Heterogeneous Segmentation in Labor Markets

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Abstract

We construct a model that captures two features related to labor markets: (i) positive wage gap between formal and informal jobs (ii) negative relation between the wage gap and the worker’s productivity. The model is built on the idea that asymmetric information about productivity and past history of workers impact wages and labor contracts. This is particularly relevant if informal workers are able to resort to the legal system to punish the firms. Using Brazilian data, we test an implication of our model that there exists a negative relation between the average workers’ skills and the number of labor lawsuits.

1 Introduction

Informal jobs are broadly defined as employment relationships not subject to labor regulations. These relationships constitute a prevalent feature of the labor market in developing economies. In fact, Maloney (2004) estimates that informal jobs cover from 30% to 70% of the labor market in the majority of the Latin American countries. Thus, it comes as no surprise that much empirical work has been dedicated to the relation between formal and informal jobs in developing economies. However, there is not yet a theory that consistently explains all the empirical regularities observed, particularly the ones uncovered in the most recent empirical work. This paper contributes towards the objective of developing such a theory by putting forward a model that captures the relation between wages in formal jobs and wages in informal jobs.

1Labor regulations vary from country to country and include minimum wage, annual bonuses, vacations, advance notice, severance pay, seniority premium, among other mandate benefits. Heckman and Pagés (2000, 2004) summarize job regulations in Latin American and Caribbean countries.
In particular, we construct a model that captures two key empirical features. The first is that informal jobs pay on average less than formal jobs. This regularity has been extensively documented in the literature\textsuperscript{2} and at least two alternative theories have been proposed as possible explanations. According to Fields, 1975; Chandra and Khan, 1993; Loayza, 1994, 1997, formal jobs pay more because there exists barriers to entry in the formal sector and, as a result, even though firms and workers would prefer to participate in the formal sector, for some of them the informal sector is the only option. Alternatively, Rosenzweig, 1988; Maloney, 1998, 1999; Tybout, 2000 argue that firms and workers can choose between formal and informal contracts, and that some of them actually prefer informal contracts in order to escape labor regulations. The choice between a formal and an informal relation is thus explained by differences in workers and firms characteristics. For instance, workers may have distinct preferences over the fringe benefits provided by the formal sector, and firms may have distinct costs associated with maintaining a formal status.

The second feature is that there exists a negative relation between the wage gap, that is, the difference between the formal and the informal wage, and the productivity of the worker. This regularity has been documented by a more recent empirical work. Botelho and Ponczek (2009) show that for workers in the higher quintile of the wage distribution, informal contracts pay a higher wage than formal contracts in Brazil.\textsuperscript{3} Lehman and Pignatti (2007) study the Ukrainian labor market and show that the informal jobs in the upper tail of the wage distribution pay equal or more than the formal ones, but there is a wage premium in favor of formal jobs in lower parts of the wage distribution. To the best of our knowledge, no model has yet been proposed as explanation for this feature. In this paper, we propose a model that fills this gap and at the same time is consistent with the first empirical regularity.

In few words, our model can be explained as follows. The labor market is subject to asymmetries of information that cause both an adverse selection and a moral hazard problem. The adverse selection problem occurs because workers have private information about their productivity and the moral hazard problem occurs because firms cannot directly observe the actions of the workers in their previous jobs. Thus, if a firm wants to obtain information about the productivity and the history of her current worker she has to incur a cost. It is under these informational constraints that a firm chooses between a formal and an informal contract when employing a worker. In an informal contract, the firm does not need to pay benefits to the worker. However, the worker may choose to sue the firm and, in this case, we assume that benefits have to be paid and a penalty is incurred by the

\textsuperscript{2}Roberts, 1989; Magnac, 2001; Pradhan and von Soest, 1995; Funkhouser, 1996, 1997; Gong and Van Soest, 2002; Frank McInteyre, 2004; Badaoui et. al, 2007.

