

Informal labor market and access to education in developing economies

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Abstract

This theoretical paper studies the impact of access to education on labor market flows in a search and matching model of the labor market representing a developing economy. It then addresses the issue of the impact on the market efficiency of public policies aiming at increasing education. An increase in education raises the size of the formal sector and reduces that of the informal sector but more educated workers enter into informality.

Keywords: Informality, education, labor market, developing economies.

JEL Codes: I25, J21, J42, J64.

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1 Introduction

Informality or what is also called the shadow economy represents a variable but generally large share of developing economies. Estimates from [Scheider and Enste \(2000\)](#) indicates that in Latin America the shadow sector represents a percentage of GDP that ranges from 25 to 65%, showing the importance of the informal sector in the labor market of developing economies. Dual economy flows has been a crucial point of interest of the well known Harris-Todaro migration model ([Harris and Todaro 1970](#)) and standard models of informal labor market generally assimilate informality to the rural sector and the formal sector to a urban/modern sector. Compared to formal workers, it is commonly admitted that on average, informal workers work in less productive firms and receive lower wages. Informal firms tends to hire less skilled workers and are generally smaller due partly to self-employment but not only.

Access to education in developing countries as been broadly studied in the empirical literature. However to the best of our knowledge no theoretical paper linking access to education and labor market distortions in the presence of an informal sector exists. Knowing the importance of the informal sector, which concentrate the majority of uneducated workers, this connection cannot be avoided. Our paper aim at studying the impact of educational changes on the dual labor market composition. In order to address this issue, we build a search and matching model of the formal sector with interactions with the informal sector. Uneducated workers' search is first directed toward the informal sector whereas educated workers can search in both sectors depending on their expected asset values.

Market frictions, as defined by [Mortensen and Pissarides \(1999\)](#), represents the time required to a worker (a firm) to obtain (to find) a job (a worker). These frictions delays the moment at which a firm and a worker meet, explaining the coexistence of unemployment and job vacancies. Matching models (see [Pissarides 2000](#)) are therefore a suitable pattern to represent the formal sector (see [Zenou \(2008\)](#) for a brief but clear review of the literature regarding the tradition of search model in the migration literature and for detailed explanation of matching models). Regarding search-frictions in the informal sector, their presence is still debated. Two points of view conflict: the informal sector should be simply considered as a stage toward formal employment (see [Fields 1975](#)); the two sectors are symmetric and competitive (see [Heckman and Sedlacek 1985](#); [Magnac 1991](#)). In the former case the informal sector is generally regarded as a precarious competitive sector, or at least a sector in which frictions are not the rule, that workers wish to leave. In the latter case both sectors would allow for search frictions.

Defending the latter, [Maloney \(2004\)](#) presents evidences that the informal sector should be more considered as an unregulated micro-entrepreneurial sector rather than a disadvantaged residual segment of the labor market. Relying on the case of Latin America, especially Mexico, [Maloney \(2004\)](#) shows that a large part of the informal sector is composed of self-employed which have chosen this sector. He relies on [Balan *et al* \(1973\)](#) which argued that one path of the labor market is that workers first enters into

salaried work and accumulate knowledge before opening their own informal businesses. As [Maloney \(2004\)](#) explains, those workers are neither necessarily less well payed than in the formal sector nor precarious. He also specifies that being voluntarily in the informal sector doesn't mean workers are happier or better-off, but simply not worse-off.

[Albrecht, Navarro and Vroman \(2009\)](#) studies the effect of labor market policies and examine the distributional implications of those policies in an economy with an informal sector which has [Maloney \(2004\)](#)'s characteristics. The labor market faces search-frictions but it is not segmented. The transition rate to formal employment is endogenous whereas the transition rate toward the informal sector is exogenous. Opting for exogenous transition rate into informality seems radical as it either implicitly means transition to informality is only a matter of choice or independent on market conditions. Many authors in favor of Maloney's perspective rather choose to endogenize this probability by assuming search-frictions in both sectors. This is the case for [Boeri and Garibaldi \(2007\)](#) which investigate the border between formal employment, shadow employment, and unemployment in a labor market not necessarily representative of a developing economy, as well as [Charlot, Malherbet and Terra \(2011\)](#).

The competitiveness of the informal sector is crucial in the model by [Charlot, Malherbet and Terra \(2010\)](#). Their paper deals with the issue of the size of firms in the formal and in the informal sector in a framework in which regulations in the product market affect the labor market. [Charlot, Malherbet and Terra \(2011\)](#) assume matching frictions in the two sectors. They claim there is no evidence that the informal sector is fully competitive but that entry costs in the formal sector tend to make the informal sector more competitive.

