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Ethnic Diversity, Market Structure and Risk Sharing in Agrarian Societies

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Abstract

We consider a population of heterogenous laborers and landlords who belong to different ethnic groups so that working together implies a cost (because of language and cultural differences). Part of the production is random (because for example of climate change) and not observable (ex ante) by both landlords and laborers. We study the optimal risk sharing contract set by landlords who imperfectly compete to attract laborers. We show that, in equilibrium, landlords tend to hire laborers of similar ethnic background and landlords' co-ethnics earn more than other laborers. We also show that wages strongly depend on the degree of isolation of laborers from other communities. Large language and cultural differences imply that only laborers and landlords of similar ethnic origin can work together. This gives a high monopsony power to landlords which are able to set low wages. Finally, we find that the variable part of the remuneration offered to the laborers increases with the degree of ethnic diversity in the region whereas the fixed part is reduced when ethnic costs increase.

Keywords: landlords, laborers, ethnic diversity, piece rates, fixed wages.

J.E.L. Classification: D43, J33, O12

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1 Introduction

It is well documented that in most countries, individuals tend to work with employers of the same ethnic origin. In developed countries, foreigners and recent migrants, like for example the Cubans in Florida or the Chinese and Mexican in California, form closed-knit societies and work together (see e.g. Borjas, 1999). The same is true in the U.K. for Indians, Bangladeshi or Pakistanis (see e.g. Modood et al., 1997). In less developed countries, the ethnic origin is even more crucial to understand the way labor markets work (see e.g. Assaad, 1997, for Egypt, van de Walle and Gunewardena, 2001, for Viet Nam, Barr and Oduro, 2002, for Ghana). The aim of this paper is to theoretically investigate the impact of ethnic diversity on wage setting by focusing on agrarian societies.

The standard literature on agricultural tenancy explains the existence of different contracts, such as sharecropping, fixed-rental and fixed-wage contracts, in rural areas, without taking into account the role of ethnic diversity. In general, to account for these different contracts in LDCs, three major explanations have been offered in the literature: (i) trade off between risk sharing and transaction costs (uncertainty, risk and moral hazard problems), (ii) screening workers of different abilities (adverse selection problems), (iii) market imperfections for inputs besides land (see in particular Binswanger and Rosenzweig, 1982, McIntosh, 1984, Eswaran and Kotwal, 1985).

All of these approaches have been well developed both theoretically and empirically (see in particular Stiglitz, 1974, Cheung, 1969, McIntosh, 1984, Newberry and Stiglitz, 1979, Shaban, 1987, and more recent surveys in books like the ones of Basu, 1997 and Ray, 1998), even though the third approach has received less attention in the literature.

However, empirical evidences (especially in LDCs) have shown that the ethnic origin of both employers and employees is crucial to understand the wage setting in rural labor markets. For example, in Ghana, Barr and Oduro (2002) find that eleven percent of workers are employed by a relative and a further 23% are employed by a non-related member of the same ethnic group. They also show that being related to the employer is associated with a 23% earnings premium.

To the best of our knowledge, the link between ethnic diversity and wage contracts has been neglected and the aim of this paper is to provide a simple model that sheds some light on these aspects.

In our model, we consider a population of laborers and landlords who belong to different ethnic groups so that working together implies a cost (because of language and cultural differences). Part of the production is random (because for example of climate change) and not observable (ex ante) by both landlords and laborers. We evacuate moral hazard as well as adverse selection problems by focusing on closely-knit village communities. Indeed, the ignorance on the part of landlords about tenants' abilities is quite inappropriate for most rural communities (this is already discussed in Bardhan, 1984 and Eswaran and Kotwal, 1985). Concerning moral hazard problems, the assumption of closely-knit village communities means that all agents (landlord and laborers) belong to the same ethnic group or even the same family (it is well documented that in LDCs people of the same ethnic group or even of the same extended family tend to work together; see e.g. Barr and Oduro, 2002, or Pandey, 2002). This in turn prevents laborers to shirk (moral hazard) because of reputation effects and peer group (or family) pressures.

Contrary to the 'standard' approach with moral hazard where the focus is on the tension between the interests of the laborers and the landlord in an environment where (like here) output is not perfectly observable, in our model, the 'tension' is between landlords of different ethnic origins. Indeed, because laborers and landowners belong to different ethnic groups, there is a cost for laborers to work for a landlord with a different ethnic background. This implies that landlords have market power over laborers having similar ethnic origin so that they play a Nash game with other landowners to determine the optimal wage contract. In particular, given the competition in the labor market and the volatility of output, profit-maximizing landlords set wages to attract enough laborers and to reduce the risk associated with the output's uncertainty. It is not surprising that most of our results will depend on the degree of competition in the labor market (as measured by the number of landlords, the ethnic cost ...) and on the degree of risk aversion of both laborers and landlords. In particular, if landlords are very risk averse, they will be very sensitive to large variations in output and in this case will transfer as much as risk as they can onto laborers. So our main question is *how to share the risk of a random production that affects both landlords' profits and laborers' utility in a framework where all agents are ethnically differentiated and where landlords imperfectly compete with each other to attract laborers.*

Our results are the following. We first show that, in equilibrium, landlords tend to hire laborers of similar ethnic background and landlords' co-ethnics earn more than other laborers. We also show that wages strongly depend on the degree of isolation of laborers from other communities. Large language and cultural differences imply that only laborers and landlords of similar ethnic origin can work together. This gives a high monopsony power to landlords which are able to set low wages. We then show that if landlords are risk neutral and laborers risk averse, then landlords set a fixed (or time) wage whereas if they are risk-averse and laborers are risk neutral, landlords propose a piece rate contract. We also show that when both laborers and landlords have the same degree of risk aversion, then it is optimal for landlords to set an impure piece rate contract in which laborers' salary consists of a fixed part and a variable one that is proportional to their production. Finally, we demonstrate that the variable part of the remuneration (piece rate) offered to the laborers increases with the degree of ethnic diversity in the region whereas the fixed part is reduced when ethnic costs increase.

The rest of the paper is organized as follows. The next section presents the general model whereas section 3 analyzes the labor market equilibrium. In section 4, we determine the different landlords' method of pays and derive some testable predictions in section 5. We also discuss some implications of the model in section 5. Finally, section 6 concludes.

