Wages And Employment In Traditional Agriculture

James McIntosh
Economics Department
Concordia University
1455 De Maisonneuve Blvd. W.
Montreal Quebec, H3G 1M8, Canada
and
Danish National Institute of Social Research
Herluf Trolles Gade 11
DK-1052 Copenhagen K, Denmark

May 25, 2004

Abstract

Wages in traditional agrarian societies are often observed to be above reservation wages even in the slack season when markets are in a state of excess labour supply. Models of non-cooperative wage setting by landlords which explicitly take account of the costs of supervising hired labour and emphasize worker heterogeneity are developed and analyzed. Conditions are given for the existence of competitive equilibria and their relationship to Nash equilibria. Nash equilibria are shown to be more likely to exist. Nash equilibria exhibit wage dispersion and involuntary underemployment with identical workers earning different wage rates.

Key Words: Wages, Involuntary unemployment, Underemployment, Supervision costs.

JEL Classification Numbers: J24, J41, J43

1 Introduction

One of the features of third world rural labour markets is the presence of high unemployment rates in the off-peak seasons. In addition, as a number of authors have noted, wage rates for casual or landless labour tend to be less than fully flexible in response to changing seasonal demands for labour. Consequently, unemployment is involuntary and the unemployed can not improve their position by offering to work for less or by looking harder for work. The plight of landless labour is, in fact, one of the most distressing problems facing less developed countries.[1] While there seems to be little disagreement among scholars who study these markets that they are characterized by substantial periods of involuntary unemployment there is considerable variety in terms of potential explanations of the causes of such phenomena.

This paper examines the theory of agricultural labour markets. The next section briefly surveys the literature in this area.[2] There are a number of papers which attempt to explain wage rigidity and involuntary unemployment as products of the behaviour of rational optimizing agents. Two such classes of model are discussed here. These are variations on "efficiency wage" models and labour bargaining models. This discussion reveals certain limitations in the established theory of agricultural labour markets and the need for a new class of model to be developed. This is done in Section (3) in a model which explicitly considers supervision costs and permits workers to be paid wages which reflect the observable characteristics that determine their productivity.[3] Section (4) contains a summary and a discussion of the main

[1] Dréze and Sen (1989, p. 5) describe it in the following way: "People who possess no means of production excepting their own labour power, which they try to sell for a wage in order to an adequate income to buy enough food, are particularly vulnerable to changes in labour market conditions. A decline in wages *vis-à-vis* food prices, or an increase in unemployment, can spell disaster for this class. .... The class of landless wage labourers has indeed recurrently produced famine victims in modern times. For example, in the Indian subcontinent, the majority of famine victims in this century and the last has come from this group.

[2] Dréze and Mukherjee (1989) provide an excellent survey of research on labour markets in the Indian subcontinent. They list a number of "stylized facts" for casual labour markets (page 246) the first four of which are: "(1) Casual labour is the most important type of labour contract. It is generally hired on a day to day basis. (2) Search on the casual labour market is usually carried out on the previous night by *employers* who usually 'call' on the evening preceding the execution of the work. (3) The village labour market is largely closed; labour hiring across neighbouring villages is rare. (4) Involuntary unemployment is common, particularly during the slack agricultural season. Less productive workers are especially vulnerable to forced leisure."

[3] These are important features of casual agricultural labour markets as the following description of the hiring process for daily rate labour by Walker and Ryan (1992, p. 110) shows. "In Sholapur, employers look for more efficient and reliable workers first and offer premiums. Workers who have to approach prospective employers

results.

2 Theoretical Wage Models

Among endogenous explanations of involuntary unemployment efficiency wage models are perhaps the most well known. Although, there are quite a large number of papers on this topic only a small sub-sample will be considered here. There are several versions. These are based on nutritional requirements, the employer's inability to determine individual worker productivity, turnover costs, and incentive considerations.

In the nutrition based version which originates with Leibenstein (1957) and extended by Stiglitz (1976), Bliss and Stern (1978) and Basu (1994), worker productivity is determined by consumption which is in turn determined by the worker's wage. Workers with very low wages do not have the physical strength and stamina to main high effort or productivity levels. Raising wages does alleviate this problem, however. Consequently, there is a link between wages and productivity. Under certain not unreasonable assumptions there exists a lower bound on the wage rate, the efficiency wage. If farmers pay wages below this rate their profits actually fall because worker efficiency falls and reduces revenue more than wage costs. Even when there is an excess supply of labour at this wage farmers prefer to pay the efficiency wage rather than let the wage fall to clear the market. This is what Dasgupta and Ray (1986, p. 1024) describe as a competitive non-Walrasian equilibrium in which there is involuntary unemployment.

