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CIDE

FORMALIZATION OF INFORMAL EMPLOYMENT

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PRESENTA

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*Es a quienes quieran descubrir un mundo nuevo,
saltando todas las barreras de sus áreas especializadas.*

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# Summary

*I analyze mechanism of the firm's formalization using occupational choice model with the focus on human capital factors and firm size. Using an equilibrium matching problem on the profit maximization of a representative firm, I find that there is a positive assortative matching with regards to the firm's technological characteristics and manager abilities which the firm will employ. Using the result of the positive assortative matching on firm's technology and managing skills in the equilibrium, I show that the optimum firm size possesses discontinuity in managing skills so that an informal firm may produce more employment than a formal one. The reduction of financial burdens required in the formal sector does not contribute to increasing the formal employment, even when the formalization is the optimum decision made by a firm.*

*Key words: Occupational choice; Market design; Matching; Positive assortative matching; Labor informality*

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# Chapter 1

# Introduction

The labor informality in Mexico is one of the important issues keeping Mexico from improving its labor productivity and thus from enjoying sustainable economic development. Since a firm in the informal sector does not have access to the financial market, it becomes more difficult to prepare financial resources for improving their productivity, such as introducing more efficient physical capitals or more competitive human resources. In spite of this clear disadvantage that the informal sector has, the labor market in Mexico has been facing high rate of the labor informality rate: Around the $50\%$ of total labor forces in Mexico are working for the informal sector, and some $22\%$ of annual GDP derives from the informal sector.

The formalization problems has been an important issue for more sustainable development of emerging economy, and thus there have been formalization programs as well as empirical analysis of formalization effects. Usually the analysis is based on the reduction of the costs which are considered as burden for the formalization such as high payroll taxation or difficulty in registration of firms. However, this perspectives did not always demonstrate significant effects on improving formalization of informal firms, just as Ulyssea (2020) mentions.

In this thesis I analyze formalization problems from the viewpoint of production. In my

model, each firm faces the choice between being formal and informal. Being in the formal sector provides the firm with access to a more efficient technology; however at a higher cost, e.g, social security contributions.

I analyze a model wherein firms, heterogeneous with respect to capital, are matched endogeneously with managers of heterogeneous ability. Both firm capital and managerial ability the total factor productivity (TFP). In a formal firm, at a given level of capital and managing ability, TFP is higher. However a formal firm faces a higher cost of employing a given level of workers. Then the decision of formalization requires trade off. The result says that there is a positive assortative matching because firm capital and managerial ability are complements. There is a cutoff level of manager's ability below which all firms choose to be informal and above which they choose to be formal. Within each sector both firm output and firm size as measured by labor employment are increasing in manager's ability. While all formal firms produce more output than the informal firms, the equilibrium firm size is discontinuous: There may be an informal firm which is larger than a formal firm even if the formal firm has more capital and higher manager's ability. If the cost required in the formal sector such as social security contribution decreases, the difference in firm size between the formal and informal sector also decreases, as well as the managing skill necessary for the formalization is reduced. While the entry barrier to the formal sector is eased, the reduction of such cost does not eliminate the fact that a formal firm may be smaller than an informal one in firm size. If the manager's skill is limited, then the output is insufficient to compensate a huge cost in the formal sector so that the firm is not able to employ too much workers.

## 1.1  Literature Review

There have been a number of empirical investigations on the labor informality problems in which they intended identifying determinants of the spreading informality. Mainly they have told that

a firm may decide being formal or not, calculating cost and benefit of each case. The formalization will enable the firm to have an access to financial products such as credit or investment, even though it requires taxation duty and social security payment for the employees. On the other hand, in the informal sector, a firm is able to ignore these social obligations and obtain labor flexibility which may be more beneficial for the administrators than in the formal sector.

In my research, I am interested in analyzing productive side because last empirical analysis with the focus on reducing cost did not always provide significant effects of reducing formalization cost on provoking incentives for formalization. First I show previous literature based on this cost-side perspectives and I mention why I believe this view is not of my interest. Then, I present some literatures based on the idea of improving productive factors to incentivize formalization of informal employment.

### 1.1.1 Perspectives on the cost of formalization

In order that a firm chooses to be formalized, a number of researchers intended to propose a mechanism which reduces possible administrative burdens such as high payroll taxation, complicated registration of formalizing the firm. However, their results did not necessarily show convincing arguments because the reducing such cost does not provoke more incentives for a firm to formalize itself (Ulyssea, 2018; De Giorgi and Rahman, 2013; Ulyssea, 2020).

Ulyssea (2018) realized empirical simulation for the Brazilian labor market where there is a significant labor informality as well.[1] He found that reducing the taxation rate could decrease the number of informal employments for both of higher and lower skilled people, but at the same time the reduction of the income tax rate does not imply an equivalent reduction of the share of

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[1] According to the statistics published by the organization "World Economics", specialized in data analysis for the development economics, the Brazilian informal economy size as a percentage of GDP counts 33.2% The size of informal economy in Brazil is higher than in Mexico where the informal economy occupies 22% of the total GDP.

informal jobs. The author mentioned a possibility that cutting tax rate may incentive a firm to formalize itself but the formal sector's entry cost would be more influential factor to determine firm's formalization.

Then it is of interest to observe how much the reduction of entry cost to the formal sector contributes to accelerating the labor formalization. Bruhn (2011) used Mexican microdata on measuring effects of the reduction of formalization cost on the number of registered enterprises, that is, formalization of informal employments. The author found that the simplification of registering firms provoked the increase by 5% of the total number of registered business. However, this effect is too small to improve labor formality only by reducing the cost.

De Giorgi and Rahman (2013) also reported no significant results of positive correlation between simplified transmission of information about business registration and increase in the formalization of informal firms in Bangladesh. Then it is too early to articulate that reducing the entry cost to the labor formalization means improvement of labor formality. De Andrade et al. (2013) did not find a long-term effect of simplification of business registration on the firm's income. If the expected income after labor formalization does not increase, then a firm should not be always willing to accept the formalization no matter how the registration simplified is. Reduction of cost associated with the labor formalization is insufficient to explain the reduction of the labor informality.