[Fugazza and Jacques \(2004\)](#) propose a model of the labor market where vacancies and workers search are directed at a specific labor market. The informal sector only arises because the government lack to enforce fiscal contribution. Considering evidences that individuals willing to operate in the informal sector need connections that takes time to be established, both sectors, formal and informal face search frictions. Taking this behavior into account derives from the standard theory in favor of a walrasian informal sector and disregard the fact that sectors are not rigid, *i.e.* many transitions occurs between the two.

To our opinion, the competitiveness consideration of the informal sector depends on the importance of self-employment, entrepreneurship, and family employment in the informal sector. Being short, we think there is more than one way of defining informality depending on countries. Our model could of course embedded a matching function in the informal sector but this would move us away from informality as we consider it. [Zenou \(2008\)](#) mentions the empirical literature on the informal market shows the informal sector generally consists of self-employment, entrepreneurship or family related works. Therefore the hiring process is much quicker. Even if not all workers meet instantaneously their firms, search frictions are not in the same range that those in the formal sector and could therefore be avoid for the sake of simplicity. In [Zenou \(2008\)](#)'s dual labor market model, only the formal sector faces search-matching frictions and therefore unemployment. The informal sector is assumed competitive. In this framework, he evaluates different policies

aiming at reducing unemployment. He shows that employment or wage subsidies increase the size of the informal sector whereas hiring subsidies have the reverse effect. In our model the formal sector is devoted to educated workers whereas the informal sector can welcome all type of workers. It is not a precarious sector. Our model assumes that informal wages are exogenously determined. Self-employment indeed implies that wages workers perceive are wages they can possibly afford to allocate themselves.

[Chalot, Malherbet and Terra \(2011\)](#) shows several stylized facts regarding Brazilian labor market transitions between informal jobs, formal jobs and unemployment. Using the Monthly Employment Survey, conducted by the Brazilian Institute of Geography and Statistics, for several regions, they indicate the probability of transition after one year: unemployed workers have 1/3 of chances to remain unemployed, find a formal or and informal job, whereas the transition rate from informality to unemployment is 5,3% and informality to formality is 23,1%.

These figures indicate that, contrarily to [Zenou \(2008\)](#)'s consideration, informal workers can search while on the job to obtain a formal job. This empirical observation is taken into consideration in our framework. The transition probability is endogenous and depends on the tightness of the formal sector and therefore implicitly on wage differentials as the formal sector wages are bargained. In our model, informality is a first step for uneducated workers whereas educated workers choose their path depending on their expected incomes. Therefore, part of educated workers evolves for some times in the informal sector. The labor market is segmented but significant mobility between the two sectors exists, and the informal sector cannot be considered as precarious, it only reflects an average lower productivity.

Whereas standard dual labor market model such as [Harris and Todaro \(1970\)](#) or [Lewis \(1954\)](#) assimilate the informal sector to the rural sector and the formal sector to the urban sector, [Satchi and Temple \(2009\)](#) distinguish two types of informality, seeming especially consistent for middle-income countries. As in the standard literature the rural sector is informal and fully competitive, whereas the urban sector is divided into a formal sector where search-frictions arise and an informal sector composed of self-employed workers, the latter waiting for formal jobs. [Satchi and Temple \(2009\)](#) perform an efficiency study and obtain efficiency of the labor market under the standard Hosios condition (see [Hosios 1990](#)). We also perform an efficiency study but in our model the optimality of job creation in the formal labor market is only one solution amongst inefficient possibilities.

[Fields \(1974a\)](#) has been one of the first to theoretically study the relation between individual demand for education and labor market conditions in developing countries. The empirical evidence that a large number of workers continue to demand education whereas the labor market seems not able to absorb them leads [Fields \(1974a\)](#) to consider the issue of allocation of educated workers between different labor markets. Similarly to [Satchi and Temple \(2006\)](#), [Fields \(1974a\)](#) considers the agricultural sector to be restricted to uneducated workers whereas the urban sector is divided between skilled and unskilled jobs where all educated workers decide at first to enter into the skilled sector. [Fields](#)

(1974a) considers that education is an individual choice which depends on private financial considerations and the expected return to education. As for us, education is not guided by personal wishes or financial ability. We assume that all workers would opt for education if this was possible for them to obtain it. The reason for this is that we deeply believe that education bring workers more than job opportunities, those provision being out of the rang of economics. However staying in the fields of economics it can be argued that education provides the worker with the possibility to switch job. Education is also generally perceived as a mean to improve its personal situation disregarding a potential high average education attainment of the population. The three models presented by Fields (1974a), namely the bumping model, the stratification model and the pooling model explains possible explanations for the persistence of a high demand for education, unemployment and recruitment of educated workers at low-skill positions.