2 The model

We develop a theoretical model that is specific to less developed countries. For that, we would like to model the interaction in the labor market (i.e. wage setting) between landlords (employers) and laborers (workers) of different ethnic origins.

We assume that there is an ethnic 'distance' between workers and employers of different ethnic groups and, as a result, a cost t per unit of (ethnic) 'distance' is borne when they interact with each other. The most natural interpretation of t is 'language and culture'. There is indeed a cost to work with individuals of different cultures and different languages since, as stated by Lazear (1999), 'common culture and common language facilitate trade between individuals'. There are very strong evidences on this issue (see among others Chiswick, 1978, Chiswick and Miller, 1996, Dustman and Preston, 2001, for the U.S. and the U.K, and Assaad, 1997, or Barr and Ondoro, 2002, for less developed countries) showing that it is indeed costly to work with individuals of different ethnic groups because of language and cultural differences.[1]

[1] Co-ethnicity is defined with repect to shared ethnic identity.

In order to model this ethnic 'distance', we choose to represent the ethnicity space by the circumference C of a circle of length L (Salop, 1979). On this circle, n landlords (employers) and a continuum of laborers (workers) are uniformly distributed along its circumference. This captures the fact that ethnic diversity is pre-determined and that the ethnic distance between a laborer of a certain ethnic group and a landlord of the same group is obviously smaller than with a landlord of a different ethnic group. For simplicity, we assume that landlords are equally spaced along the circumference C so that L/n is the ethnic distance between two adjacent landlords. Laborers reside in different 'locations' along the circumference, which implies that they support different ethnic costs to work with different landlords. In other words, we segment the population into several groups that are distinct in terms of language and/or culture. Formally, the ethnic cost is given by a linear function $t\,|x - y_i|$ of the difference between a worker of ethnicity $x \in C$ and an employer of ethnicity $y_i \in C$.

All laborers (workers) are identically productive and produce q observable units of output. This means that agents are *horizontally* differentiated, which implies that landlords (employers) do not come predominantly from one ethnic group (which is the case in most LDCs). For example, in the Ghanaian context, Barr and Oduro (2002) show that the ethnic distributions of employers and employees are very similar, even though ethnic diversity is quite important. In Ghana, there are over 100 distinct ethnic groups and many of the ethnic groups have distinct languages. Others, while sharing their language consider themselves to be distinct for cultural or historical reasons. Furthermore, Ghana's index of ethnolinguistic fractionalization (i.e. the probability of two randomly drawn individuals in Ghana belonging to different ethnic groups) is 0.71 and the average for sub-Saharan Africa is 0.65.

It should be clear that, because of both landowners and laborers ethnic diversities, the competition in the labor market is imperfect since landowners have local monopsony power over laborers of similar ethnic background. This is because it is more costly for a laborer of a certain ethnic group to work with a landlord of a different ethnic background than with a similar one.

Firms produce an homogeneous good (which is taken to be the numeraire) sold on a competitive market whose production is random. Indeed, even if all the inputs that a farmer can reasonably control are properly applied, the size of the harvest is still heavily dependent on Nature and will vary. To express this uncertainty, we suppose that the production level is $q + \widetilde{\theta}$, where q is the observable part of the production and where $\widetilde{\theta}$ is described by a random variable whose mean is chosen to be 0 (without loss of generality) while its variance is σ^2. As in Sandmo (1971), greater output uncertainty is measured by an increase in σ^2: a mean preserving spread in production. In the context of LDCs, the random part of the production is due for example to climate changes. In other words, all laborers are assumed to produce q but there is a common shock (uncertainty) captured by $\widetilde{\theta}$ that is out of control of both the laborer and the landlord and that affects production.

We would now like to define the optimal contract on which both the landlord and the laborer (working on the landlord's land) agree. As discussed in the introduction, because of the specific context of small villages in LDCs, moral hazard problems are assumed to be relatively small so that we have chosen to ignore them. This is admittedly a simplifying assumption but help us to focus on labor heterogeneity and ethnic issues. Therefore, in this paper, we would like to focus on *optimal risk sharing* and on *landlords' choice of method of pay* in a framework where *both landlords and laborers are ethnically differentiated.*

For that, each landlord $i = 1, ...n$ proposes the following revenue (contract) to the laborer:

$$\widetilde{R}_i = \alpha_i(\widetilde{\theta} + q) + \beta_i \qquad\qquad i = 1, ..., n \tag{1}$$

with $0 \leq \alpha_i \leq 1$ and $\beta_i \gtreqless 0$. It is easy to see from (1) that this contract is composed of two elements: a fixed part β_i that can be positive, negative or equal to zero, and a variable part which is tied to the (random) output. In fact, the laborer obtains a percentage α_i of his/her production and the landlord gets a percentage $1 - \alpha_i$ of the laborer's production. The following definition characterizes the different possible contracts.

Definition 1 *For laborers working on landlord i's land:*

- **A fixed-wage contract** is when their compensation is independent of what they produce, i.e. $\alpha_i = 0$.
- **A pure piece-rate contract** is when they are only paid according to what they produce, i.e. $\beta_i = 0$.
- **An impure piece-rate contract** is a mix of fixed and piece-rate contracts, i.e. $0 < \alpha_i < 1$ and $\beta_i > 0$ or $\beta_i < 0$. There are indeed two parts in the compensation: a fixed one, which is independent of production and a variable one, which is a percentage of production.

One of the main originality of our framework is to consider not one but a finite numbers of heterogenous landlords (in terms of ethnicity) and a continuum of heterogenous laborers (in terms of ethnicity). Because of this double heterogeneity, the competition in the labor market will be imperfect since landlords have some monopsony power over laborers that are ethnically 'close'. The other original part of this work is that the outside option of laborers is endogenous and depends on the strategies of other landlords. Indeed, each landlord has to decide the optimal contract by taken into account the strategies of the other landlords in the market. Even if some laborers are ethnically different from a landlord, they may work with him/her if this landlord proposes a more advantageous contract.