\textsuperscript{3}Tanuri – Pianto and Pianto (2003), using Brazilian cross-sectional data, also show that the earnings gaps between formal and informal workers are wider at low income quantiles than at high ones.
Table 1: Dispersion of wages by schooling

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Men</th>
<th>Women</th>
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<tbody>
<tr>
<td>3 or less years of schooling</td>
<td>7.0</td>
<td>7.2</td>
<td>6.8</td>
</tr>
<tr>
<td>4 to 7 years of schooling</td>
<td>13.6</td>
<td>14.2</td>
<td>12.8</td>
</tr>
<tr>
<td>8 or more years of schooling</td>
<td>25.7</td>
<td>32.0</td>
<td>21.9</td>
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source: Brazilian Household Survey - Pnad 2006

firm. We further assume that the variance of the worker's productivity increases with his skills. We demonstrate that the firm only has an incentive to incur the cost of observing the productivity and the history of her current worker if she is matched with a skilled worker. Intuitively, because unskilled workers have similar productivity, gaining information about them is beneficial only to the extent that this information is useful in anticipating whether the worker will sue the firm over unpaid benefits. It turns out that, irrespective of the cost of accessing past histories, there is no equilibrium in which firms have an incentive to access the record of an unskilled worker. As a result, the equilibrium wage of an unskilled worker in the informal sector is relatively low because it incorporates the employer's expectation that the worker will sue the firm at the end of the contracting period. In contrast, since skilled workers are heterogeneous, the firm has an incentive to incur the cost of observing their past history irrespective of their behavior. In the aggregate, this implies that firms can condition their choice of contract on the past behavior of skilled workers, which may discipline their behavior. As a result, the equilibrium wage of a skilled worker in the informal sector is relatively high because it incorporates the employer's expectation that the worker will not sue the firm at the end of the contracting period.

As can be seen in the discussion above, two assumptions are particularly important in our model and thus deserve a closer examination. First, we assume that a worker hired in an informal job has the right to receive benefits in case he chooses to sue the firm. This is consistent with the evidence that in most countries job regulations require the payment of mandate benefits even for workers hired under informal contracts (see Heckman and Pagés, 2000). Moreover, the employer is usually liable to pay fines over unpaid benefits.\footnote{For example, the Brazilian labor code stipulates a 50% fine; the Philippine code stipulates a fixed P100,000.00 penalty (around US$2,000.00).} In fact, justice branches in many countries (e.g. Argentine, Brazil, Chile, Dominican Republic) have
special courts specialized in labor disputes which generally rule in favor of the plaintiff, particularly if the worker is informally hired. Second, we assumed that the variance of the worker’s productivity increases with his skills. Table 1 and 2 present evidence on the standard deviation of wages (proxy for productivity), education levels and age (proxies for skills) in Brazil. As expected, the wage distribution becomes more disperse as the workers become more educated and more experienced.

Finally, a key implication of our model is that there exists a negative correlation between the skills of the worker and the likelihood that he will sue the firm if hired under an informal contract. We test this implication using Brazilian labor justice data. In particular we test whether in municipalities in which workers are more educated and have more experience there is a small number of lawsuits filled in their courts compared to municipalities that have a less skilled labor force. The empirical evidence shows a negative correlation between the number of labor lawsuits filled and measures of average labor force skills in the municipalities.

The paper proceeds as follows. In the next section, we present the model. In section 3 we discuss the empirical evidence. The last section concludes.

2 Model

Consider an infinite horizon economy with one good, a unit continuum of workers and a unit continuum of firms. Each worker is either unskilled (u) or skilled (s). An unskilled worker has ability $a_w = 0$ while a skilled worker has abilities $a_w \in \{1, 2\}$. Skills are observable but abilities are private information. The measure of unskilled workers is $\mu \in (0, 1)$ and the fraction of skilled workers with ability $a_w = 1$ is $\pi \in (0, 1)$. In every period, firms and workers meet randomly and in pairs. In a match, total production is equal to $y_{a_wa_f}$, where $a_w \in \{0, 1, 2\}$ is the ability of the worker and $a_f \in \{0, 1, 2\}$ is a costly action ($c_{a_f}$ is the
cost of action $a_f$) taken by the firm. We think of the action as an investment decision, e.g. the purchase of an equipment that is going to be operated by the worker. We assume that $y_{awaf}$ is strictly increasing in $aw$ and $af$, and $ca_f$ is strictly increasing in $af$. We also assume that the ability of the worker and the action of the firm are complements in the production of the good. More precisely, we assume that the function $y_{awaf}$ is strictly supermodular.\footnote{Let $aw_1 > aw_2$ and $af_1 > af_2$. Strict supermodularity implies that $y_{aw_1af} - y_{aw_2af}$ is strictly increasing in $af$ and $y_{awaf_1} - y_{awaf_2}$ is strictly increasing in $aw$.}