Boeri and Garibaldi (2007) present evidences for Italy that the higher the level of education, the higher the chance to obtain a formal job. However evidences from Mexico presented by Gong and Van Soest (2002) as well as Gong, Van Soest and Villagomez (2004) show a negative association between informal employment and education level within countries. Maloney (2004) concludes that education should not necessarily be positively correlated to sectors. This point of view seems at first in contradiction with the commonly admitted assumption that uneducated workers are directed toward the informal sector whereas educated workers would favor the formal sector. Gong and Van Soest (2002) state that the wage is the main factor driving the sector choice and that the probability of formal sector employment strongly rises with the education level. Their results could be interpreted this way: the lower the education, the higher the chance to be in the informal sector. However, even if high education means a higher chance to be in the formal sector, it does not mean that educated workers cannot search for an informal job. This is exactly the framework we choose by assuming educated worker faces a migration condition making workers deciding in which sector to apply.

To address this issue of the impact of access to education on labor market repartition, we consider a segmented labor market with a formal sector and an informal sector. Three states coexist: unemployment, formal employment and informal employment. Uneducated workers are forced to apply to the informal sector whereas educated workers may apply in both sectors depending on their expected asset values. The formal sector is subject to market frictions and the wages are bargained, whereas wages are exogenously determined in the informal sector. Unemployment thus only exists in the formal sector and acts as a pool of entry to formal employment. Informal employees may possibly search on-the-job for a formal job. This last feature of the model implies that modifying access to education distorts the repartition of workers in the labor market. Two assumptions are made: first, education is increased by external intervention (international subvention to education). Second, education is self-financed by taxes paid by the formal sector (the local government faces a budget constraint). We also compare the decentralized equilibrium situation to the social planner equilibrium.

The paper is organized as follows: Section 2 presents the analytical framework with the interacting segmented labor market. Section 3 and 4 present respectively the formal sector specification and equilibrium, and the informal sector specification and the on-the-job search condition of informal workers. Section 5 focuses on the migration condition of educated workers. Workers' flows and formal job creation equilibrium are presented in section 6. The impact of a better access to education is discussed in section 7. Section 8 performs an efficiency study and finally section 9 concludes.

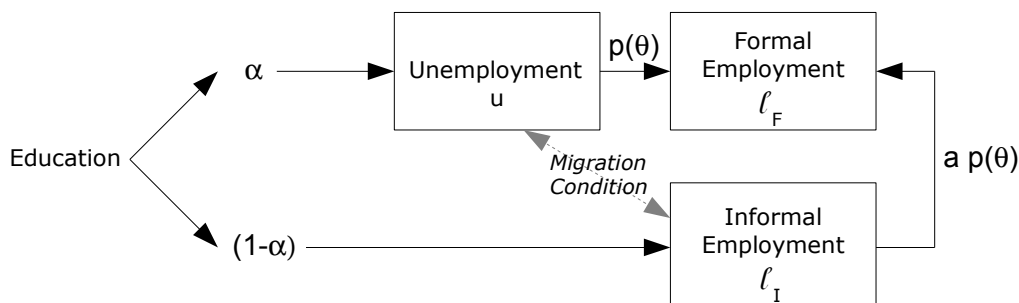
2 Analytical framework

The economy consists of two types of agents: workers and firms. Firms are infinity-lived whereas workers have a finite life expectancy of $1/m$. Time is continuous and parameter m measures the workers' labor market exit rate. Each worker who leaves the market is replaced with a newcomer. The measure of the total labor force is constant and normalized to one. All agents are risk-neutral and discount future payoffs at rate r ($r \geq 0$).

The labor market is segmented between two interacting sectors: a formal sector, in which employment, denoted by ℓ_F , and unemployment, denoted by u , coexist, and an informal sector where employment is denoted ℓ_I . When entering the labor market, firms choose the sector in which to operate. They then create a single job. Workers are of two types: educated workers amounting for an exogenous share α and uneducated workers amounting for a symmetric share $(1 - \alpha)$.

Figure (1) represents workers' flows.