The same outcome is obtained in the asymmetric information model developed by Weiss (1980) and discussed detail in chapter 13 of Mas-Colell *et al* (1995), but the mechanism is quite different. When farmers can not observe the characteristics which determine the productivity of farm labour they can not discriminate on this basis and thus must pay a common wage to everyone they employ. Individuals differ not only with respect to their ability but have different reservation wages which usually are assumed to be positively correlated with their ability. Since workers enter the labour market only if their reservation wage is at least as great as the market wage average productivity increases with the wage rate.

generally accept discounted wages. ...Employees are willing to work for almost all employers and they regularly change their employer throughout the year." See Foster and Rosenzwieg (1993, Table 7 p. 777) for empirical support for this proposition. A paper that considers the problems that arise with worker heterogeneity is McIntosh (1984). Unfortunately the model developed there does not consider the possibility of involuntary unemployment or underemployment.

An efficiency wage can arise in this case and will be supported by farmers if reductions in the wage by driving the highest productivity workers out of the market reduce average productivity more than wage costs. As already mentioned, the causal mechanism is based on the presence asymmetric information and while both versions of the model are characterized by involuntary unemployment this version is immune to the criticism leveled against the nutrition based version that this was a longer term relationship and that individual farmers had no incentive to pay the efficiency wage since they would not likely reap the benefits. However, the validity of this type of model really does depend on there being asymmetries in the distribution of information about worker characteristics.

What farmers know about the labour which they employ is an empirical question. There may be situations where there is less than perfect information about worker characteristics in which case this version of the model is relevant.[4]

Shapiro and Stiglitz (1984) explore another informational asymmetry. When farmers do not monitor the efforts of their workers, workers may not perform their required duties if the effects of shirking are not detected unless the employer actually monitors his employees continuously. If being unemployed is costly then unemployment can be used as an alternative to continuous monitoring and farms will pay higher than market clearing wages to generate this unemployment. Unemployed workers can not bid wages down because the unemployed are needed to keep the employed workers from shirking. The relevance of this model for rural agriculture is questionable, however, since the sheer volume of unemployment appears to be more than that which is needed to discipline employed workers.

Turnover costs give employers an incentive to pay higher than reservation wages if higher wages reduce turnover costs as Stiglitz (1975) argues. Unemployed workers can not find employment by bidding down the wage because if the reduction in wages does not compensate the farmer for higher turnover costs. In terms of results this model is not very different from efficiency wage models.

A radically different approach is adopted by Mukherjee and Ray (1992) who see the determination of wages as the outcome of conflict or bargaining between land-owning farmers and landless labourers. There are two periods representing the slack and peak seasons. There is

[4]Foster and Rosenzwieg (1996, p. 368) in their study of Philippine labour markets show that less than half the variation in worker productivity is explained by what farmer employers know.

surplus labour in the slack season and wages are low. Workers have opinions as to what a "fair wage" is and when the peak season arrives they remember which farmers paid fair wages and those who did not. In the peak season those farmers who paid unfair wages in the slack season experience higher recruitment costs due to refusals by workers who thought their slack season wages were unfair. To avoid this costly situation farmers have an incentive to pay more than reservation wages in the slack season. The authors propose a Nash equilibrium which farms of different size pay possibly different wages which and these minimize total expected two period costs by paying more than reservation wages in the slack season to reduce expected recruitment costs in the peak season.

Now there are two problems with this model. The first the is credibility of the behaviour of landless peasants. For workers who must survive a large number of two season years, is it reasonable to assume that they would threaten a landlord by refusing to work for him in the peak season because he paid low wages in the previous slack season and risk the possible retaliation of this landlord in the following slack season? This possibility is assumed away because there are only two periods but it is a problem, nonetheless. Secondly, the emphasis on intertemporal considerations gives the model a seasonal interdependence that runs counter to what many observers report.

Another type of bargaining model is considered by Osmani (1991, p. 6) who believes " ...that it is the workers rather than employers who resist the wage rate from being pushed down to the competitive level." He sees the modelling of casual labour markets as a repeated non-cooperative game between a group of homogenous peasant workers and a group of passive landlords. Given this representation of the casual labour market it is possible to show that all slack season workers get a wage above their common reservation wage and this is sustained as a sub-game perfect Nash equilibrium with each worker following a "trigger strategy".