At the beginning of every period, after matches are formed, each firm can incur a cost $ch \in \mathbb{R}^+$ and access a technology that allows her to observe the “record” of her current worker. As it will become clear, the record of the worker includes the information about his ability and a summary of his behavior in all his previous matches. After her choice of whether to observe the record of the worker, each firm chooses her action $af$ and also chooses between a formal contract ($F$) and an informal contract ($I$). In a formal contract, the worker earns wage $w$ and receives benefit $b(w)$. In an informal contract, there is no benefit and the worker only earns the wage. We assume that firms are heterogeneous in terms of the costs and the benefits of being formal. For instance, a formal firm may have an easier access to the credit market and to subsidies offered by the government. However, she may face transaction costs associated with maintaining a formal status. We do not dwell here on the reasons underlying this heterogeneity. We simply denote the net cost of being formal by $c \in \mathbb{R}$. This cost is privately observed by the firm and comes at the beginning of period 1 as a random draw from a cdf $G(c)$.

At the end of every period, all matches exogenously break down. However, before this break occurs, each worker may choose to sue the firm if the firm chose an informal contract. In this case, the worker wins the lawsuit. The firm then faces a penalty $P$ and pays benefit $b(w)$, where $w$ is the wage received by the worker. In every match, workers and firms bargain over the wage. This bargaining occurs after the firm’s decisions but before the worker’s decision on whether to sue the firm. We solve the bargaining problem by applying the generalized Nash solution, where the bargaining power of the firm is equal to $\theta \in (0,1)$. Finally, workers maximize the sum of wages and benefits, and firms maximize profits. The discount factor of workers and firms is equal to $\delta \in (0,1)$. Figure 3 summarizes the sequence of events in a period.

Throughout our analysis, we assume that $aw = \arg \max_{af \in [0,1]} (\theta y_{awaf} - ca_f)$. As it will become clear, this assumption implies that if the firm knows the ability $aw$ of the worker, she chooses $af = aw$. 

\begin{align*}
\end{align*}
Firm and worker match
Production occurs and wage is paid
Worker chooses whether to sue the firm
Firm chooses action and contract
Firm chooses whether to observe record of the worker

Figure 1: Sequence of Events in a Period

**Benchmark**  We initially consider a scenario where the cost $c_h$ is infinite and firms do not have access to the record of their current worker. In this case, firms and workers behave myopically since their current decisions have no impact on their future payoffs. This sets a benchmark against which we analyze the case where $c_h$ is positive but finite.

Fix a generic match between a firm and a worker. First, consider the decision of the worker on whether to sue the firm. In a formal contract, the worker does not sue. Consider instead an informal contract. Because the wage $w$ is chosen before the worker’s decision, the worker obtains $w$ if he does not sue, and obtains $w + b(w)$ if he sues. It is thus a strictly dominant choice to sue for all $b(w) > 0$ (we assume that the worker does not sue if he is indifferent). As a result, in any equilibrium with $b(w) > 0$, if the firm chooses an informal contract, she takes into account that the worker will sue with probability one.

We now solve the bargaining problem. Under a formal contract, it consists of finding the wage $w$ that solves

$$\max_w \left[ y_{aw} a_f - w - b(w) \right]^\theta \left[ w + b(w) \right]^{1-\theta}.$$  

The first order condition implies a wage $w_F$ such that $w_F + b(w_F) = (1 - \theta) y_{aw} a_f$. In an informal contract, the worker always sues the firm. The bargaining problem is then

$$\max_w \left[ y_{aw} a_f - w - b(w) - P \right]^\theta \left[ w + b(w) \right]^{1-\theta}.$$  

Hence, the wage $w_I$ is such that $w_I + b(w_I) = (1 - \theta) (y_{aw} a_f - P)$. For now, assume that the firm chooses action $a_f$. The profit of the firm under a formal contract is $\theta y_{aw} a_f - c - c_{a_f}$, and under an informal contract it is $\theta (y_{aw} a_f - P) - c_{a_f}$. The firm chooses a formal contract if and only if

$$\theta y_{aw} a_f - c - c_{a_f} \geq \theta (y_{aw} a_f - P) - c_{a_f},$$  

that is, $c \leq \theta P$ (we assume that a firm chooses a formal contract if she is indifferent). Note
that the choice of contract by the firm does not depend on the skill and the ability of the worker.