Figure 1: Workers' flows



Educated workers can search a formal job, they therefore joint unemployment and find a formal job at rate $p(\theta)$. They can also decide to obtain an informal job. The share of educated workers which decide to obtain an informal job rather than being unemployed is denoted by π . This share depends on the formal sector tightness θ . This link is captured by a migration condition.

Uneducated workers direct their search toward the informal sector. However once they have obtained an informal job, they start searching while on the job for a formal job. For

those workers, the probability of obtaining a formal job depends on the formal sector tightness (through the probability $p(\theta)$), but it also depends on an endogenous parameter a with $0 \leq a < 1$ so that obtaining a formal job coming from the informal sector will always be harder than for educated workers which endures a spell of unemployment. This reflects the fact that working in the informal sector is badly perceived by formal firms (empirical studies shows this phenomenon). This parameter a is a function of the share of educated workers, π , who opted for the informal sector. We have:

$$a = a(\pi) \tag{1}$$

with $a'(\pi) > 0$. When the share π of educated workers in overall informal employees increases, we observe an increase in a . It is easier for informal employees to obtain a formal job. This reflects the fact that firms tend to be less discriminative toward the informal sector, knowing that many educated workers work in there.

3 The Formal sector

In the formal sector, search-frictions exist that prevent the instantaneous matching of jobs with workers. Firms thus have to pay a cost, c , in order to keep their vacancy open. When matched with a worker, jobs yield output y_F . Firms operating in the formal sector pay a wage w_F which is negotiated according to a Nash bargaining game.

3.1 Formal matching fonction

A matching function must be defined in the formal sector. The tightness θ depends on the number of formal vacancies v and on the number of formal job seekers. Formal job seekers are unemployed workers u as well as the share a of informal workers which are searching on-the-job, $a\ell_I$. Tightness θ is therefore defined as:

$$\theta = \frac{v}{u + a\ell_I}$$

The matching function is $h = h(v, (u + a\ell_I))$. It is assumed to be increasing in both its arguments, concave and homogenous of degree 1. Job vacancies are filled by random sorting according to a Poisson process of rate q . Hence, the homogeneity of the matching function implies:

$$q = \frac{h(v, (u + a\ell_I))}{v} = h\left(1, \frac{1}{\theta}\right) = q(\theta)$$

where q is the rate at which a formal job is filled. By the properties of the matching technology, $q'(\theta) \leq 0$. Unemployed workers and on-the-job seekers find a formal job at rate p , determined as $p(\theta) = \theta q(\theta)$ with $p(\theta) \geq 0$.

3.2 Asset Values

Let W_F be the asset value of a worker in a formal job, and U that of an unemployed worker. We have:

$$rW_F = w_F - mW_F \quad (2)$$

$$rU = d + p(\theta)[W_F - U] - mU \quad (3)$$

There is no better situation than being employed in the formal sector, earning w_F . Therefore formal workers keep their formal job until they retired from the labor market. Unemployed workers earn their domestic output, d , and search for a formal job that they can obtain at rate $p(\theta)$.

Formal firms can be either in situation of vacancy or having their job occupied. Let J_F be the asset value of a productive firm, and J_F^V the asset value of a firm in situation of vacancy. Bellman equations can be written as follows:

$$rJ_F = y_F - w_F - m[J_F - J_F^V] \quad (4)$$

$$rJ_F^V = -c + q(\theta)[J_F - J_F^V] \quad (5)$$

Firms produces y_F and pay their workers w_F . They become firms in situation of vacancy when their workers exit the labor market which happened at rate m . Firms with a vacancy have to pay a cost c (per period) in order to maintain the vacancy open, until they find a worker at rate $q(\theta)$.

In the formal labor market, the free-entry condition applies. Firms enter freely in the formal sector until all positive profits are exploited, driven the value of a firm in situation of vacancy to zero.

$$J_F^V = 0 \quad (6)$$

3.3 Bargained wages

In the formal section wages are bargained according to a Nash bargaining game where β is the bargaining power for workers and $(1 - \beta)$ the bargaining power for firms operating in the formal sector.

When a worker and a firm agree to form a match, they create the surplus S which is dispatched between them according to their bargaining power. The surplus can be written as:

$$S = [W_F - U] + [J_F - J_F^V]$$

where

$$\beta S = [W_F - U]$$

$$(1 - \beta)S = [J_F - J_F^V]$$

Combining the free-entry condition (6), the asset values (2), (3), (4), with the two previous equations leads to the determination of the formal wage:

$$w_F = \frac{\beta y_F(r + m + p(\theta)) + (1 - \beta)d(r + m)}{r + m + \beta p(\theta)} \quad (7)$$

3.4 Formal sector job creation

The free-entry condition (6), combined with (4) and (5) leads to:

$$c(r + m) = q(\theta)[y_F - w_F] \quad (8)$$

Replacing the wage equation (7) into (8) allows us to obtain the formal sector job creation equation:

$$0 = -c + q(\theta)(1 - \beta) \frac{y_F - d}{r + m + \beta p(\theta)} \quad (9)$$

This equilibrium is the standard Pissarides solution.

