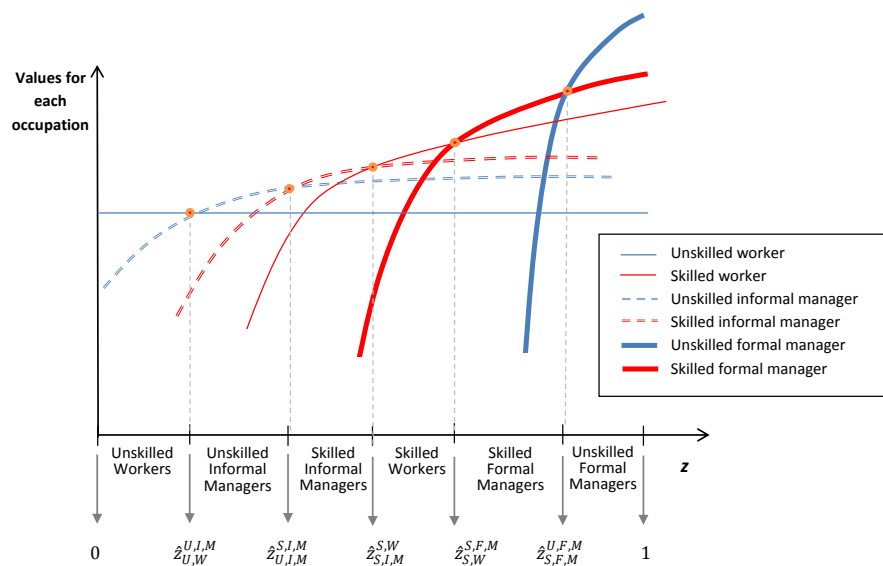


Figure 14: Case 3: Cutoffs for occupational, educational, and sector choices along the support of  $z$ .

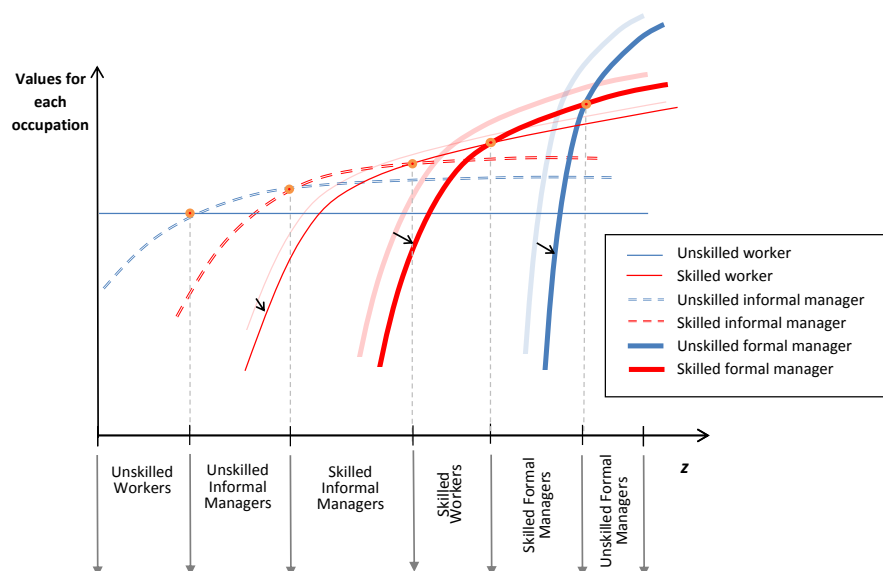


Figure 15: Case 3: Changes of the cutoffs for occupational, educational, and sector choices along the support of  $z$  for higher costs of enforcing contracts (a lower  $\eta$ ).

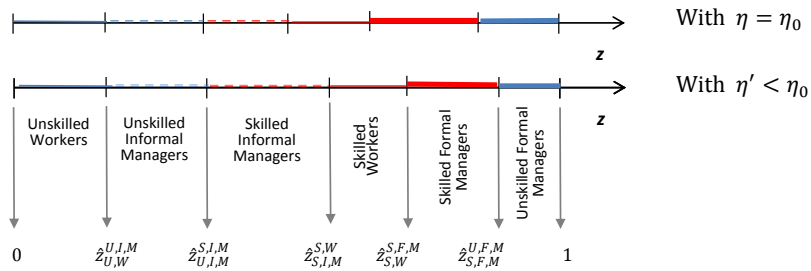


Figure 16: Case 3: Occupational cutoffs for two values of  $\eta$  ( $\eta_0$  and  $\eta'$ , with  $\eta_0 > \eta'$ ).