We now turn to the firm’s choice of action \( a_f \). First, \( a_w = \arg \max_{a_f \in \{0,1,2\}} (\theta y_{awaf} - c_{af}) \) implies that the firm chooses \( a_f = 0 \) in a meeting with an unskilled worker. Consider now a meeting with a skilled worker. In principle, we could allow the worker to make an announcement to the firm about his ability. However, since \( y_{awaf} \) is strictly increasing in \( a_w \), the worker always has an incentive to announce that he has ability \( a_w = 2 \). Thus, the firm cannot trust the worker’s announcement when making her choice of action and must assume that the probability she is facing a worker with ability \( a_w = 2 \) is equal to the unconditional probability \( \pi (1 - \pi) \). Given this belief, if the firm chooses \( a_f \), her expected profit under an informal contract is \( \theta [\pi y_{1af} + (1 - \pi) y_{2af} - P] - c_{af} \), while her expected profit under a formal contract is \( \theta [\pi y_{1af} + (1 - \pi) y_{2af}] - c - c_{af} \). Note that the choice of action by the firm does not depend on the contract. In fact, irrespective of the contract, the firm chooses \( a_f \) such that

\[
\max_{a_f \in \{0,1,2\}} \{ \theta [\pi y_{1af} + (1 - \pi) y_{2af}] - c_{af} \}.
\]

For instance, if \( \pi \) is sufficiently close to 1 (0), \( a_w = \arg \max_{a_f \in \{0,1,2\}} (\theta y_{awaf} - c_{af}) \) implies that the optimal choice of the firm is \( a_f = 1 \) (\( a_f = 2 \)). Henceforth, we assume that

\[
\pi > \max \left\{ \frac{(\theta y_{22} - c_2) - (\theta y_{21} - c_1)}{\theta (y_{22} - y_{12}) - \theta (y_{21} - y_{11})}, \frac{(\theta y_{20} - c_0) - (\theta y_{21} - c_1)}{\theta (y_{20} - y_{10}) - \theta (y_{21} - y_{11})} \right\}.
\]

This ensures that it is optimal for the firm to choose \( a_f = 1 \). Proposition 1 summarizes our result.

**Proposition 1** There exists a unique perfect Bayesian equilibrium. In this equilibrium, in every period (i) workers under an informal contract always sue the firm; (ii) firms choose \( a_f = 0 \) in a meeting with an unskilled worker, and choose \( a_f = 1 \) in a meeting with a skilled worker; (iii) firms choose a formal contract if and only if \( c \leq \theta P \).

A direct implication of Proposition 1 is that the distribution of workers in terms of skills and ability is the same under formal and informal contracts. However, the choice of the contract depends on the decision of workers on whether to sue the firm. For instance, if workers would never sue under an informal contract, all firms with cost \( c > 0 \) would prefer to choose an informal contract.

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6This assumption is not necessary for any of the main results of the paper. It is only used to simplify the exposition.
In what follows, we are interested in the difference between wages under formal contracts and wages under informal contracts. For this reason, in order to provide an explicit expression for wages, we assume that \( b(w) = bw \), where \( b > 0 \). This implies

\[
  w_F(a_w, a_f) = \frac{(1 - \theta) y_{a_w a_f}}{1 + b},
\]

and

\[
  w_I(a_w, a_f) = \frac{(1 - \theta) (y_{a_w a_f} - P)}{1 + b}.
\]

Not surprisingly, wages are increasing in skills and ability, as higher skills and ability are associated with a higher surplus in a match. Moreover,

\[
  w_F(a_w, a_f) - w_I(a_w, a_f) = \frac{(1 - \theta) P}{1 + b} > 0.
\]

The wage under a formal contract is higher than the wage under an informal contract, irrespective of the skill and the ability of the worker. This occurs because the worker always sues the firm and obtains the benefit under an informal contract, which reduces the surplus of the match by a positive amount \( P \).

**General Case** Henceforth, we assume that \( c_h \) is finite. In every period, the set of possible records of a worker is given by

\[
  H = \{ h = (a_w, A) : a_w \in \{0, 1, 2\} \text{ and } A \in \{S, S\} \}.
\]

The first entry of vector \( h \) corresponds to the ability of the worker, and the second entry is a summary of the worker’s past behavior. It is equal to \( S \) if the worker never sued a firm in the past, and is equal to \( S \) otherwise. In general, the benefit of observing the worker’s record is twofold. First, the firm can condition her choice of action on the ability of the worker. Second, she can condition her choice of contract on the past behavior of the worker. For instance, the firm may decide to choose a formal contract if she observes that the worker sued a firm in the past, and an informal contract otherwise.