Formally, landlords choose simultaneously α_i and β_i (Nash equilibrium) and therefore laborers's revenues, $\widetilde{R}_1, .., \widetilde{R}_i, .., \widetilde{R}_n$, before the realization of the risk $\widetilde{\theta}$ but anticipating the impact of their compensation on laborers' labor supply. Thus, given (1), the *realized wage* of a laborer of ethnicity x working for a landlord of ethnicity y_i is given by:

$$\widetilde{Z}_{x,y_i} = \widetilde{R}_i - t\,|x - y_i| = \alpha_i(\widetilde{\theta} + q) + \beta_i - t\,|x - x_i| \tag{2}$$

In this section, we assume that *laborers are risk averse*. In order to obtain closed forms solutions, we further assume that a laborer of ethnicity x working for a landlord of ethnicity y_i has a mean-variance utility function given by:[2]

$$\begin{aligned} U_{x,y_i} &= E(\widetilde{Z}_{x,y_i}) - \frac{a}{2}Var(\widetilde{Z}_{x,y_i}) \\ &= E\left[\alpha_i(\widetilde{\theta} + q) + \beta_i - t\,|x - y_i|\right] - \frac{a}{2}Var\left[\alpha_i(\widetilde{\theta} + q) + \beta_i - t\,|x - y_i|\right] \\ &= W_i - t\,|x - x_i| \end{aligned} \tag{3}$$

where $W_i = \alpha_i\, q + \beta_i - \frac{a}{2}\alpha_i^2\sigma^2$ is the expected utility gross of ethnic costs when working in landlord i, $E[\cdot]$ is the expectation operator, $Var[\cdot]$ is the variance operator and $a \geq 0$ is the degree of absolute risk aversion.[3]

Observe that W_i *is not a random variable* since landlords commit to wages and employment before output realizations. Once each landlord i proposes W_i, each laborer chooses to be hired by the landlord that gives the highest utility (net of ethnic costs). Since landlords anticipate the choice of laborers, they hire all the laborers who want to work at the prevailing expected utilities,

[2]It is easy to see that the case of risk neutrality is a special case of our mean-variance utility function when $a = 0$. We will study this issue in the next section.

[3]To derive (3), one must use our initial hypotheses: $E[\widetilde{\theta}] = 0$ and $Var[\widetilde{\theta}] = \sigma^2$.

$(W_1, .., W_i, .., W_n)$, because they know that these laborers are ethnically quite similar. The reservation wage is assumed to be the same across laborers since they are all identical in terms of productivity. Thus, without loss of generality, the reservation wage is set equal to zero.

Given W_{i-1} and W_{i+1}, landlord i's labor pool is composed of two subsegments whose outside boundaries are given by marginal laborers $\underline{x}$ and $\overline{x}$ for whom the net wage is identical between landlords $i-1$ and i, on the one hand, and landlords i and $i+1$, on the other. In other words, $\underline{x}$ is the solution of the equation:

$$W_i - t(y_i - \underline{x}) = W_{i-1} - t(\underline{x} - y_{i-1})$$

so that

$$\underline{x} = \frac{W_{i-1} - W_i + t(y_i + y_{i-1})}{2t} \tag{4}$$

In this case, landlord i attracts laborers whose locations belong to the interval $[\underline{x}, x_i]$ because the expected utility net of ethnic costs they obtain from landlord i is higher than the one they would obtain from landlord $i-1$. Clearly, laborers belonging to the interval $[x_{i-1}, \underline{x}]$ are hired by landlord $i-1$. In a similar way, we show that:

$$\overline{x} = \frac{W_i - W_{i+1} + t(y_i + y_{i+1})}{2t} \tag{5}$$

Consequently, landlord i's labor pool is defined by the interval $[\underline{x}, \overline{x}]$. In this context, landlord i's *realized profits* can thus be written as:

$$\begin{aligned} \widetilde{\Pi}_i &= \int_{\underline{x}}^{\overline{x}} (\widetilde{\theta} + q - R_i) dx \\ &= (\widetilde{\theta} + q - R_i)(\overline{x} - \underline{x}) = \left[(1-\alpha_i)(\widetilde{\theta} + q) - \beta_i\right](\overline{x} - \underline{x}) \end{aligned} \tag{6}$$

In this section, we assume that *landlords are risk averse.* Here also, in order to obtain closed forms solutions, we further assume that landlords have a mean-variance utility function given by:[4]

$$V_i = E(\widetilde{\Pi}_i) - \frac{\rho}{2} Var(\widetilde{\Pi}_i) \tag{7}$$

[4]Again, it is easy to see that the case of risk neutrality is a special case of our mean-variance utility function when $\rho = 0$. We will study this issue in the next section.

where $\rho \geq 0$ is the degree of absolute risk aversion and where $\widetilde{\Pi}_i$ is defined by (6). Hence, we can rewrite (7) as follows:

$$V_i = [(1-\alpha_i)q - \beta_i]\,(\overline{x} - \underline{x}) - \frac{\rho}{2}(1-\alpha_i)^2(\overline{x} - \underline{x})^2\sigma^2 \tag{8}$$

Since landlords and laborers are all assumed to be risk averse, the problem here is how to share the risk in the context of imperfect competition. Landlords play a Nash game to determine α_i and β_i. We will see that distinct types of compensations will emerge depending on the values of the different parameters.

3 Labor market equilibrium

We can now derive our first result. We assume that all laborers take a job in equilibrium. In this context, the outer boundaries of landlord's labor pool are given by (4) and (5). Landlord i chooses α_i and β_i to maximize his/her utility (8). We have the following result.[5]

Proposition 1 *If*

$$q > 3\frac{\sigma^2\rho\,L\,a}{\rho\,L + a\,n} + \frac{4tL}{n} \tag{9}$$

holds, there exists a unique symmetric Nash equilibrium given by:

$$\alpha^* = \frac{\rho\,L}{\rho\,L + a\,n} \tag{10}$$

$$\begin{aligned}\beta^* &= (1-\alpha^*)q - \frac{\rho\,L}{n}(1-\alpha^*)^2q^2\sigma^2 - \frac{tL}{n} \\ &= \frac{a\,n}{\rho\,L + a\,n}\left(q - \frac{\sigma^2\rho\,L\,a}{\rho\,L + a\,n}\right) - \frac{tL}{n}\end{aligned} \tag{11}$$

and, before ethnic costs, all laborers obtain the same following positive utility:

$$W^* = q - \frac{\sigma^2\rho\,L\,a\,(\rho\,L/2 + a\,n)}{(\rho\,L + a\,n)^2} - \frac{tL}{n} \tag{12}$$

whereas the equilibrium landlords' profit is equal to:

$$V^* = \left(\frac{L}{n}\right)^2\left[t + \frac{\rho}{2}\left(\frac{a\,n}{\rho\,L + a\,n}\right)\sigma^2\right] \tag{13}$$

[5] Since at the symmetric Nash equilibrium all firms pay the same wage, we have skipped the index i.