### 1.1.2 Perspectives on the productive factors

Then I consider that there should be more variables that will let a firm choose entering formal sector than that related to payroll tax or cost of registering formal business. The variable I propose is one assciated with human capital or educational factors. Dougherty and Escobar (2013) demonstrated that education is a key determinant of informality by using panel Generalized

Method of Moments (GMM) fixed effect estimation for Mexico between 2005 and 2010. Thus investment in education is also worth considering when a policy maker pursues formalization of informal employments. Romanello and Gonçalves (2017) propose that universal education program introduced in Brazil may impulse more labor formalization and thus they insist in that educational aids will function very well as a solution to the increasing labor informality.

The International Labour Organization (ILO) (2014) reported several practices in Mexico of formalization programs for informal firms, and the institution also reported formalization effect between 2010 and 2013. The table 1.1 summarizes the evaluation made by the ILO (2014). Relatively successful results are observed in the states of Nuevo León and Querétaro, in which each local government offered the job training for young labor force and employment for the informal workers in the formal sector. The government of Nuevo León launched "Specific Employment Workshop (JALE)" with the aim to increase the job placement rate of the people registered in the State Employment Service and to train them job skills without charge. The program "Employment for Youth" set scholarships in order to finance young population aged 16 to 29 without work experience, and it paid the first month's salary to the companies that hire such young people. The 2885 of 4000 members of the program were able to obtain formal employment in 2013 (ILO, 2014). In Querétaro, the government promoted a transportation program "Q Network" so as to increase transportation efficiency, employing 2000 people in the informal sector to formalize them as driver.

Table 1.1: Programs for formalization in some Mexican states and their effect

| States | Effective practice | Changes in the informality rate |
|---|---|---|
| Chihuahua | Vivebus and university advisors | -4.8 |
| Mexico City | Unemployment insurance | 0.9 |
| Hidalgo | Tuzobus employing 400 formal workers | -2.5 |
| Nuevo León | JALE, Employment for Youth | -3.3 |
| Querétaro | Q network | -4.4 |

Source: The information is available on the page 9, ILO (2014)

The reduction of labor informality can be archived if the government implements job training aid or it produces directly formal employment for the people working for the informal sector. However, it inevitably means a large amount of public investment and thus sustainable public finance for a long period because it is difficult to train a person in a short time. The monetary cost and enormous time may make a small firm less interested in formalization. In this sense, three years of observation may not be sufficient to determine that an increasing human capital determines more incentives of formalization.

Some possible extensions on these two papers are proposing and proving hypothesis in which the labor informality rate will decrease if a firm receives more educational resources. If the human capital is a determinant factor of explaining labor informality, one may have an idea that access to more educational resources induce labor formalization. In order to prove this thesis, first a theoretical argument is required to describe why education promotes labor formalization. Berniell (2017) implemented occupational choice model with human capital investment and the author demonstrated that there is a informal firm owner interested in acquiring more managing skills in order to survive in the informal sector. From this conclusion, I see a possible extension of arguing formalization of the firm because such a firm owner should be willing to internalize higher managing skills, with the productivity sufficiently increasing. Then staying informal may not be optimal choice for maximizing its benefit because the informality limits the productivity growth.

# Chapter 2

# Descriptive statistics

In this chapter, I will argue the relevance of management of determining the informality in Mexico using actual data observed in this country. The data used for my research is collected from the National Institute of Statistics and Geography (INEGI), Data Mexico administrated by the Government of Mexico, Mexican Economic Census 2019. Since the data of the capital stock by state is only available for 2013, I used the data of share of capital stock for Gross Domestic Product (GDP) in 2013 and state data of GDP in 2018 to impute the data of capital stock for 2018, assuming that the share of capital stock of GDP is constant. The table 2.1 sums up the information about the data used for this research.

Table 2.1: Information about the data used for the analysis

| Variable name | Information | Unit | Data source |
|---|---|---|---|
| Informality Percentage | Labor informality rate accounting for the labor forces, observed in 2018. | Percentage | Data México (2022a) |
| Years of education | Average years of education in each state of Mexico, observed in 2015. | Years | INEGI (2022a) |
| Rate of trained personals | The rate of capacitated employees in a firm | Percentage | INEGI (2019) |
| Rate of expenditure for personnel training | The expenditure rate of a firm in training | Percentage | INEGI (2019) |
| Capital stock | Observed in 2013, with which I simulated values for 2018. | Millions of Mexican pesos | INEGI (2018) |
| Labor hours | Observed in each state of Mexico, 2018 | Thousand hours | INEGI (2022b) |

The figure 2.1 shows the magnitude of correlation between all the variables used. As the color of each cell is more clear, it means that there is more substantial correlation between the variables. I find that the variables related to years of education, the rate of trained personals,

Figure 2.1: Correlation between the labor informality and variables related to production
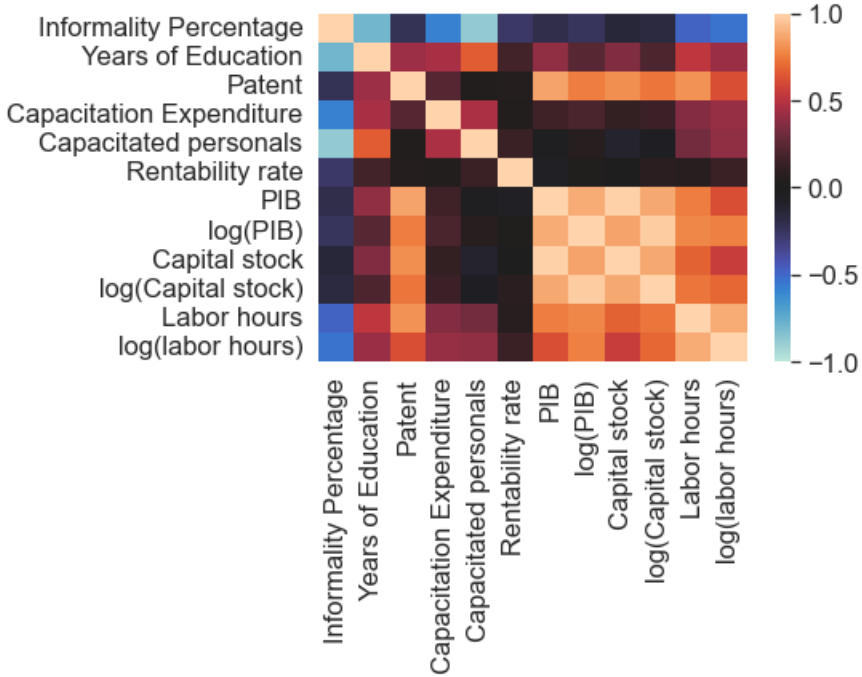
and the rate of expenditure for personnel training demonstrate relatively higher correlation with the informality rate among all the variables. Furthermore, these variables are closely related to human capital factors, so that it may let me define the variable of human capital used for my model. Then they are the variables of my interest.