In what follows, we restrict attention to symmetric and stationary strategies. Consider a generic match between a firm and a worker. The history of the worker includes his past behavior and the past behavior of firms in all matches in which he participated. In turn, the history of the firm includes her past behavior, the past behavior of workers in all matches in which she participated and the records of workers with whom she matched in the past and sustained the cost \( c_h \). Note that there is no loss in generality if we assume that the worker does not condition his behavior on the behavior of firms in past matches. There is also no loss in generality if we assume that the worker with a summary of past behavior \( S \)
does not condition his behavior on the particular sequence of past choices that underlies the summary \( S \). The reason is that in an environment with a continuum of agents and random meetings, this information is private to the worker and is independent of the strategies of his current and future firms. This implies that the strategy of the worker is fully described by a function

\[
\sigma_w : \{\overline{S}, S\} \times \{0, 1, 2\} \rightarrow \{\overline{S}, S\},
\]

In words, the behavior of the worker at any point in time depends non-trivially only on his record and on the action of the firm he is currently matched with. Note that the worker does not condition his behavior on the current choice of contract by the firm because the worker is called upon to make a decision only if the firm chose an informal contract. Note also that the worker does not condition his behavior on whether the firm is able or not to observe his record. The reason is that this choice does not affect the worker’s current payoff and is not directly observed by firms in his future matches.

We now turn to the firm’s strategy. An argument similar to the one above implies that there is no loss in generality if we assume that the firm does not condition her behavior on the behavior and record of workers in past matches. This implies that the strategy of the firm is fully described by a pair of functions \( \sigma = (\sigma_a, \sigma_b) \), where

\[
\sigma_a : \mathbb{R} \times \{u, s\} \rightarrow \{\text{yes, no}\},
\]

and

\[
\sigma_b : \mathbb{R} \times \left[\{u, s\} \cup (\{\overline{S}, S\} \times \{0, 1, 2\})\right] \rightarrow \{I, F\} \times \{0, 1, 2\}.
\]

The function \( \sigma_a \) describes the choice of the firm with cost \( c \in \mathbb{R} \) on whether to incur the cost \( c_h \) (“yes”) upon meeting a skilled or an unskilled worker. In turn, the function \( \sigma_b \) describes the choice of contract and the choice of action of the firm with cost \( c \in \mathbb{R} \), conditional on the observed characteristics and observed record of the worker. Lemma 1 partially characterizes the behavior of firms and workers in a perfect Bayesian equilibrium.

**Lemma 1** In any perfect Bayesian equilibrium, firms do not pay the cost \( c_h \) in meetings with unskilled workers.

**Proof.** Assume that there is a perfect Bayesian equilibrium in which some firm incurs the cost \( c_h \) upon meeting an unskilled worker. The only benefit a firm obtains in accessing the record of an unskilled worker occurs when there is a positive measure of workers with record \( S \) and a positive measure of workers with record \( \overline{S} \). Moreover, it must be the case that workers condition their behavior on their record. Otherwise, regardless of the record, unskilled workers would choose the same action and the firm would be able to infer their
behavior without observing the record. Clearly, a worker with record $S$ strictly prefers to sue because his current action has no impact on his record. This implies that workers with record $\overline{S}$ do not sue. Now, if a worker with record $\overline{S}$ does not sue, it must be because the associated benefit is larger than the benefit of suing. However, this implies that there would be no worker with record $S$, a contradiction. ■

In the remainder of this section, we restrict attention to the following strategy profile. Unskilled workers always sue, irrespective of their record; and skilled workers sue if they have a record $(., S)$ and do not sue if they have a record $(., \overline{S})$. In turn, the behavior of firms is as follows. First, in meetings with a skilled worker, firms pay the cost $c_h$ and observe the record of the worker. In this case, they choose action 1 (2) if and only if the worker has ability 1 (2). If, by any chance, they do not observe the action of the worker, they choose $a_f = 1$. Moreover, they choose a formal contract if $c \leq 0$ and an informal contract if $c > \theta P$. If instead $c \in (0, \theta P]$, firms choose a formal contract if the worker has record $(., S)$ and an informal contract if the worker has record $(., \overline{S})$. Finally, in meetings with unskilled workers, firms do not pay the cost $c_h$. Moreover, they always choose action $a_f = 0$ and, as long as $c \leq \theta P \ (c > \theta P)$ they always choose a formal (informal) contract.