Proof. See the Appendix.

The following comments are in order. First, we obtain that, in equilibrium, landlords (employers) tend to hire laborers (workers) of similar ethnic background (in equilibrium, the maximum 'distance' to hire someone is $L/2n$) and employers' co-ethnics earn more than other workers (indeed, even though the remuneration (12) is the same for all laborers, because of ethnic costs, the net remuneration decreases with the ethnic 'distance' to the landlord). These results are consistent with empirical studies. For example, in Ghana, Barr and Oduro (2002) find that eleven percent of workers are employed by a relative and a further 23% are employed by a non-related member of the same ethnic group. More generally, worker from every ethnic group are more likely to work for a member of their own ethnic group than for a member of another Ghanaian ethnic group. Furthermore, they show that being related to the employer is associated with a 23% earnings premium.

Second, this general case corresponds to an 'impure' piece rate contract in which laborers have a fixed pay equals to $\beta \gtrless 0$ and a variable one which is a fraction $0 < \alpha < 1$ of what they produce (see Definition 1 above). In our model, the only choice laborers have is to decide which landlord they want to work to (this depends on both their ethnic distance to that landlord and the compensation offered). Given this choice, each landlord i chooses α_i and β_i that maximize his/her profit by taking as given the choice of the αs and βs of the other landlords in the economy. Each landlord also takes into account the impact of his/her compensation policy on his/her 'natural' laborers (i.e. those whose is enough close to the landlord's ethnic group). In this respect, we have:[6]

$$\frac{\partial W}{\partial \alpha} = q - a\alpha\sigma^2 > 0$$

and

$$\frac{\partial W}{\partial \beta} = 1 > 0$$

This means that when landlords increase the variable part α or the fixed part β of the salary, his/her labor supply increases. It is interesting to observe from $\partial W/\partial \alpha$ that the reaction of laborers negatively depends on both σ^2 the variance of the production and a the laborers' degree of risk aversion.[7] In

[6] Observe that $\frac{\partial W^*}{\partial \alpha} > 0$ by using (20) in the Appendix.

[7] Indeed, it is easy to check that:

$$\frac{\partial^2 W^*}{\partial \alpha \partial \sigma^2} < 0 \qquad \text{and} \qquad \frac{\partial^2 W^*}{\partial \alpha \partial a} < 0$$

particular, if laborers are very risk averse, their utility will not increase very much following a rise in α.

Third, one can verify from (10) that an increase in ρ, the degree of risk aversion of landlords, and/or a decrease in a, the degree of risk aversion of laborers, raises α^*. Concerning a, this is quite natural since more risk averse laborers prefer to see a reduction in α the uncertain part of their salary. Concerning ρ, the decision to increase α^* depends on the competition in the labor market. If it is very fierce because landlords are not very risk averse (low ρ), then landlords reduce α^* to attract more laborers. The effects of ρ and a on β, the fixed part of the pay, are more complex, and will be analyzed in more details in the next section.

However, at this stage, we can analyze the effect of ethnic diversification on α and β. First, it is easy to see that the unit ethnic cost, t (which is a measure of firms' market power) does not affect α but negatively affects β. Indeed, when t increases (for example the cost of learning a language is very large or cultural differences are extreme), landlords have higher monopsony power on similar laborers since it becomes too costly for these laborers to be attracted by other landlords with more diverse ethnic origin. So, when t rises, landlords can decrease the fixed part of the wage. They cannot however affect the piece rate since the latter is tied to output only. Second, by differentiating (10) and (11), it is easy to verify that

$$\frac{\partial \alpha^*}{\partial L} > 0 \quad , \quad \frac{\partial \alpha^*}{\partial n} < 0$$

$$\frac{\partial \beta^*}{\partial L} < 0 \quad , \quad \frac{\partial \beta^*}{\partial n} > 0$$

Observe that L captures the degree of ethnic diversity in the economy. Indeed, when L increases, the ethnic space is bigger and thus laborers of a certain ethnic group are even more attached to landlords of similar ethnic group and more distant to landlords of other groups. This implies that local landlords have a higher monopsony power over laborer of similar ethnic background. Observe also that n captures the number of landowners in the economy. So, when n increases, laborers are more likely to find landowners of similar ethnic background, which implies that landowners have less monopsony power. As a result, when L rises, landowners face less competition to attract workers of similar ethnic background and thus they can reduce β the fixed part of the remuneration and increase α the variable part. However, when n, the number of landlords, increases, then we have the reverse results since it is easier for laborers to find landowners of similar ethnic background.

More generally, one of the 'new' result here (compared to the case of one landlord/firm and one laborer/worker) is that laborers' and landlords' utilities as well as α and β depend on ethnic diversity through t, L and n since these parameters measure *the degree of isolation of laborers from other communities.* For example, a very large t (i.e. large language and cultural differences) implies that only laborers and landlords of similar ethnic origin can work together. This gives a high monopsony power to landlords which are able to set low wages. Our results on ethnic diversity are summarized by the following proposition.

Proposition 2

(i) *The piece rate α^* that is offered to the laborers becomes smaller when the number of landlords increases but rises when the degree of ethnic diversity increases. We have the reverse results for β the fixed part of the remuneration.*

(ii) *The piece rate is independent of the ethnic cost t but the fixed part β of the wage is not. More precisely, higher ethnic costs t imply lower β.*

Observe that the two results (i) and (ii) of Proposition 2 are due to the fact that the outside option of each laborer is endogenous because we have taken into account all the structure of the labor market (number of landlords, ethnic diversity).

Finally, the equilibrium wage (12), or more precisely the equilibrium utility before ethnic costs, is always below q the marginal productivity of laborers. This is because landlords have market power in the labor market and thus tend to exploit laborers by setting wages below their marginal productivity. The following result confirms this intuition.

Proposition 3 *When the number of landlords becomes arbitrarily large, then*

$$\lim_{n\to\infty} \alpha^*(n) = 0 \text{ and } \lim_{n\to\infty} \beta^*(n) = q$$

and the equilibrium wage tends to its competitive level ($W^* = q$) while profits tend to zero.