First I start with analyzing relevance of years of education to the informality share to the total labor forces in Mexico. The figure 2.2 is a scatter-plot which describes the correlation between average years of education and informality rate observed in all the Mexican states. Note that it is easy to observe a negative correlation between years of education and informality rate across all the Mexican states. This fact may imply that the human capital is closely related to the improvement of the labor informality, as Dougherty and Escobar (2013) have mentioned once. Intuitively, if you choose to be educated more years, this leads you to enjoy opportunities to acquire more sophisticated skills for the labor market. If you are willing to own business you

Figure 2.2: Scatter plot of education period, number of patents and labor informality rate by state level
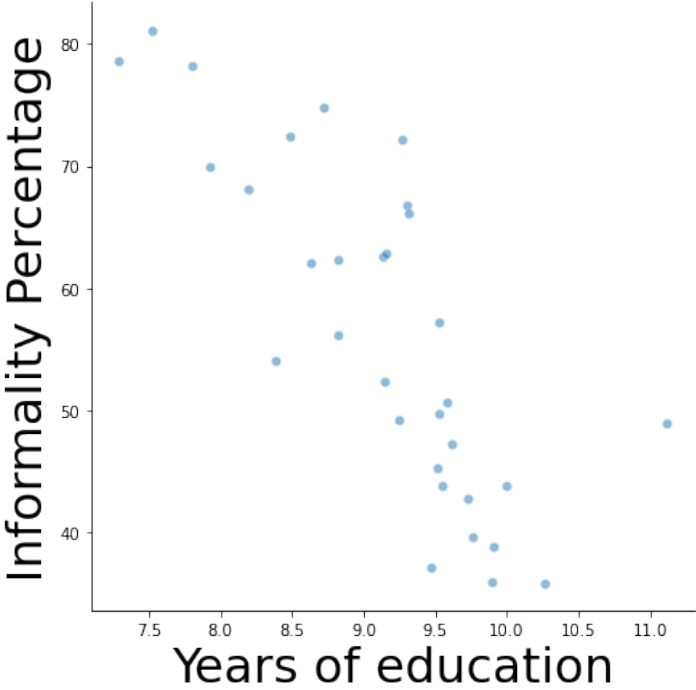
will be able to implement a more productive business. In this sense, the decision of choosing formal or informal sector depends on what and how much you have learned before engaging in a business.

Since the data of years of education treats average years of education which the residents in average has received, firm owners can possess heterogeneity in educational background. Such heterogeneity is worth considering as component of the variable for the human capital factor, because it differentiates well the difference of informality rate among the Mexican states.

The figure 2.3 captures correlation between the rate of trained personnel in an average firm and the informality in each Mexican state. The data is average value of trained personnel in a representative firm in each Mexican state. It is easy to observe a negative correlation, as the relationship between the years of education and labor informality is. If the rate of trained personnel

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Figure 2.3: Scatter-plot and correlation between the informality rate and the percentage of trained personals
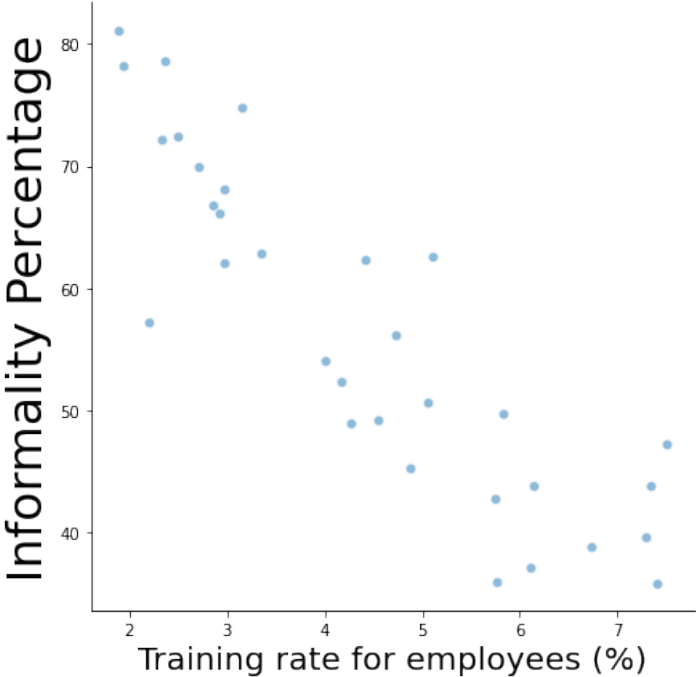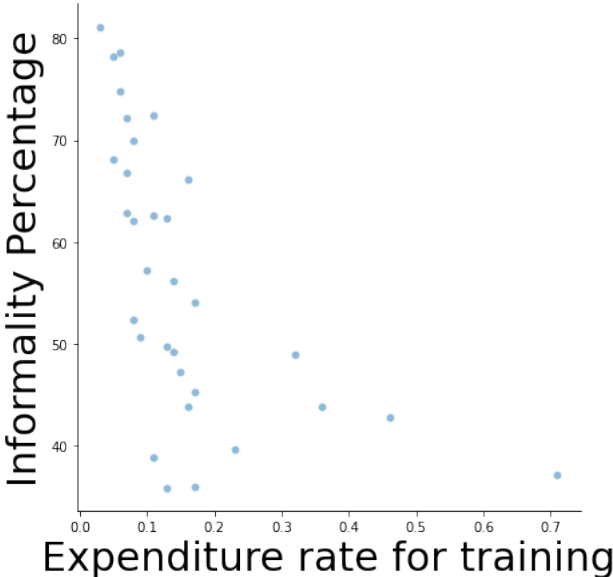


Source: Own elaboration using data of Data México (2022a) and INEGI (2019)

increases, it may contribute to the improvement of labor productivity of a firm. An increasing productivity can provide the firm with more productive operations and thus more economic competitiveness.