**Proposition 2** The strategy profile described above is a Perfect Bayesian equilibrium if and only if, for all $a_w \in \{1, 2\}$ and $a_f \in \{0, 1, 2\}$,

$$\delta \geq \frac{b_{y_{aw}a_f}}{b_{y_{aw}a_f} + [1 - G(\theta P)] P},$$

and

$$c_h \leq (1 - \pi) [(y_{22} - c_2) - (y_{21} - c_1)].$$

**Proof.** First, a direct implication of Lemma 1 is that, in any perfect Bayesian equilibrium, an unskilled worker simply maximizes his current payoff and sues the firm in every opportunity. Indeed, because he expects that no firm will ever observe his record, the worker has no incentive to maintain the record $\overline{S}$. Consider now the behavior of a skilled worker. Clearly, a skilled worker with a record $S$ sues if he has the opportunity to do so because it increases his current gain and does not affect his continuation gain. Now, in match in which the worker has ability $a_w \in \{1, 2\}$ and the firm has chosen action $a_f \in \{0, 1, 2\}$, a skilled worker with record $(a_w, S)$ does not sue if given the opportunity if and only if

$$\frac{\delta}{1 - \delta} y_{aw}a_f \geq b_{y_{aw}a_f} + \delta \{G(\theta P) y_{aw}a_w + [1 - G(\theta P)] (y_{aw}a_w - P)\}.$$

We can rewrite this condition as

$$\delta \geq \frac{b_{y_{aw}a_f}}{b_{y_{aw}a_f} + [1 - G(\theta P)] P}.$$
Consider now the choice of action of a firm with cost $c \in \mathbb{R}$. In a meeting with a skilled worker, because $a_w = \arg \max_{a_f \in \{H,L\}} (\theta y_{a_w a_f} - c_{a_f})$, the firm chooses $a_f = a_w$ whenever she observes the ability of the worker and chooses $a_f = 1$ if she does not observe the ability of the worker. In turn, in a meeting with an unskilled worker, she chooses $a_f = 0$. It remains to consider the firm’s choice of contract and her choice of whether to incur the cost $c_h$. In meetings with unskilled workers, Lemma 1 implies that the firm does not incur the cost $c_h$. Moreover, because she anticipates that unskilled workers always sue, she chooses a formal contract if and only if $c \leq \theta P$. Instead, in meetings with skilled workers, the firm chooses to incur the cost $c_h$ as long as $c_h < (1 - \pi) [(y_{22} - c_2) - (y_{21} - c_1)]$. Moreover, if she has cost $c \leq 0$, she always chooses a formal contract, irrespective of the behavior of the worker; and if she has cost $c > \theta P$, she always chooses an informal contract, irrespective of the behavior of the worker. Finally, consider a meeting between a firm with cost $c \in (0, \theta P]$ and a skilled worker. If the firm anticipates that the worker sues (which happens when the worker has a record $S$) she chooses a formal contract. Otherwise, she chooses an informal contract. This concludes our proof.

Proposition 2 describes one possible equilibrium in the economy. However, in the region of parameters where it exists, this equilibrium is efficient in the sense that it achieves the highest surplus in the class of all perfect Bayesian equilibria. In fact, on the equilibrium path, a skilled worker never sues and the surplus is not reduced by the penalty $P$. Moreover, in a meeting with a skilled worker, the firm chooses a formal contract if and only if $c \leq 0$, and the firm always chooses the action that is complementary with the ability of the worker.

It is interesting to compare our results with the scenario where $c_h = 0$. In this case, it can be shown that there is an equilibrium in which workers never sue, irrespective of their skills. This equilibrium though cannot be sustained when $c_h > 0$, no matter how small $c_h$ is. The argument runs as follows. Assume that there is an equilibrium in which workers never sue. In this equilibrium, workers do not sue because they fear the future punishment in case they change their record from $\overline{S}$ to $S$. For any $c_h > 0$, this fear can only be effective as a deterrent of opportunistic behavior if a positive measure of firms is willing to face the cost $c_h$ and “monitor” the behavior of unskilled workers. The problem is that, if a positive measure of firms is effectively preventing a misbehavior by unskilled workers, an isolated firm has no incentive to incur this cost. First, there is no need to learn the ability of the worker because all unskilled workers have the same ability. Second, she can free-ride on the monitoring that other firms are offering.

Proposition 2 implies that the difference in wages between a formal contract and an
informal contract for an unskilled worker is
\[
\Delta w_0 = \frac{(1 - \theta) P}{1 + b} > 0,
\]
while the corresponding difference in wages for a skilled worker with ability \( a_w \in \{1, 2\} \) is
\[
\Delta w_{a_w} = -\frac{b (1 - \theta)y(a_w, a_w)}{1 + b} < 0.
\]
The difference between wages under formal contracts and wages under informal contracts is thus decreasing in skills. Moreover, the average wage of a worker in the formal sector is higher than the average wage in the informal sector as long as the proportion of unskilled workers \( \mu \) is high enough, that is, as long as
\[
\mu > \frac{\pi y_{11} + (1 - \pi) y_{22}}{P + \pi y_{11} + (1 - \pi) y_{22}}.
\]
Thus, our model reproduces all stylized facts discussed in the introduction. First, on average the wage premium favors formal workers. Second, there exists heterogeneous segmentation conditional on the workers’ skills.