This result shows that the competitive model of the labor market is indeed the limit of the spatial model. Once again a key element of our analysis is the interaction between landlords to attract laborers. So when $n \to +\infty$, landlords have no more market power since each laborer works for a landlord belonging exactly to the same ethnic group (ethnic costs are equal to zero). As a result, competition pushes the wages to laborers' marginal product.

4 Landlords' choice of method of pay[8]

We have obtained a general result. We would now like to see under which condition landlords set different types of compensations. We start with the following result.

Proposition 4 *There exists a unique Nash equilibrium in which* $W^* = q - tL/n$ *and landlords' profits are equal to* $V^* = tL^2/n^2$ *if:*

(i) *either landlords are risk-neutral* ($\rho = 0$) *and laborers are risk-averse* ($a > 0$)*. In this case, landlords set a fixed wage such that* $\alpha^* = 0$ *and* $\beta^* = q - tL/n$*.*

(ii) *or laborers are risk-neutral* ($a = 0$) *and landlords are risk-averse* ($\rho > 0$)*. In this case, landlords set a piece rate such that* $\alpha^* = 1$ *and* $\beta^* = -tL/n$*.*

The results and comparative statics of Proposition 4 strongly depend on the competition in the labor market and, therefore, on the degree of ethnic diversity of both landlords and laborers. Indeed, as stated above, ethnic diversity is measured here by t, L and n. So when the laborers' ethnic cost t or the degree of ethnic differentiation L increases or when the number of landlords n decreases, then, laborers' utility decreases whereas landlords' utility increases. Moreover, the wage contract set by landlords also hinges on ethnic diversity. Indeed, even though the two cases (i) and (ii) leads to the same utility level W^* for laborers and the same profit level V^* for landlords, the wage contract is quite different. In case (i) where landlords are risk-neutral and laborers are not, it is optimal for landlords to set *a fixed wage* that do not depend on the production q of laborers so that $\alpha^* = 0$ and $\beta^* > 0$. However, this fixed part β^* decreases with ethnic diversity so that when laborers and landlords are more ethnically differentiated (t and L high and n low), β^* decreases because laborers are more isolated from landlords of different ethnic background and closer to landlords of similar ethnic origin. On the contrary, when landlords are risk averse and laborers risk neutral (case (ii)), landlords set a *piece-rate* contract in which $\alpha^* = 1$ and $\beta^* < 0$. In other words, laborers are exactly paid according to what they produce ($q + \widetilde{\theta}$) minus a fixed part β. In this case, landlords care about random production (since it affects their profit) but

[8] Since all propositions in this section are a special case of Proposition 1, the existence and uniqueness of equilibrium is always guaranteed by condition (9), which is written using the parameters of each special case.

laborers do not. Therefore, they can set a pure piece-rate system and still attract laborers. Here also, β^* negatively varies with ethnic diversity.

The results (i) and (ii) are quite intuitive. When landlords are risk neutral, they are not worried about the random part of the production but laborers who are risk averse do. Since landlords compete with each other to attract laborers, they need to eliminate the random part of the compensation to have enough labor supply that maximize their profit. It is thus quite natural to have a fixed-wage contract. For case (ii), we have the reverse framework. Risk-averse landlords are very sensitive to output fluctuations while laborers are not. So the problem is not as in (i) to attract enough laborers but to set wages knowing that landlords dislike a risky production environment. A straightforward illustration of case (ii) is the following. The landlord rents the laborer (who can in this case be considered as a tenant) a plot of land at a price $\beta^* = -tL/n$ and then the laborer/tenant obtains the full benefits of the harvest ($\alpha^* = 1$).

Corollary 1 *When laborers are risk-neutral ($a = 0$), landlords are risk-averse ($\rho > 0$) and the ethnic cost t is equal to zero, then landlords set a pure piece rate such that $\alpha^* = 1$ and $\beta^* = 0$. The equilibrium utility and profit levels are respectively given by $W^* = q$ and $V^* = 0$.*

This corollary reinforces our previous result on piece-rate contracts. It says that, if laborers do not bear any ethnic cost to work with landlord of different ethnic groups, then it is optimal for landlords to set a pure piece-rate contract in which laborers are paid according to what they produce. In this case, all risk-neutral laborers obtain the same maximum level of utility q whereas all risk-averse landlords get the lowest profit level 0. This is because t is a measure of landlords' market power and thus of the degree of competition in the labor market since higher t implies more market power and thus less intense competition. So when the ethnic cost t is equal to zero, the competition between landlords to attract laborers becomes fiercer and risk-averse landlords do not obtain anymore the fixed compensation of their laborers.

Observe that this case does not imply that labor is not differentiated since $L > 0$. In order to have no heterogeneity at all in this model, one must assume that $L = 0$. Then, without any other hypothesis, it is easy to verify that $\alpha^* = 0$ and $\beta^* = q$ so that $W^* = q$ and $V^* < 0$.

Let us now assume that landlords and laborers are both risk averse but have exactly the same degree of risk aversion, i.e., $\rho = a > 0$. In this case, landlords will optimally set an impure piece-rate contract to laborers. We have indeed:

Proposition 5 *When both laborers and landlords have the same degree of risk aversion, $\rho = a > 0$, there exist a unique Nash equilibrium given by:*

$$\alpha^* = \frac{L}{L+n}$$

$$\beta^* = \frac{n}{L+n}\left(q - \frac{\rho L \sigma^2}{L+n}\right) - \frac{t\,L}{n}$$

Before ethnic costs, laborers obtain:

$$W^* = q - \frac{\sigma^2 \rho\, L\,(L/2+n)}{L+n} - \frac{t\,L}{n}$$

and landlords' profits are equal to:

$$V = \left(\frac{L}{n}\right)^2 \left[t + \frac{\rho}{2}\left(\frac{n}{L+n}\right)^2 \sigma^2\right]$$

In this case, landlords find optimal to set an impure piece rate contract where laborers receive a fixed part β^* and a variable part α^*. This is because landlords and laborers are both risk averse and thus must share the risk of uncertain production. It is thus obvious that α^* or β^* can never be equal to zero because both parties want to avoid the randomness of the production.