The figure 2.4 indicates that the expenditure to train personnel possess negative correlation against the informality rate. The expenditure rate for training is observed in every size of firms in each Mexican state, and I computed a average expenditure rate of a representative firm in each state. The data shows how much investment the representative firm realize for personnel or owners themselves. The expenditure for training personnel may be associated with how much a firm is willing to train personnel. If a firm size is larger, the firm may have more flexibility to realize investment in training employees or owner.[2]

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[2] Note that the effect of the training expenditure to the informality may vary among the economic sectors. For example, the states with less informality rate locate in the northern part of Mexico where there is a dense concentration of transnational manufacturing. This sector usually employ engineers or sales persons with higher

Figure 2.4: Expenditure rate for training personnel and informality rate



Source: Own elaboration using data of Data México (2022a) and INEGI (2019)

The figure 2.5 shows difference of wage levels in the formal sector from the counterpart in the informal sector for 12 years. In whole the observed period, the wage level in the formal sector is superior to that in the informal sector. There is a significant difference in wage level by 50%, which may also reflect gap in productivity between the formal and informal sector, supposing equilibrium condition in which the wage level is equivalent to the labor productivity.

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human capital skills, so that more talented workers match to the formal industries. On the other hand, if there is few enterprises requiring high skills, the training does not always make sense for reducing informality because there is little employment for people with higher human capital level.

Figure 2.5: Wage gap in formal and informal sectors
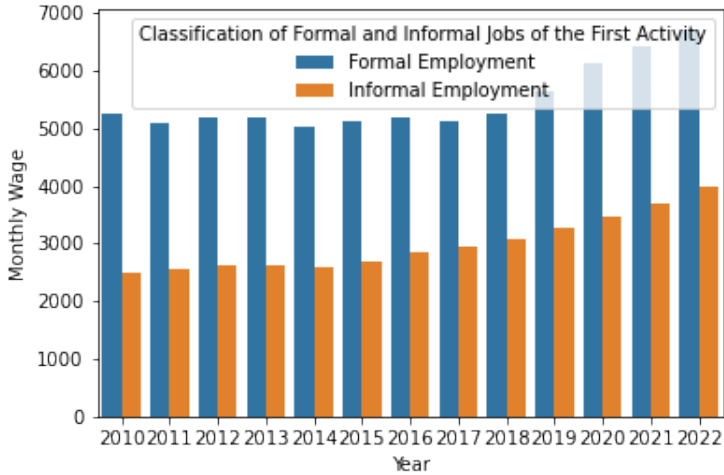


Source:Own elaboration using data cited from Data México (2022b)

# Chapter 3

# The model

Suppose that there is a representative firm whose goal is to maximize the profit. For simplicity, I suppose that the economy is competitive, with little product differentiation, just as an informal economy is. The firm is able to utilize labor forces and total factor productivity to produce certain level of production. Since the model treats firm's behavior, I propose comparative analysis on the firm's benefit in both of formal and informal sectors: If the benefit in the formal sector is larger than in the informal sector, the firm should be willing to enter the formal sector. I propose two different production functions respectively for the formal and informal sector, due to the evident difference of productivity between the two sectors. Such difference consists in the contribution of the variables related to the capital stock and human capital factors for the production between the formal and informal sector.

## 3.1   Technologies of the formal and informal sectors

Let $y_j$ production function of the sector $j$ (F: formal sector, I: informal sector) defined in following ways. Let $A_j$ total factor productivity (TFP) in the sector $j$ and $l$ labor forces. Here the labor forces possess decreasing return to scale for output so that the variable has a concave function form. Suppose that $z, m$ are firm capital and manager's skill respectively. This setting is case

with either formal or informal firm:

$$y_j = A_j(z, m)\sqrt{l} \tag{3.1}$$

where $A_j$ is TFP in the sector $j$ that depends on $z, m$. Note that a Cobb-Douglas production function contains the complementary relationship among inputs. In the formal sector, the TFP is given by

$$A_F = zm,$$

while the TFP of the informal firm is

$$A_I = \sqrt{zm}$$

## 3.2   Choice of organization of a given firm

Now that I obtained the functional form of the TFP in each sector, it allows me to define the profit function of a representative j-type firm.

$$\pi_j(l; z, m) = A_j(z, m)\sqrt{l} - c_j l \tag{3.2}$$

where $c_j$ implies the cost required in each labor sector. Let $w$ wage level in either formal or informal sector, and $s$ cost required in the formal sector such as tax, registration cost or social security contributions. Then the cost function $c_j$ has the following structure.

$$c_F = w + s \tag{3.3}$$

$$c_I = w \tag{3.4}$$

Now that I substitute the production and cost function defined as above, the profit maximiza-

tion in both sectors provides the following results:

$$\max_{l} A_j \sqrt{l} - c_j l \tag{3.5}$$

The fist order condition induces the optimum level of $l^*$ such as:

$$l^*(A_j, c_j) = \frac{A_j^2}{4c_j^2} \tag{3.6}$$

Substituting $l^*$, I will obtain the maximized profit function in each labor sector $\pi_j^*(A_j, c_j)$ expressed below.

$$\pi_j(A_j, m) = A_j \sqrt{l^*} - c_j l^* = \frac{A_j^2}{4c_j} \tag{3.7}$$

In particular, any firm will choose being formal if and only if $\pi_F > \pi_I$. This implies that formalization is feasible if and only if $\frac{A_f}{A_I} \geq \sqrt{\frac{c_F}{c_I}}$. Since I assumed that $A_F = zm$ should be larger than $A_I = \sqrt{zm}$, I have a condition such as

$$A_F(z, m) - A_I(z, m) \geq 0$$
$$zm - \sqrt{zm} \geq 0 \tag{3.8}$$
$$zm \geq 1$$

Note that I suppose that $z \in [z_{min}, z_{max}], m \in [m_{min}, m_{max}]$ such that $z_{min} m_{min} \geq 1$. Therefore, I obtain

$$\frac{A_F}{A_I} = \sqrt{zm} \tag{3.9}$$

Then formalization occurs if and only if

$$\sqrt{zm} \geq \sqrt{\frac{c_F}{c_I}} \quad \Longleftrightarrow \quad zm \geq 1 + \frac{s}{w} \tag{3.10}$$

## 3.3 Assortative firm-manager matching

The purpose of this thesis consists in pursuing relationships between increasing human capital and formalization. This aim is feasible if I can show that the profit in the formalization case is larger than in the case of staying informal, given an increasing quantity of the variable $m$. On the other hand, the previous argument is based on the assumption that a formal firm should always have larger quantity of manager's skill than a informal one. To keep the argument clear of a possibility that such assumption is violated, I introduce equilibrium matching methodology which will support existence of positive assortative equilibrium with respect to the capital stock per firm and the manager's skill. The aim consists in demonstrating that a firm with larger quantity of capital stock such as formal enterprise will have higher level of manager's skill than an informal firm, which have less capital stock. I thus require to consider model in which any firm considers employing a manager with certain level of skill, $m$ while maximizing profit.