4 The Informal sector

The informal sector is not subject to search-frictions as we assume that workers and firms match instantaneously. The informal wage, w_I , is exogenously determined. One can see this wage as a subsistence wage. Knowing that the informal sector is composed of self-employment, entrepreneurs or family workers, this wage can also be seen as the wage workers can possibly offers to themselves. Informal firms produce y_I . We assume the informal sector to be less productive that the formal sector but more productive than the output generated by unemployed workers, so we have $d < y_I < y_F$.

4.1 Asset values

Let W_I be the asset value of a worker in an informal job. We have:

$$rW_I = w_I + ap(\theta)[W_F - W_I] - mW_I \quad (10)$$

At the current period, informal workers earn the exogenous wage w_I . They all search on-the-job for a formal job. They have a probability $ap(\theta)$ to obtain such a job.

There is no unemployment in the informal sector, therefore, all informal firms have their job occupied by a worker. Let J_I be the asset value of an informal productive firm, and J_I^V the asset value of a firm in situation of vacancy. Bellman equations can be written in the following way:

$$rJ_I = y_I - w_I - m[J_I - J_I^V] \quad (11)$$

$$rJ_I^V = 0 \quad (12)$$

Informal firms receive y_I and pay w_I to their workers. If the worker retires from the labor market, firms instantaneously find a new worker.

4.2 OJS condition

For the on-the-job search process of informal workers to take place, informal workers should have an interest in obtaining a formal job. This is true as long as W_F is above W_I , that is to say $[W_F - W_I] > 0$. Using equations (2) and (10). This on-the-job search condition is equivalent to:

$$w_F > w_I \quad (13)$$

If wages are equals in the two sectors, informal workers remain in their informal job.

5 The Migration condition

Uneducated workers do not have any choice but to look for an informal job. Educated workers can of course look for a formal job but they can also obtain an informal job if they want to. This decision of educated workers is capture by the migration condition. Educated workers would be indifferent between being unemployed or having an informal job when $W_I = U$. Taking equations (10) and (3) into account, this condition is equivalent to:

$$w_I(r + m + p(\theta)) - d(r + m + ap(\theta)) = w_F p(\theta)(1 - a)$$

Replacing the formal wage by (7), the previous equation can be rewritten as:

$$(w_I - d)(r + m + \beta p(\theta)) = (1 - a)p(\theta)(y_F - d)\beta \quad (14)$$

This equation (14), depending exclusively on the endogenous variable θ , determines the repartition of educated workers between unemployment and informal employment. The migration condition determines π as a function of θ .

$$\frac{\partial \pi}{\partial \theta} = \frac{p'(\theta) (1 - a)(y_F - d) - (w_I - d)}{a'(\pi) p(\theta)(y_F - d)} \quad (15)$$

The share of educated workers working for the informal sector decreases with θ , hence with the probability of obtaining a formal job, if and only if:

$$(1 - a)(y_F - d) - (w_I - d) < 0$$

If $(1 - a)(y_F - d) - (w_I - d) > 0$, the share of educated workers working for the informal sector increases with a rise in θ . The reason why the impact of θ on π is not straightforward is that an increase in π also increases the parameter a . The impact would therefore depends on the sensitivity of a to π . If a is very sensitive to a variation of π , it might be that the chances to get a formal job via the informal path is more interesting than waiting in unemployment. Then a rise in θ will incline educated workers to take an informal job.

6 Equilibrium and Workers' flows

6.1 Decentralized equilibrium

An equilibrium of the labor market can be defined as follows:

Definition 1. *An equilibrium of the labor market is a pair of variables (θ, π) which jointly satisfy equations (9), (14).*

From formal sector tightness θ and the share π , one deduces the employment and unemployment levels by using the conditions for flow-equilibrium.