2.1 Comments

Our model contains a number of assumptions and three of them deserve special attention. First, and most important, we assumed that the dispersion of productivity increases with the skills of the workers. This assumption is appealing because, as argued in section 1, it is consistent with the empirical observation that the dispersion of wages (a proxy for dispersion of productivity) increases with education and age (proxies for skills). We have shown that, combined with the assumption that the ability of the worker and the action of the firm are complements in the production of the good in a match, it sets the ground for the existence of an equilibrium in which the incentive of a firm to acquire information increases with the skill of the worker. It is important to point out that there may be alternative reasons as to why firms end up more informed about workers with higher skills. For instance, if we assume that the productivity of skilled workers is more persistent than the productivity of unskilled workers, employers may have more incentive to observe the history of the skilled worker because it reveals more information about his current productivity. Alternatively, we can assume that workers form social networks that allow them to exchange information about themselves and transmit this information to firms. If we further assume that skilled workers are more able to form such networks, a natural implication is that firms will end up more informed about workers with higher skills. The important aspect to note is that, irrespective of the framework considered, the main conclusions of our model remain valid.
In fact, it is the presence (absence) of information about skilled (unskilled) workers that generates the result that the differential between formal and informal contract wages is a decreasing function of the skills.

Second, we considered a particular market structure where firms and workers meet randomly and in pairs, there is one meeting per period and matches exogenously break down at the end of every period. This structure captures in a simple way the idea that in a market where interactions between firms and workers are short-lived, the presence of imperfect information by firms about the abilities and the past histories of the workers is a prevailing feature. As long as this idea is preserved, our results are robust to alternative specifications. For instance, it may be argued that a competitive search framework in which firms compete for workers by posting wage offers that condition on skills is more realistic than a random search framework with ex-post Nash bargaining. We conjecture that this alternative specification generates similar results. In fact, if a firm posts a wage that attracts skilled workers and chooses an informal contract, she will have two benefits: the higher productivity, and the absence of the lawsuit penalization for not paying the benefits. This is so because a skilled worker does not sue even when hired under an informal contract, as he anticipates that his past history will be observed by firms in his future matches. In contrast, if she posts a wage that attracts skilled workers but chooses a formal contract, she will benefit from the higher productivity of the worker but she will have to pay the benefits. This implies that in equilibrium, there must exist a wage premium in favor of the skilled workers hired under an informal contract.

Finally, we also considered a structure where workers have two types of skills and three types of abilities and firms pay the same cost when observing the record of the workers. It may be argued that a better specification involves a continuum of skills and abilities for the workers and a continuum of costs for the firms. In this case, we conjecture that there exists an equilibrium in which the proportion of workers who do not sue if faced with an informal contract increases with the skill. The reason is that the cost of choosing a wrong action and thus the benefit of monitoring increases with the dispersion of the ability. Hence, the fraction of firms that will pay the monitoring cost increases with the skill level of the matched worker. As a result, a worker with a higher skill has more incentives to behave well by not suing a firm who chooses an informal contract. Finally, because firms anticipate that workers with a higher skill will not sue, they will pay higher wages under an informal contract. All in all, this implies that, in equilibrium, the differential between formal and informal contract wages will be a decreasing function of the skills.
3 Empirical Evidence

A key implication of our model is that high-skilled workers faced with an informal contract would choose to not sue the employer to maintain a good record. In what follows we use data from the Brazilian Special Labor Courts to check if there exists a correlation between workers’ skills and labor lawsuits in the Brazilian Municipalities.

The Brazilian Labor Judicial System encompasses several courts spread over the country. Each municipality has one or more labor courts responsible for lawsuits in its jurisdiction. A worker can only file a lawsuit in labor courts responsible to the municipality he works. We have data on the number of labor lawsuits filed in each court in the country in 2007 and 2008. Since the mapping between courts and municipalities is not one-to-one we proceed as follows. For municipalities in which there is more than one court responsible to the labor lawsuits, the number of lawsuits in each court is summed up. For courts responsible for more than one municipality, we input the number of lawsuits filed in that court divided by the number of municipalities to all municipalities in the court jurisdiction.