**Definition 3.3.1.** Let $z$ denote firm capital and $m$ denote manager skill which are distributed uniformly on the interval $[1, b]$. A type-type matching $z = \mu(m)$ is a positive assortative matching if $\mu(m)$ is an increasing function.

An equilibrium matching is a solution to the following maximization problem. Each type-$z$ firm solves

$$\max_z \pi(z, m) - u(m), \tag{3.11}$$

where

$$\pi(z, m) = \max\{\pi_I(z, m), \ \pi_F(z, m)\},$$

and $u(m)$ is compensation for each type-$m$ manager. It is well-known that if the profit function $\pi(z, m)$ has *increasing differences* in $(z, m)$, i.e., for any $z'' > z'$ and $m'' > m'$, it is the case that

$$\pi(z'', m'') - \pi(z'', m') \geq \pi(z', m'') - \pi(z', m'), \tag{3.12}$$

the the equilibrium matching is positively assortative. However, due to the binary choices in each firm which implies $\pi(z, m) = \max\{\pi_I(z, m), \pi_F(z, m), \pi(z, m)$ does not necessarily has increasing differences even if each of $\pi_I(z, m)$ and $\pi_F(z, m)$ has increasing differences in $(z, m)$. Define $\hat{m}(z)$ that is given by

$$\pi_F(z, \hat{m}(z)) = \pi_I(z, \hat{m}(z))$$

Dam, Ripperger-Suhler, and Serfes (2022) show that (a) if both $\pi_I(z, m)$ and $\pi_F(z, m)$ have increasing differences in $(z, m)$, and (b) if $\hat{m}(z)$ decreases with $z$, then the combined profit function $\pi(z, m)$ also has increasing differences in $(z, m)$, and hence, the equilibrium matching is positive assortative. My model satisfies both the aforementioned properties. Therefore,

**Theorem 1.** *No matter what form of organization a firm chooses—formal or informal, a more capitalized firm employs a higher-skill manager following a positive assortative matching pattern.*

Given the sector-specific technologies, in any firm higher manager skill is desirable. However, greater managerial skill is more effective in more capitalized firms (reflected in the increasing differences property). Thus, in equilibrium, more skilled managers are matched with more capitalized firms (positive sorting).

## 3.4 Equilibrium organizational forms

In equilibrium, which firm would choose to be formal and which would stay informal depends on the TFP of each firm, and the relative cost of formality. Write
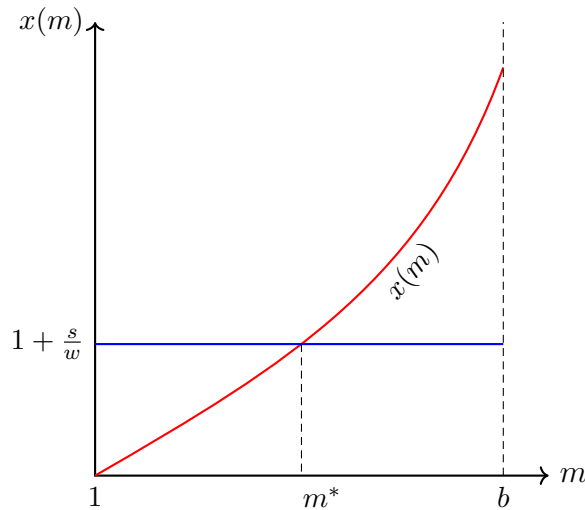
$$x(m) \equiv m\,\mu(m),$$

which is an increasing function of $m$ because both $m$ and $\mu(m)$ are increasing in $m$. Then, condition (3.10) reduces to

$$x(m) \geq 1 + \frac{s}{w}. \tag{3.13}$$

Define $m^*$ that solves $x(m) = 1 + \frac{s}{w}$, which exists and is unique because $x(m)$ is strictly increasing in $m$. This is depicted in Figure 3.1.

Figure 3.1: The threshold level of managerial skill below which all firms are informal.



Source: Own elaboration

Following (3.13), all firms with managerial skill below this cutoff choose to stay in the informal sector. Formally,

**Theorem 2.** *There is a unique threshold value of managerial skill, $m^* \in (1, b]$ such that all firms with managerial skill level $m$ choose to operate in the informal sector if and only if $m < m^*$. The*

*size of the formal sector is given by $G(m^*)$ where $G(\cdot)$ is the cumulative distribution function of $m$.*

Given our assumption that both $z$ and $m$ are uniformly distributed on $[1, b]$, positive sorting implies that

$$G(\mu(m)) = G(m) \implies \mu(m) = m.$$

Thus, $m^*$ is given by

$$m^* = \sqrt{1 + \frac{s}{w}}.$$

The fraction of firms that choose to be informal is given by

$$G(m^*) = \frac{m^* - 1}{b - 1} = \frac{\sqrt{1 + \frac{s}{w}} - 1}{b - 1},$$

which is the size of the informal sector, which is increasing in $s$, the cost of formalization, decreasing in $w$, the worker wage, and decreasing in $b$, the dispersion of managerial skill.

## 3.5   Equilibrium managerial compensation

As I have noted earlier that any type-$z$ firm solves the following maximization problem in order to optimally hire its manager:

$$\max_m \pi_(z, m) - u(m).$$

The first order condition of the above maximization problem yields the following ordinary differential equation:

$$u'(m) = \begin{cases} \frac{\partial \pi_I(\mu(m), m)}{\partial m} = \frac{m}{4w} & \text{if } m < m^*, \\ \frac{\partial \pi_F(\mu(m), m)}{\partial m} = \frac{m^3}{2(w+s)} & \text{if } m \geq m^*. \end{cases} \tag{3.14}$$

Therefore, the equilibrium managerial compensation function $u(m)$ is strictly increasing in managerial skill. Figure 3.2 depict the function $u(m)$. In Figure 3.2, the red curve is the equilibrium

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Figure 3.2: The equilibrium managerial compensation
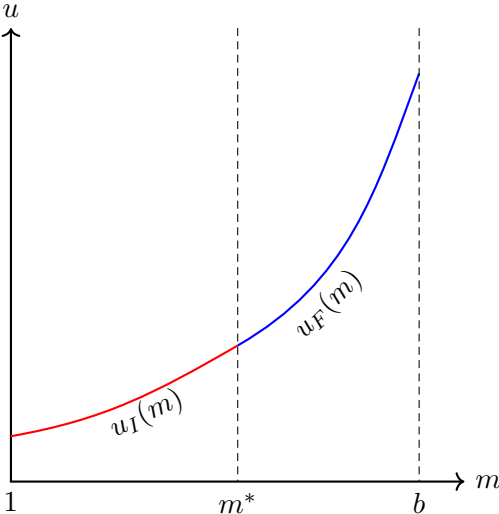


Source: Own elaboration

compensation function for the informal sector, and the blue one corresponds to the counterpart for the formal sector.