It is interesting to observe that, in this case, α^* *only depends on the degree of ethnic diversity in the economy, i.e. L and n.* When n the number of landlords increases, then α^* is reduces whereas β^* is augmented if n is sufficiently large.[9] Indeed, *more landlords or less ethnic diversity implies fiercer competition since laborers and landlords become more and more ethnically similar so that landlords tend to increase the fixed part and decrease the variable part of wages.* On the contrary, when laborers are more differentiated (L increases) and thus laborers are more ethnically isolated from other ethnic groups, α^* increases whereas β^* decreases if n is sufficiently large.[10] This is because a higher L implies bigger 'distance' to landlords and thus higher ethnic costs for laborers and therefore more market power for landlords. As a result, landlords tend to increase the variable part of the compensation and to reduce the fixed part.

[9] It is indeed easy to check that $L < n$ is a sufficient condition to ensure that $\partial\beta^*/\partial n > 0$.

[10] Again, it is easy to verify that $L < n$ is a sufficient condition to ensure that $\partial\beta^*/\partial L < 0$.

Observe also that reducing t increases the fixed part of the wage β^*. As above, this is because competition between landlords become fiercer since each landlord has less market power over their (local) laborers.

An interesting question that can be raised is what happen to the model when $\rho = a = 0$. It is then a model without uncertainty. Let us solve this new model where the utility function of a laborer working for landlord i is now given by $W_i = \alpha_i q + \beta_i$ and the profit function of landlord i is equal to $V_i = [(1-\alpha_i)q - \beta_i](\overline{x} - \underline{x}) = (q - W_i)(\overline{x} - \underline{x})$, where $\underline{x}$ and $\overline{x}$ are still given by (4) and (5). By solving the symmetric Nash equilibrium, it is easy to verify that we obtain the following relation:

$$(1-\alpha)q - \beta = tL/n \tag{14}$$

which implies that

$$W^* = q - tL/n \qquad \text{and} \qquad V^* = tL^2/n^2 \tag{15}$$

We have the following result.

Proposition 6 *When both laborers and landlords are risk neutral ($a = \rho = 0$), then any pay system can emerge. However, laborers' utilities and landlords' profits are always given by (15) and they depend on the degree of isolation of laborers from other communities.*

Indeed, we have as many values of α and β as we want that can satisfy equation (14), given that α and β are negatively correlated. Therefore, any wage system could be implemented and each of them will always lead to (15). For example, if $\alpha = 0$, then $\beta = q - tL/n$ and a pure fixed-wage emerges. If $\beta = 0$, then $\alpha = 1 - sL/(nq) < 1$, landlords set a pure piece-rate pay. If $\alpha = 1/2$, then $\beta = q/2 - tL/n$, then an impure piece-rate contract prevails. Finally, if $\alpha = 1$, $\beta = -tL/n$, we have a (kind of) piece-rate pay in which laborers receive all the benefits of their production but pay back some money to the landlord. Interestingly, laborers' and landlords' utilities as well as β depend on ethnic diversity (or equivalently the degree of isolation of laborers from other communities) through t, L and n.

Once again this result is very intuitive since both landlords and laborers are totally insensitive to the randomness of the production. So any compensation system that maximizes landlords' profit and that gives to laborers a sufficiently high utility level (to induce them to work and to choose a particular landlord) will be acceptable for both parties.

5 Coexistence of fixed-wage and piece-rate contracts in a regional context

Our framework can easily be extended to account for the coexistence of fixed-wage and piece-rate contracts within and between regions, a widely observed feature of labor markets in LDCs (see for example Bardhan and Rudra, 1981, Drèze and Mukherjee, 1989, Ray, 1998, Baland, Drèze and Leruth, 1999). Indeed, so far, we have assumed that all landlords located in the region (i.e. equally spaced along the circumference of the circle) have exactly the same level of risk aversion ρ.

Assume now that there are two types of risk aversion among the landlords ρ_1 and ρ_2 and that all laborers are still characterized by a. Assume also that $\rho_1 < a < \rho_2$ and that, along the circumference of the circle, the location of landlords alternate from a landlord of type ρ_1 to a landlord of type ρ_2 (such that there exactly n_1 landlords of type ρ_1 and n_2 landlords of type ρ_2, with $n_1 + n_2 = n$). It then easy to see that, in equilibrium, if t is sufficiently large (closed-knit societies), both fixed-wage and piece-rate contracts will coexist. Landlords of type ρ_1 set fixed-wage contracts whereas landlords of type ρ_2 set piece-rate contracts. Interestingly, some laborers who have quite similar ethnic background (for example, the ones on the right of $\underline{x}$ and the ones on the left of $\underline{x}$) will obtain different contracts. However, the general result here is that laborers who are ethnically similar (i.e. belonging to the 'natural catchment area' of each firm; for example laborers working for landlord i and residing within an ethnical 'distance' $[\underline{x}, \overline{x}]$ from landlord i) obtain the same type of contract.

Another interesting result, already stressed above, is the importance of the degree of ethnicity of the region. If the region is very diverse (i.e. large L), then differences between fixed wages and piece rates will increase. Finally, this model also show that different areas offer different wage contracts. Indeed, if some regions are characterized by landlord with a high degree of risk aversion (for example, regions with small farms) and others by landlords with a low degree of risk aversion (for example, regions with large farms), then this model enables us to explain the existence of different wage contracts across regions.

Our results can be compared with the ones of Baland, Drèze and Leruth (1999). Using a very elegant model, in which individual effort is explicitly taken into account, they show that very-able laborers as well as low-ability laborers work on piece rates because they can chose their own effort level (the optimal number of tasks performed under a piece-rate contract increases with the laborer's ability). Laborers of middle ability will then be paid using fixed-wage contracts. They also show that a monopsonistic employer always finds profitable to hire laborers under both types of contracts. Our results are complementary since the focus of Baland et al. (1999) is on endogenous effort and laborers' ability whereas our focus is on risk sharing, market structure and ethnic origins of both laborers and landlords.

6 Concluding remarks

Though the model used in this paper may seem quite stylized, we believe that it captures some basic features of optimal compensations in rural labor markets in the context of ethnically differentiated laborers and landlords. It shows the role of market structure, ethnic diversity and market competition as well as of the degree of risk aversion of laborers and landlords in the determination of landlords' choice of methods of pay. In an uncertain production environment, our model shows that, in equilibrium, landlords tend to hire laborers of similar ethnic background and landlords' co-ethnics earn more than other laborers. It also shows that large language and cultural differences lead to lower wages because only laborers and landlords of similar ethnic origin can work together.