6.2 Workers' flows

Let u denote unemployment, ℓ_F formal employment, and ℓ_I informal employment. Informal employment is divided into two subsets: uneducated informal workers, ℓ_I^{NE} , and educated workers who has decided to choose the informal path to obtain a formal job, ℓ_I^E . So we have $\ell_I = \ell_I^{NE} + \ell_I^E$. Educated (respectively uneducated) informal employees amount for an endogenous share γ (respectively $(1 - \gamma)$) of informal employees. We have:

$$\begin{aligned}\ell_I^E &= \gamma \ell_I \\ \ell_I^{NE} &= (1 - \gamma) \ell_I\end{aligned}$$

The share γ of educated informal employees increases with the share π of educated workers which have decided to obtain an informal job. So we have $\gamma = \gamma(\pi)$ with $\gamma'(\pi) > 0$.

In steady state, employment and unemployment levels are deduced from the flow-equilibrium conditions. Total population is normalize to one so we have:

$$u + \ell_F + \ell_I = 1$$

Flows in and out of each employment state are such that inflows equalize outflows. For respectively unemployment, informal employment of educated workers, informal employment of uneducated workers, and formal employment, we have:

$$\begin{aligned}\alpha(1 - \pi)m &= u(m + p(\theta)) \\ \alpha\pi m &= \ell_I^E(m + ap(\theta)) \\ (1 - \alpha)m &= \ell_I^{NE}(m + ap(\theta)) \\ p(\theta)u + ap(\theta)\ell_I &= m\ell_F\end{aligned}$$

These flows leads to the determination of the following levels of unemployment, u , informal employment of educated workers, ℓ_I^E , informal employment of uneducated workers, ℓ_I^{NE} , total informal employment, ℓ_I , and formal employment, ℓ_F .

$$u = \frac{\alpha(1 - \pi)m}{m + p(\theta)} \tag{16}$$

$$\ell_I^E = \frac{\alpha\pi m}{m + ap} \tag{17}$$

$$\ell_I^{NE} = \frac{(1 - \alpha)m}{m + ap} \tag{18}$$

$$\ell_I = \frac{(1 - \alpha)m + \alpha\pi m}{m + ap} \tag{19}$$

$$\ell_F = 1 - \frac{\alpha(1 - \pi)m}{m + p} - \frac{(1 - \alpha)m + \alpha\pi m}{m + ap} \tag{20}$$

Table (1) shows the direct effect of variables on employment levels.

Table 1: Partial derivatives of employment and unemployment levels

	u	ℓ_F	ℓ_I	ℓ_I^E	ℓ_I^{NE}
α	$\frac{(1-\pi)m}{m+p}$	$\frac{mp(1-a)(1-\pi)}{(m+ap)(m+p)}$	$-\frac{m(1-\pi)}{m+ap}$	$\frac{m\pi}{m+ap}$	$\frac{-m}{m+ap}$
$p(\theta)$	$-\frac{\alpha(1-\pi)m}{(m+p)^2}$	$\frac{am[\alpha\pi+(1-\alpha)]}{(m+ap)^2} + \frac{\alpha m(1-\pi)}{(m+p)^2}$	$-\frac{am[\alpha\pi+(1-\alpha)]}{(m+ap)^2}$	$-\frac{am\alpha\pi}{(m+ap)^2}$	$-\frac{am(1-\alpha)}{(m+ap)^2}$
a	0	$\frac{mp[\alpha\pi+(1-\alpha)]}{(m+ap)^2}$	$-\frac{pm[\alpha\pi+(1-\alpha)]}{(m+ap)^2}$	$-\frac{pm\alpha\pi}{(m+ap)^2}$	$-\frac{pm(1-\alpha)}{(m+ap)^2}$
π	$-\frac{\alpha m}{m+p}$	$-\frac{mp(1-a)\alpha}{(m+ap)(m+p)}$	$\frac{\alpha m}{m+ap}$	$\frac{\alpha m}{m+ap}$	0

	u	ℓ_F	ℓ_I	ℓ_I^E	ℓ_I^{NE}
α	+	+	-	+	-
$p(\theta)$	-	+	-	-	-
a	0	+	-	-	-
π	-	-	+	+	0

Increasing the formal sector tightness θ leads to a reduction in unemployment as it becomes easier for educated workers to find a formal job ($p(\theta)$ raises). Informal employment is reduced for educated workers as well as for uneducated workers. The reason is it also becomes easier to obtain a formal job coming from the informal sector ($ap(\theta)$ raises). As a consequence, formal employment increases sharply.

When the share of educated workers in informal employment increases, unemployment is being reduced because more educated workers choose to join informality. For this reason formal employment is reduced and informal employment of educated workers increases.