**Proposition 3.5.1.** *Equilibrium managerial compensation is increasing in manager skill. Moreover, it is steeper for the formal sector.*

Managerial skill is more effective in enhancing the formal sector TFP, and hence, as manager ability increases, they require a sharper increase in managerial pay. In other words, managerial skill is marginally more valued in the formal sector. This can be interpreted as follows. In the formal sector, firms invest in training of workers to enhance managerial skills. In order to have a unit increase in manager ability, firms in the formal sector not only requires to invest more, but also the investment cost increases at a faster rate.

## 3.6   Equilibrium firm size and productivity

We finally analyze equilibrium firm size as measured by the total employment of labor, $l$, and the productivity which is represented by the aggregate production function, $y$.

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**Firm size.** Following the analysis of the previous section, the equilibrium size of an informal and a formal firm is respectively given by

$$l(m) = \begin{cases} l_I(m) \equiv \frac{m^2}{4w} & \text{if } m < m^*, \\ l_F(m) \equiv \frac{m^4}{4(w+s)^2} & \text{if } m \geq m^*. \end{cases} \tag{3.15}$$

Note that $l_I(m^*) > l_F(m^*)$. This is because the firm with the threshold managerial skill $m^*$, who is indifferent between being informal and formal, would employ more labor while operating with the less efficient production technology as the equilibrium profits from the two technologies are equalized. The equilibrium firm size as a function of manager skill is depicted in Figure 3.3.

Figure 3.3: The equilibrium firm size
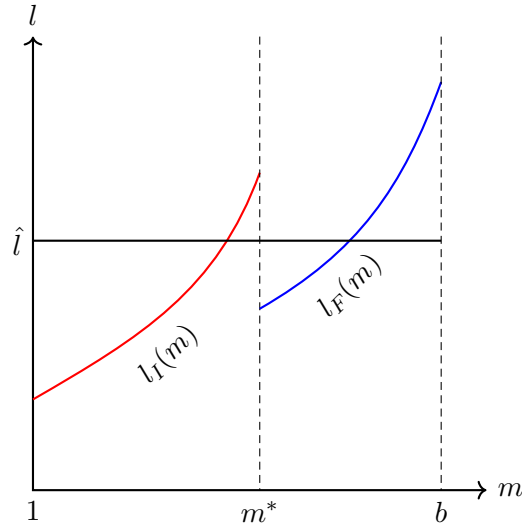


Source: Own elaboration

From Figure 3.3 it is evident that there is a discontinuity in the equilibrium firm size. There is an interesting implication of this result. There exists a formal firm with manager skill $m'' > m^*$ that is lower in size that an informal firm with manager skill $m' < m^*$.

**Proposition 3.6.1.** *There are informal firms that are larger in size than some formal firms.*

From Figure 3.3 and the above proposition, it is evident that we can always find an informal

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and a formal firm of the same size, denoted by $\hat{l}$ in the figure. Clearly, there is a gap between the informal and formal employments of the labor force. In a quest of increasing formality in our stylized economy, this leaves room for policy intervention which I shall analyze later in this chapter.

**Firm productivity.** Firm productivity is sector $j = I, F$ is measured by the output that a firm produces in sector $j$. This is given by:

$$y(m) = \begin{cases} y_I(m) \equiv \frac{m^2}{2w} & \text{if } m < m^*, \\ y_I(m) \equiv \frac{m^4}{2(w+s)^2} & \text{if } m \geq m^*. \end{cases} \tag{3.16}$$

The equilibrium firm productivity is depicted in Figure 3.4.

Figure 3.4: The equilibrium output
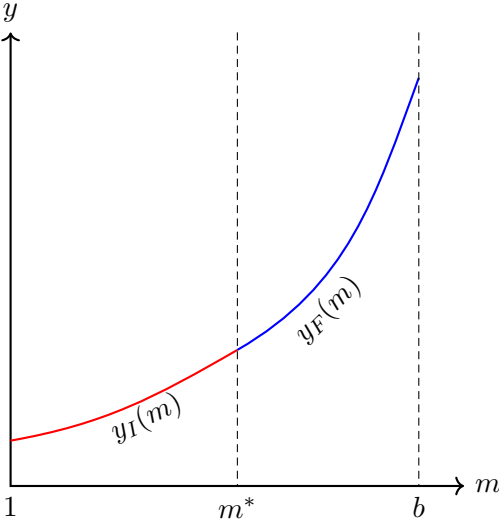


Source: Own elaboration

Equilibrium firm productivity is increasing in managerial skill, $m$. Moreover, any formal firm is more productive than any of its informal counterpart. This is not only because formal firms have a higher TFP, but also in these firms higher managerial skill is more effective in enhancing TFP.

# Chapter 4

# Testable implications

In this chapter, we analyze several testable implications of our stylized model.

## 4.1 Positive assortative matching

The two key variables for any firm for the sectoral choices are firm capital, $z$ and managerial skill, $m$. In this section, I use Mexican data with which I can evaluate the implications of the result on equilibrium matching. To this end, I make use of the labor market data of the National Institute of Statistics and Geography (INEGI) and the National Survey of Occupation and Employment(ENOE, 2022). Since the data on capital stock of each firm is not accessible directly, I compute capital stock per capita which should reflect how much productive each agent is. The data of the effective population is available in ENOE.