More generally, we believe that the ethnic origin of both employers and employees is of paramount importance to understand the working of labor markets (both in less developed and developed countries) and should therefore be investigated further. We leave that for future research.

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APPENDIX

Proof. of Proposition 1

Our model uses the circle model of Salop (1979). So the spirit of our model is quite the same but the proof of existence and uniqueness is quite different since landlords strategically choose two variables α and β whereas in Salop they choose only one variable, the prices.

As it is well-known in the circle model of Salop (1979), the labor supply function[11] for each landlord is not differentiable and not continuous. There are in fact three regions: the *monopsony* region where each landlord attracts only laborers between $\underline{x}$ and $\overline{x}$ and some laborers do not work; the *competitive* region (our case) where all laborers take a job and landlords compete to attract them and finally the *supercompetitive* region where one landlord, by setting a wage sufficiently high, can attract all laborers of its neighbor landlord. This labor supply is not differentiable everywhere because there is a first kink when one switches from the monopsony region to the competitive region and another one when one switches from the competitive region to the supercompetitive region (see Figure 1, page 143, in Salop, 1979). This labor supply is also not continuous because when one switches from the competitive region to the supercompetitive region, a landlord i that attracts the laborer located at y_{i+1}, i.e. the location of the landlord $i+1$, attracts at the same time all laborers located between y_{i+1} and the marginal laborer who is indifferent between landlords $i+1$ and $i+2$ (see Figure 1, page 143, in Salop, 1979). Therefore, in order to show the existence and uniqueness of our *symmetric* equilibrium, we proceed as follows. We first restrict ourselves to the competitive region (as we did in the text) where the labor supply is continuous and differentiable everywhere (within the competitive region) and show that the profit function $V(\cdot)$ is strictly concave so that, within this region, there exists a unique maximum. We then have to check that, at this equilibrium, all laborers take a job. Furthermore, we also have to check that all possible deviations of landlord i from our symmetric equilibrium is not profitable. There are in fact only two possible deviations: one in the supercompetitive region, one in the monopsony region. We already know from Salop (1979) that a deviation to the supercompetitive region is never profitable because landlord i has to set a wage higher

[11] Since Salop deals with the product market and us with the labor market, what we called here the labor supply corresponds to the product demand in Salop's model. Similarly, wages correspond to prices, monopsony to monopoly, etc...

or equal than the marginal productivity of its laborers and thus make negative or null profits. However, we have to check that the second deviation, i.e. to the monopsony region, is not profitable for landlord i.

Let us start with the following result.

Lemma 1 *In the competitive region, the profit function* $V(\cdot)$ *is strictly concave in* α_i *and* β_i*.*

Proof. Remember first that

$$W_i = \alpha_i\, q + \beta_i - \frac{a}{2}\alpha_i^2\sigma^2$$

so that

$$\frac{\partial W_i}{\partial \alpha_i} = q - a\alpha_i\sigma^2 \text{ and } \frac{\partial W_i}{\partial \beta_i} = 1$$

In this context, the first order conditions yield:[12]

$$\frac{\partial V}{\partial \alpha} \equiv V_\alpha = \left(\frac{q - \alpha q\sigma^2}{t}\right)\left[(1-\alpha)q - \beta - \rho(1-\alpha)^2\sigma^2(\overline{x} - \underline{x})\right] \tag{16}$$

$$- \left[q - \rho\,(1-\alpha)\sigma^2(\overline{x} - \underline{x})\right](\overline{x} - \underline{x}) = 0$$

$$\frac{\partial V}{\partial \beta} \equiv V_\beta = -(\overline{x} - \underline{x}) + \frac{1}{t}\left[(1-\alpha)q - \beta - \rho(1-\alpha)^2\sigma^2(\overline{x} - \underline{x})\right] = 0 \tag{17}$$

We have now to show that the Hessian matrix is negative definite, i.e. $V_{\alpha\alpha} < 0$ and $V_{\alpha\alpha}V_{\beta\beta} - V_{\alpha\beta}V_{\alpha\beta} > 0$. We have:

$$\frac{\partial^2 V}{\partial \alpha^2} \equiv V_{\alpha\alpha} = -\frac{a\sigma^2}{t}\left[(1-\alpha)q - \beta - \rho(1-\alpha)^2\sigma^2(\overline{x} - \underline{x})\right] - \rho\sigma^2(\overline{x} - \underline{x})^2$$

$$-2\left(\frac{q - a\alpha\sigma^2}{t}\right)\left[q - 2\rho(1-\alpha)\sigma^2(\overline{x} - \underline{x})\right] - \left(\frac{q - a\alpha\sigma^2}{t}\right)^2\left[\rho(1-\alpha)^2\sigma^2\right]$$

We want to show that $V_{\alpha\alpha} < 0$. For observe that at the symmetric equilibrium $\overline{y} - \overline{x} = L/n$. Therefore, for $V_{\alpha\alpha} < 0$, we will show that $(i) : (1-\alpha)q - \beta - \rho(1-\alpha)^2\sigma^2 L/n > 0$, $(ii) : q - a\alpha\sigma^2 > 0$ and $(iii) : q - 2\rho(1-\alpha)\sigma^2 L/n > 0$.

(i) First, using (17), we have

$$(1-\alpha)q - \beta - \rho(1-\alpha)^2\sigma^2\frac{L}{n} = \frac{tL}{n} > 0 \tag{18}$$

[12]We skip the index i since we are at a symmetric equilibrium.

(*ii*) Second, using (17), we also have:

$$q - \rho(1-\alpha)\sigma^2 \frac{L}{n} = \left(\frac{1}{1-\alpha}\right)\left(\beta + \frac{tL}{n}\right)$$

Using (9), it is easy to check that in (11), $q > \sigma^2 \rho La/(\rho L + an)$ so that $\beta + tL/n > 0$ and thus

$$q - \rho(1-\alpha)\sigma^2 \frac{L}{n} = \left(\frac{1}{1-\alpha}\right)\left(\beta + \frac{tL}{n}\right) > 0 \qquad (19)$$

Then, by plugging (18) into (16), it is easy to verify by using (19) that:

$$q - a\alpha\sigma^2 = q - \rho(1-\alpha)\sigma^2 \frac{L}{n} > 0 \qquad (20)$$

(*iii*) Finally, condition (9) guarantees that $q - 2\rho(1-\alpha)\sigma^2 L/n > 0$.