An increase in the endogenous parameter a increases the chances of informal workers to obtain a formal job. Formal employment thus increases whereas total informal employment is being reduced. Note that this is only the direct impact of a . As a depends on π which have the revers direct impact on employment levels, the overall impact might not be that clear.

7 Providing education

Fields (1974b) postulates that public investment in education in a situation in which the labor market faces unemployment and underemployment among educated workers is a suboptimal unstable situation which has a simple political background. Knowing that educational systems in developing countries are heavily subsidized, families, facing not much private educational costs, have very high returns to education. The social pressure then encourages political support for educational subsidies. As for us, we consider subsidies for education as granted. For now, the question is not to know whether public investment in education is socially efficient but to understand how those subsidies may affect the labor market repartition of workers.

Providing education to workers can be done in two ways. From the outside: education is not provided by the government of the country but by an external intervention. In this case the budget constraint of the local government is not affected. From the inside: the local government has to pay for education which implies taxing formal firms (as informal firms escape taxation).

7.1 External financial support

Equation (9) does not depend on α therefore the impact of α is straightforward and given by table (1). Increasing education necessarily increases unemployment as part of educated workers will go for the formal sector path. More unemployed means more applicants to formal jobs each facing the same probability of obtaining such a job. Formal employment thus increases. Less uneducated workers means less uneducated informal employees. However, even if total informal employment is being reduced, the reverse phenomenon appears for educated informal employees.

Result 1. *An increase in education raises the size of the formal sector and reduces that of the informal sector but more educated workers enter into informality.*

7.2 Governmental support

Let us assume that the government allocates a fixed amount of subsidy σ to all newcomers in the labor market in order to help their educational achievement. In order to balance its budget the government has to instaurate a tax τ on productive formal firms. The government budget constraint is:

$$\tau \ell_F = \sigma m$$

Which gives the following σ equation:

$$\sigma = \frac{\ell_F}{m} \tau$$

The share α of educated workers is not exogenous anymore but depends on the subsidy σ . The higher the subsidy the higher the share of educated workers. We have:

$$\alpha = \alpha(\sigma); \quad \alpha'(\sigma) > 0; \quad \alpha''(\sigma) < 0; \quad \lim_{\sigma \rightarrow +\infty} \alpha(\sigma) = 1; \quad \alpha(0) = \alpha_0 \quad \text{with} \quad \alpha_0 \in]0, 1[$$

Introducing a tax on productive formal firms changes the asset value J_F of a productive firm as well as the equilibrium of formal job creation.

$$r J_F = y_F - w_F - \tau - m[J_F - J_F^V] \tag{21}$$

$$0 = -c + q(\theta)(1 - \beta) \frac{y_F - d - \tau}{r + m + \beta p(\theta)} \tag{22}$$

Increasing the tax τ reduces θ , $\frac{\partial \theta}{\partial \tau} < 0$. Formal job creation is being reduced. In the same time, the share of educated workers raises.

The impact of a raise of access to education on employment flows depends on the tightness of the labor market and of the tax.

$$\begin{aligned}
\frac{dl_F}{d\alpha} &= \underbrace{\frac{\partial l_F}{\partial \alpha}}_{>0} + \underbrace{\frac{\partial l_F}{\partial \alpha}}_{>0} \underbrace{\frac{\partial \theta}{\partial \tau}}_{<0} \underbrace{\frac{\partial \tau}{\partial \alpha}}_{>0} \quad ? \\
\frac{dl_I}{d\alpha} &= \underbrace{\frac{\partial l_I}{\partial \alpha}}_{<0} + \underbrace{\frac{\partial l_I}{\partial \alpha}}_{<0} \underbrace{\frac{\partial \theta}{\partial \tau}}_{<0} \underbrace{\frac{\partial \tau}{\partial \alpha}}_{>0} \quad ? \\
\frac{dl_I^E}{d\alpha} &= \underbrace{\frac{\partial l_I^E}{\partial \alpha}}_{>0} + \underbrace{\frac{\partial l_I^E}{\partial \alpha}}_{<0} \underbrace{\frac{\partial \theta}{\partial \tau}}_{<0} \underbrace{\frac{\partial \tau}{\partial \alpha}}_{>0} \quad > 0 \\
\frac{dl_I^{NE}}{d\alpha} &= \underbrace{\frac{\partial l_I^{NE}}{\partial \alpha}}_{<0} + \underbrace{\frac{\partial l_I^{NE}}{\partial \alpha}}_{<0} \underbrace{\frac{\partial \theta}{\partial \tau}}_{<0} \underbrace{\frac{\partial \tau}{\partial \alpha}}_{>0} \quad ? \\
\frac{du}{d\alpha} &= \underbrace{\frac{\partial u}{\partial \alpha}}_{>0} + \underbrace{\frac{\partial u}{\partial \alpha}}_{<0} \underbrace{\frac{\partial \theta}{\partial \tau}}_{<0} \underbrace{\frac{\partial \tau}{\partial \alpha}}_{>0} \quad > 0
\end{aligned}$$