The analysis of the descriptive data in the chapter 2 provided several facts that educational variables are influential variables for the labor informality rate. In order to identify human capital factors, I consider that GDP per capita should be signal for the variable $m$. Letting $e$ and $y$ imply years of education and GDP per capita individually, I define $m$ as

$$m = log[educ * log(y)] \tag{4.1}$$

Figure 4.1: The empirical relationship informality and equilibrium matches $(z, m)$.
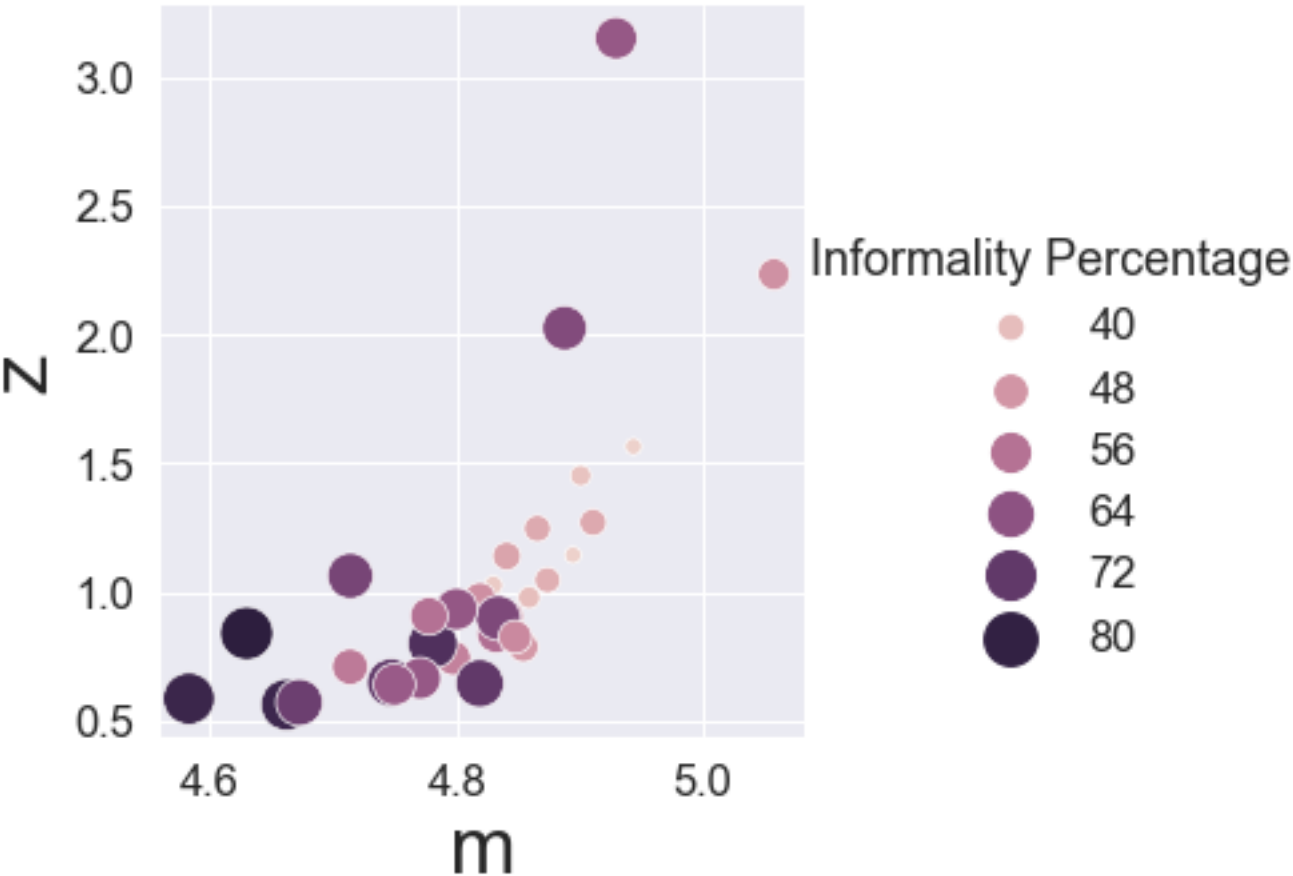
The figure 4.1 shows that the variable $z$ is increasing in the variable $m$, as well as the fact that the informality percentage is generally larger while $z$ and $m$ are smaller. Then the data supports positive sorting result proposed above, because a firm with larger capital stock tends to be a larger firm, which should be formal firm in my analysis.

**Implication 4.1.1.** *The regions wherein there are more capitalized firms and more skilled managers display less informality.*

## 4.2 Changes in the cost of formalization

In this section, I carry out a set of comparative statics results of changes in the cost of formalization. In particular, I analyze the effect of a decrease in the social security contributions of the formal firms, $s$ on the size of the informal sector, equilibrium size of the formal firms and firm productivity.

**Effect on the size of the informal sector.** As we have discussed earlier, the size of the formal sector is defined by $G(m^*)$, the measure of firms with managerial skill lower than $m^*$. Under the assumption of uniform distribution, $G(m^*)$ is given by:

$$G(m^*) = \frac{m^* - 1}{b - 1} = \frac{\sqrt{1 + \frac{s}{w}} - 1}{b - 1}$$

The above expression is clearly increasing in $s$. In other words, a decrease in the mandatory social security contribution on behalf of the formal firms decreases the size of the informal sector.

**Implication 4.2.1.** *A public policy of reducing the cost of formalization, in particular, the mandatory social security contributions made by the formal firms decreases informality.*

High cost of formalization can be seen as a barrier to entry into the formal sector. All else being equal, decreases in such entry barrier increases the number of formal firms as the initially informal firms now have access to the more efficient formal technology at a lower cost. As a result, informality is more likely to reduce.