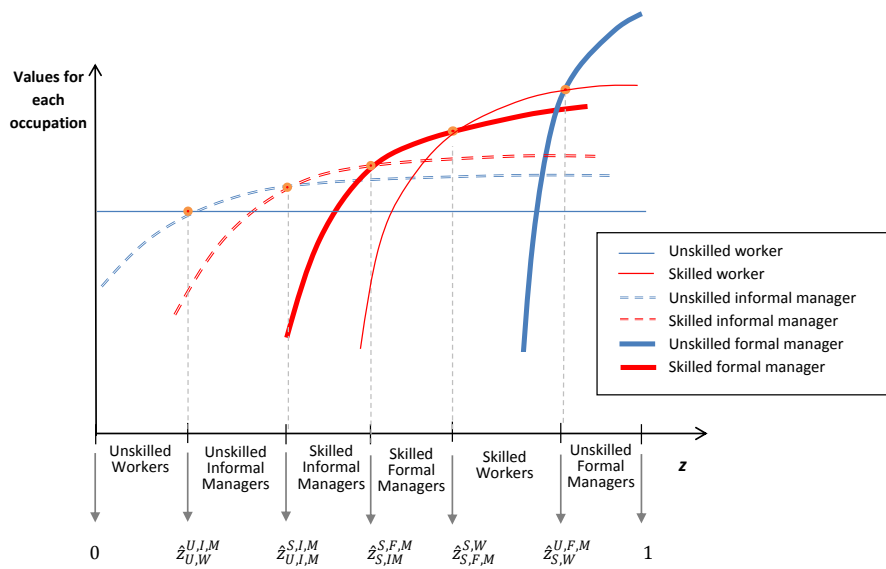


Figure 17: Case 4: Cutoffs for occupational, educational, and sector choices along the support of  $z$ .

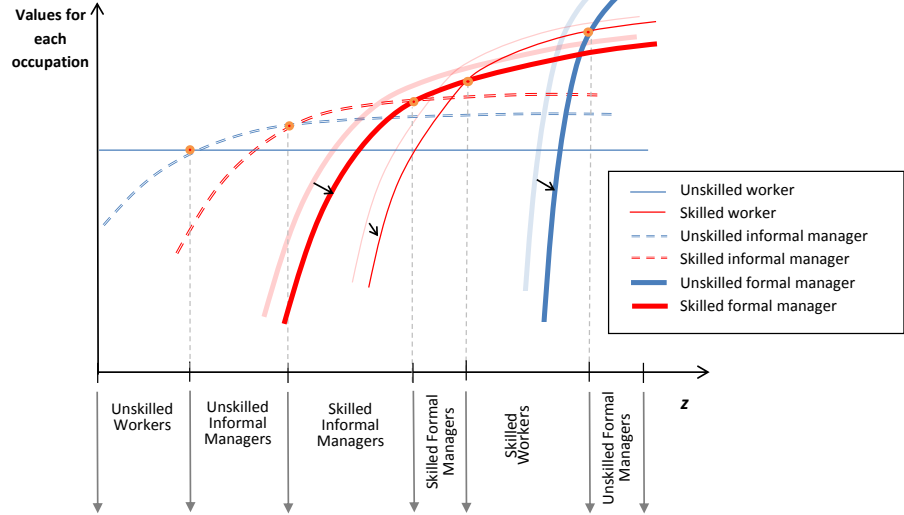


Figure 18: Case 4: Changes of the cutoffs for occupational, educational, and sector choices along the support of  $z$  for higher costs of enforcing contracts (a lower  $\eta$ ).

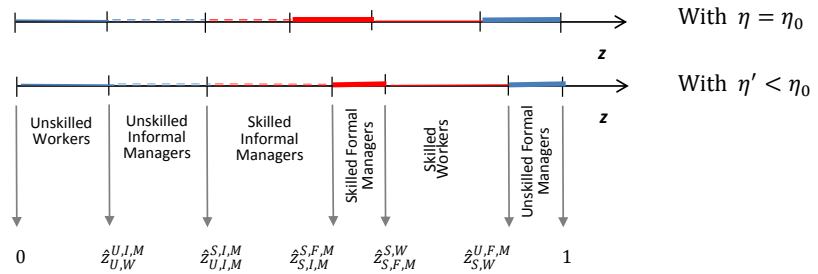


Figure 19: Case 4: Occupational cutoffs for two values of  $\eta$  ( $\eta_0$  and  $\eta'$ , with  $\eta_0 > \eta'$ ).