Now, using (*i*), (*ii*) and (*iii*), it is to see that $V_{\alpha\alpha} < 0$.

Let us continue our demonstration of the concavity of $V(\cdot)$. We have:

$$\frac{\partial^2 V}{\partial \beta^2} \equiv V_{\beta\beta} = -\frac{1}{t}\left[2 + \frac{\rho(1-\alpha)^2\sigma^2}{t}\right] < 0$$

$$\frac{\partial^2 V}{\partial\alpha\partial\beta} \equiv V_{\alpha\beta} = V_{\beta\alpha} \equiv \frac{\partial^2 V}{\partial\beta\partial\alpha}$$

$$= -\frac{1}{t}\left[q - 2\rho(1-\alpha)\sigma^2(\overline{x} - \underline{x}) + (q - a\alpha\sigma^2)\left(1 + \frac{\rho(1-\alpha)^2\sigma^2}{t}\right)\right]$$

After some manipulations and using the fact that, at the symmetric equilibrium, $\overline{x} - \underline{x} = L/n$ and (18), we obtain:

$$\begin{aligned}
& V_{\alpha\alpha}V_{\beta\beta} - V_{\alpha\beta}V_{\alpha\beta} \\
= & \left[2 + \frac{\rho(1-\alpha)^2\sigma^2}{t}\right]\left(a + \rho\frac{L}{n}\right)\sigma^2 t \frac{L}{n} \\
& + \left[q - 2\rho(1-\alpha)\sigma^2\frac{L}{n}\right]\left[3q - 4a\alpha\sigma^2 + 2\rho(1-\alpha)\sigma^2\frac{L}{n}\right] \\
& + (q - a\alpha\sigma^2)\left(\frac{2\rho(1-\alpha)^2\sigma^2}{t}\right)\left[q - 2\rho(1-\alpha)\sigma^2\frac{L}{n}\right] - (q - a\alpha\sigma^2)^2
\end{aligned}$$

By (9), $q - 2\rho(1-\alpha)\sigma^2 L/n > 0$. Moreover, using (20), we have:

$$\rho(1-\alpha)\frac{L}{n} = a\alpha$$

so that

$$
\begin{aligned}
& 3q - 4a\alpha\sigma^2 + 2\rho(1-\alpha)\sigma^2 L/n \\
= & \; 3q - 2\rho(1-\alpha)\sigma^2 L/n \\
= & \; q + 2\left[q - \rho(1-\alpha)\sigma^2 L/n\right] \\
= & \; q + 2(q - a\alpha\sigma^2) > 0
\end{aligned}
$$

We have therefore:

$$
\begin{aligned}
& V_{\alpha\alpha}V_{\beta\beta} - V_{\alpha\beta}V_{\alpha\beta} \\
= & \left[2 + \frac{\rho(1-\alpha)^2\sigma^2}{t}\right]\left(a + \rho\frac{L}{n}\right)\sigma^2 t\frac{L}{n} + q\left[q - 2\rho(1-\alpha)\sigma^2\frac{L}{n}\right] \\
& +(q - a\alpha\sigma^2)\left(\frac{2\rho(1-\alpha)^2\sigma^2}{t}\right)\left[q - 2\rho(1-\alpha)\sigma^2\frac{L}{n}\right] \\
& +(q - a\alpha\sigma^2)\left[q - 3\rho(1-\alpha)\sigma^2\frac{L}{n}\right]
\end{aligned}
$$

Since by using (9), $q - 2\rho(1-\alpha)\sigma^2 L/n > 0$ and $q - 3\rho(1-\alpha)\sigma^2 L/n > 0$, we have $V_{\alpha\alpha}V_{\beta\beta} - V_{\alpha\beta}V_{\alpha\beta} > 0$. ■

Because of Lemma 1 and because in the competitive region, the profit function $V(\cdot)$ is continuous in $(\alpha_{i-1}, \alpha_i, \alpha_{i+1})$ and in $(\beta_{i-1}, \beta_i, \beta_{i+1})$, we can guarantee that there exists a locally unique symmetric Nash equilibrium in wages. Then, by combining (16) and (17), and by equalizing the equilibrium α and β, we obtain (at the symmetric Nash equilibrium) a unique (10) and (11). Then, we deduce the equilibrium compensation W^* given by (12). Furthermore, using (8), it is easy to obtain (13).

We must now check that at the equilibrium candidate (12) all laborers take a job and that this wage is always positive. The equilibrium wage (12) is greater than 0 if:

$$
W^* > 0 \quad \Leftrightarrow \quad q > \frac{\sigma^2 \rho\, L\, a\, (\rho\, L/2 + a\, n)}{(\rho\, L + a\, n)^2} + \frac{tL}{n} \tag{21}
$$

and the condition ensuring that there is full employment at the equilibrium candidate (12) (the laborer with the worst match must have a positive utility) is given by:

$$
W^* - \frac{tL}{2n} > 0 \quad \Leftrightarrow \quad q > \frac{\sigma^2 \rho\, L\, a\, (\rho\, L/2 + a\, n)}{(\rho\, L + a\, n)^2} + \frac{3tL}{n} \tag{22}
$$

Clearly, (22) implies (21) so that (22) guarantees that in equilibrium all laborers take a job and that the utility after ethnic costs is positive for all laborers.

Now, we have to show that it is not optimal for landlord i to deviate from our symmetric equilibrium by setting the monopsony wage. It is easy to verify that the monopsony wage is equal to $q/2$. So we have to set a condition that rules out this possible deviation. It suffices to show that, at the monopsony wage $q/2$, the laborer located at x_i (i.e. at the location of landlord i) who thus have no ethnic cost prefer to work in landlord $i+1$ than to landlord i. This condition is given by:

$$W^* - \frac{tL}{n} > \frac{q}{2}$$

where W^* is the symmetric Nash equilibrium wage given by (12). It is easy to verify that condition (9) guarantees that both $W^* - tL/n > q/2$ and (22). We have thus shown that, using (9), the local maximum is a global one and that our symmetric Nash equilibrium given by (10) and (11) exists and is unique. ■