We use the Brazilian Census of 2000 to gather average data on skills and other characteristics of workers and households in each municipality. Table 3 shows the results of regressions between the number of lawsuits and different measures of workers’ skills in the municipalities. Average years of education, average human capital, proportion of individuals (over 25) with some college education and proportion of individuals with less than four years of schooling are used as proxies of workers skills. Human capital is calculated by the Research in Economics Government Agency (IPEA) based on the average years of schooling, labor market experience and on the earning returns of education and experience in each municipality (see Caperna and Oliveira, 2002).

We control for average individual and household characteristics such as income per capita; total population and its square; proportion of households below the poverty line; proportion of population occupied; proportion of population in rural areas; number of municipalities in same labor court jurisdiction; average municipal spending in education, health services and investments; average municipal revenues in tax collection, state and federal transfers; proportion of households with sewer, light, and trash collection services; and state dummies. We have information on 4,891 of the 5,561 Brazilian municipalities.

The empirical evidence is consistent with our model. In municipalities where workers...
Table 3 - Regressions: Lawsuits and Skills - Brazilian Municipalities

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Years of Education (25 or older)</td>
<td>-1,827***</td>
<td>(483)</td>
<td></td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Log of Average Human Capital</td>
<td>-2,712***</td>
<td>(300)</td>
<td></td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>% with 11 years of education or more (25 or older)</td>
<td>-406***</td>
<td>(102)</td>
<td></td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>% with less than 4 years of schooling (25 or older)</td>
<td>135***</td>
<td>(40)</td>
<td></td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Number of observations: 4,891

Table 4 - Descriptives Statistics - Brazilian Municipalities

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of lawsuits in 2007-2008</td>
<td>4,336</td>
<td>9,004</td>
<td>172</td>
<td>395,102</td>
</tr>
<tr>
<td>Average Years of Education (25 or older) (%)</td>
<td>4.04</td>
<td>1.29</td>
<td>0.81</td>
<td>9.65</td>
</tr>
<tr>
<td>Log of Average Human Capital</td>
<td>12.33</td>
<td>1.94</td>
<td>0.00</td>
<td>19.95</td>
</tr>
<tr>
<td>% with 11 years of education or more (25 or older)</td>
<td>3.31</td>
<td>3.03</td>
<td>0.00</td>
<td>33.83</td>
</tr>
<tr>
<td>% with less than 4 years of schooling (25 or older)</td>
<td>49.27</td>
<td>17.24</td>
<td>7.00</td>
<td>91.40</td>
</tr>
</tbody>
</table>

Sources: Federal Supreme Court, Brazilian Census, and IPEA

Present lower level of education and experience, the number of lawsuits is greater compared to municipalities whose workers are more educated or have more experience. For instance, one extra year of schooling on average reduces by 1,827 the number of lawsuits received in two years. This is a sizeable number since, as can be seen in table 4, the average number of lawsuits in the municipality is 4,336.

For the sake of simplification, our model assumes that the process of suing a firm is costless. However, it is possible that a costly access to justice may influence the type of workers who file a lawsuit. Although we are controlling for income per capita it is possible that unobservable characteristics associate with schooling may determine the worker’s decision to sue the firm. For instance, it is possible that a worker with college education has more knowledge about the Brazilian labor code. Nevertheless, if that is the case, we should expect a positive correlation between education and lawsuits, which runs against the results.
of the model.

4 Conclusion

In this paper we build a model addressing empirical features related to informal labor markets. The central tenet of our model is the idea that asymmetric information about the productivity and the past history of workers can have an impact on wages and on the choice of labor contract. This impact is particularly relevant in an environment where workers are able to resort to the legal system and successfully punish a firm who chooses an informal contract and does not pay labor benefits mandated by law. In fact, we construct an efficient equilibrium that displays a negative relation between the wage gap (difference between the wage under a formal contract and the wage under an informal contract) and the productivity of the worker, a result that matches the empirical evidence.

Our results shed some light on non-trivial effects of the interference of the legal system on labor relations. In fact, it is usually claimed that such interference is desirable in order to correct for inefficiencies caused by the excess of asymmetric information between workers and firms. Our model suggests that this argument is less true for skilled workers because firms have an incentive to incur in costly actions that allow them to observe the productivity of the skilled worker. More interestingly, in doing so, firms have also access to the history of the worker, and this allows for an equilibrium where the surplus is maximized in matches between firms and skilled workers.

References


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