**Effect on firm size in the formal sector.** Because the informal employment is unaffected by $s$, but the formal employment does depend on the cost of formalization, a decrease in $s$ on the one hand reduces the threshold level of managerial skill, $m^*$ by shifting the line $1 + s/w$ down, and on the other, moves the firm size of the formal sector curve, $l_F(m)$ up for every $m \geq m^*$. This is depicted in Figure 4.2

Figure 4.2: The effect of a decrease in $s$ on the equilibrium firm size
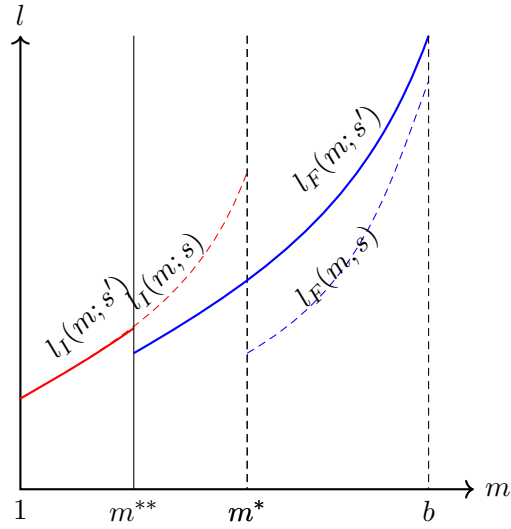
From the above figure, I can conclude that

**Implication 4.2.2.** *A public policy of reducing the cost of formalization, in particular, the mandatory social security contributions made by the formal firms increases the size of the formal firms, but leaves that of the informal firms unaffected. As a consequence, the difference between the size of informal and formal firms reduces.*

Following a policy of reducing $s$, the gap between the sizes of informal and formal firms reduces, but it is not completely eliminated. For having all formal firms larger in size than any informal firm, the decrease in the cost of formalization has to be sufficiently large, i.e., the resultant cost must be $s = 0$. Otherwise, there will always exist some informal firms employing more workers than some of the formal firms. This can be seen easily from below. Let $m^*(s)$ be the threshold skill at any given $s$. Then,

$$\Delta(s) \equiv l_I(m^*(s)) - l_F(m^*(s)) = \frac{s}{4w^3}$$

The above expression is $0$ if and only if $s = 0$, i.e., there is no additional cost of formalization.

Because the technology in each sector is given, a formal firm cannot be more productive only for the reduction of costs in the formal sector. This implies that the firm should have a limit in improving its profitability only with the costs reducing. Then even though the formalization is optimum decision after $s$ decreases, the firm must employ fewer personnel in order to pay higher costs than in the informal sector but sustain firm profitability.

**Effect on firm productivity.** A decrease in $s$ only affects the output of the formal sector, $y_F(m)$, leaving $y_I(m)$ unchanged. This effect is confounded by the fact that there is an increase in the number of formal firms (a reduction in $m^*$). This effect is depicted in Figure 4.3.

Figure 4.3: Equilibrium output when $s$ decreases
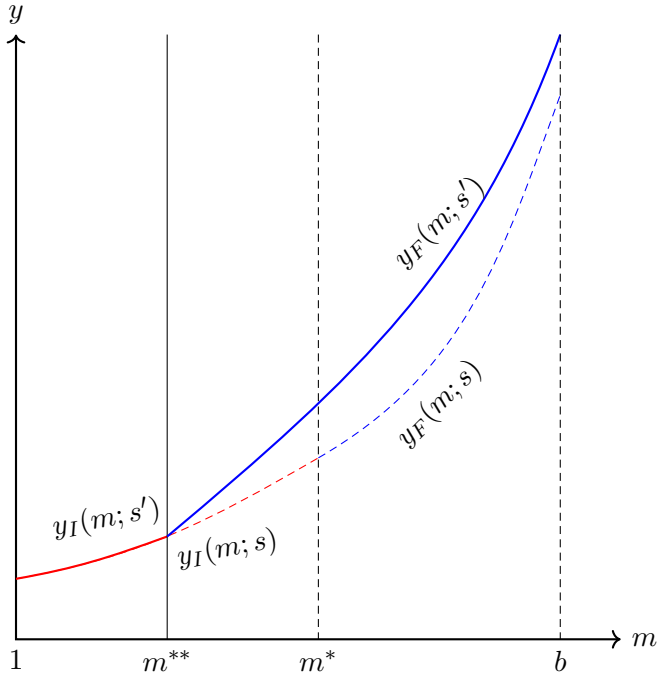


Source: Own elaboration

From the above one can conclude that

**Implication 4.2.3.** *A public policy of reducing the cost of formalization, in particular, the mandatory social security contributions made by the formal firms increases the productivity of the formal firms, while that of the informal firms remain unchanged. As a result, the aggregate*

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*productivity of the economy increases.*

Implications 4.2.2 and 4.2.3 together present an interesting policy implication. In any public policy debate that it is not desirable to eliminate completely the cost of formalization, i.e., making $s = 0$. Therefore, a reduction in $s$ to a strictly positive level will induce an increase in the aggregate productivity, but it may imply higher average informal employment of unskilled workers. This will definitely depend on the initial size of the informal sector, but the gap between informal and formal employment is never eliminated. Ulyssea (2018) mentions similar phenomenon observed among formalized firms in Brazil which reduced the number of employment. This theoretical finding is consistent with some empirical findings in Mexico and Brazil in which they found that the cost reduction for the formalization did not decrease the informality rate (Ulyssea, 2018; Bruhn, 2011; De Giorgi and Rahman, 2013).

# Chapter 5

# Conclusion

In this thesis statement, I analyzed mechanism of firm's decision to choose formalization with the focus on the human capital factor such as managing skills. There are several curious discoveries on the firm's decision to make itself formal and its effect on the firm size and productivity. (1) The level of human capital is matched to the capital stock of a firm in one-to-one manner so that a firm with lower technology should have less skilled manager and a firm with higher technology should employ more qualified managers. (2) Employing manager with higher skills induces a firm to choose the formal sector, but there is a trade off on cost and opportunity: A larger firm may compensate the high cost required in the formal sector because it has more productive technology, while a smaller firm is not able to cover such a financial burden. (3) When the financial cost charged in the formal sector reduces, the critical value of managing skills also reduces so that this facilitates formalization for any firm, as well as the firm's productivity can improve. (4) A decreasing level of the cost of the formalization induces firm's formalization, but it does not always assure an increasing number of formal employment. Unless such a formal firm has sufficient productivity and human capital, the number of formal employment is smaller than the informal counterpart. The result (4) is consistent with previous empirical findings (Ulyssea, 2018; Bruhn, 2011; De Giorgi and Rahman, 2013).

The introduction of an equilibrium matching problem enabled me to shed light on the firm's behavior on formalization given a certain level of managing skills. One possible extension could be differentiating the distribution of the firm's capital stock and managing skills, because this assumption determines the concrete form of the matching function and equilibrium firm size. A dynamic model can be interest discussion because my model is static so that it does not mention intertemporal behaviors. The thesis statement also suggests that a public policy for smoother formalization of informal firms be providing opportunities of technological transfers with which the firm can formalizes itself, acquiring more sophisticated technology and employing higher skilled managers.

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