The share of educated workers in overall informal employment increases. Unemployment increases as well. For the rest of employment level, the impact remains unclear and depends on the sensitiveness of education to the tax. When education is weakly sensitive to the tax, an increase in τ leads to a small raise in α . In that case, it could be that the increase of formal applicant is not sufficient to compensate for the impact of the tax on the sector tightness, which reduces the probability of workers to obtain a formal job. In the symmetric situation, the probability of obtaining a formal job is still reduced, but there are so many educated workers facing this probability that formal employment could raise.

8 Labor Market Efficiency

We first define a social optimum, then compare it with the labor market decentralized equilibrium.

8.1 Social optimum

Along the same lines as Hosios (1990) and Pissarides (2000), let us consider a social planner who is only subject to search frictions, and can redistribute income among agents at no cost. The social surplus is given by:

$$CS = y_F \ell_F + y_I \ell_I + du - \theta c(u + a \ell_I) \quad (23)$$

The social optimum is given when the social planner maximizes the social surplus flow CS with respect to θ and π at steady state. Equalizing the derivative of the social surplus

with respect to θ to zero give the condition under which job creation in the formal sector is socially optimal.

$$\frac{\partial CS}{\partial \theta} = 0$$

The elasticity of q with respect to θ , denoted by η gives the equality $p'(\theta) = (1 - \eta)q$. We obtain:

$$0 = -c + (1 - \eta)q \frac{(y_F - d)\alpha(1 - \pi)(m + ap)^2 + (y_F - y_I)a[(1 - \alpha) + \alpha\pi](m + p)^2}{(m + \eta p)\alpha(1 - \pi)(m + ap)^2 + (m + \eta ap)a[(1 - \alpha) + \alpha\pi](m + p)^2} \quad (24)$$

In the standard Pissarides model, the social surplus condition equals the decentralized equilibrium condition when the bargaining power of workers β is equal to the elasticity η of q with respect to θ . Here, the so-called Hosios condition is clearly not sufficient to restore the efficiency of the labor market. When formal firms create jobs they do not take into consideration the path of workers and the existence of an informal sector.

Formal job creation can be either too high or too low. Under the Hosios condition, the condition under which formal job creation is a social optimum is:

$$\frac{y_F - d}{m + \eta p} = \frac{(y_F - d)\alpha(1 - \pi)(m + ap)^2 + (y_F - y_I)a[(1 - \alpha) + \alpha\pi](m + p)^2}{(m + \eta p)\alpha(1 - \pi)(m + ap)^2 + (m + \eta ap)a[(1 - \alpha) + \alpha\pi](m + p)^2}$$

Which is equivalent to:

$$(y_F - d)(m + \eta ap) = (y_F - y_I)(m + \eta p) \quad (25)$$

- If $(y_F - d) > \frac{(y_F - y_I)(m + \eta p)}{(m + \eta ap)}$, formal firms create too many jobs.
- If $(y_F - d) < \frac{(y_F - y_I)(m + \eta p)}{(m + \eta ap)}$, formal firms create too few jobs.

Under the Hosios condition, a transfer ϕ , implemented on productive formal firms, would restore the efficiency of the labor market. Including this transfer in the asset value of a formal productive firm leads to the following Bellman equation:

$$rJ_F = y_F - w_F + \phi - m[J_F - J_F^V] \quad (26)$$

Taking (25) into account, for the efficiency to be restored, the transfer as therefore to be equal to:

$$\begin{aligned} \phi &= \frac{(y_F - y_I)(m + \eta p)}{m + \eta ap} - (y_F - d) \\ \phi &= \frac{(y_F - y_I)(m + \eta p) - (y_F - d)(m + \eta ap)}{m + \eta ap} \end{aligned} \quad (27)$$

When $(y_F - y_I)(m + \eta p) > (y_F - d)(m + \eta ap)$, ϕ is a positive subsidy, and when $(y_F - y_I)(m + \eta p) < (y_F - d)(m + \eta ap)$, ϕ is a negative tax.

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