While there in nothing wrong with the logic of the model the plausibility of the assumptions is another matter. Bardhan and Udry (1999 Sec. II) note that the threat underlying the trigger strategy is implausible. As has already been noted, there are differentials across individuals that affect both productivity and the probability of employment. While these can be accommodated in a more general "trigger strategy" equilibria when farmers have no role to play in wage determination, the situation is radically different when they do. As the models developed in the next section show, worker heterogeneity and the presence of supervision costs or not being

able to observe ability gives farmers an incentive to be selective with respect to their labour force and to set wage rates accordingly.

There is another class of model which has an intertemporal dimension and involves multi-period contracts. These are based on a farm's requirement to have sufficient labour available in the peak season. In order to insure peak season labour supplies farms can enter into multi-season contracts which pay more than slack season reservation wages to 'permanent workers' in order to insure their availability when labour markets are tight. This results in involuntary unemployment in the slack season. Recent surveys of this literature can be found in Bardhan and Udry (1999) and Pal (2002).

The model developed in the next section focuses on the implications of supervision costs for slack season wage determination. The importance of supervision costs has long been appreciated by economists interested in the study of traditional third world agriculture. It is fairly obvious that farmers expose themselves to moral hazard problems if they do not monitor or direct hired labour because of the incentives that wage earners have to either overstate their production in a piece-rate system or shirk when they are being paid by the day. Frisvold (1994) in his study of Indian farms provides convincing evidence that supervision improves the productivity of agricultural hired workers as well as brief survey of the theoretical literature on supervision costs. For further discussion of this issue see Foster and Rosenzweig (1993, p. 763).

However, the implications of costly supervision have yet to be fully worked out. When workers differ by ability or productivity the presence of supervision costs as a function of farm employment causes a number of things to happen. First, the substitutability between different levels of ability is no longer solely determined by the characteristics of the individuals but depends on the farms that could potentially employ them. It is well known that in competitive markets workers with different but observable productivities are paid wages which are equal to these productivities. In many cases the competitive pricing of labour makes perfect substitutes out of different quality labour by making them equally costly to the employer.[5] Secondly, supervision costs are not part of the compensation package paid to labour although they must be paid by the employer. This means that when there are supervision costs farms can improve profitability by hiring proportionately more high ability labour because the higher wage costs are offset by lower supervision costs. As will be seen in the model developed in the next section

[5]See McIntosh (1984, p. 572) for examples.

this trade-off can be accompanied by farm specific wages that are not only above reservation wages but above that justified by the differences in individual abilities.

There are also implications for employment. Higher wages generally lead to lower employment levels. This will turn out to be true for models based on supervision costs and like some of the models referred to earlier in this section there will be involuntary underemployment or unemployment and, because the wage rates are chosen by land owning farmers, those looking for work will be unable to obtain it by bidding down the wage.

3 A Model of Slack Season Employment

Production in traditional agriculture is a continuous process throughout the crop cycle. It culminates with the harvest; but in order for this to happen tasks have to be performed at various times prior to harvesting. These include plowing, weeding, applying fertilizer and pesticides, preparing irrigation ditches etc. The amount of work that has to be done at each point in the crop cycle is assumed to be determined by the maximization of an intertemporal objective function. Without specifying the precise nature of this procedure it is assumed that farmer i requires a fixed amount of labour, q_i. Since various types of worker can be employed this labour requirement will be measured in efficiency units. Here time subscripts are suppressed to simplify the notation but it should be remembered that these requirements vary over time.

Starting with workers, assume that they are characterized by their ability level, θ. Workers can either work for wages if they can get acceptable employment with farmers in their locality or they can work, possibly with other members of their family, in a house-hold mode of production. A worker of type θ has a utility function

$$u(\ell, \theta) = y(\ell, \theta) - c(\ell) \tag{1}$$

In equation (1) ℓ is the amount of effort expended by the worker and $y(\theta)$ is the income earned. For house-hold production this is generated by a concave production function, $g(\ell, \theta)$; for a wage earner it is his wage, $w(\theta)$, which is also assumed to depend on the worker's type.

The nominal value of utility is the difference between income and the nominal disutility of

working, $c(\ell)$. c is assumed to be differentiable with positive first and second derivatives.[6]

Individuals who are engaged in house-hold production choose an effort level which maximizes their utility and generates the following value function

$$V(\theta) = \max_{\ell}[g(\ell, \theta) - c(\ell)] \tag{2}$$

Since farms have to compete with this alternative when they attempt to hire labour for wages they must pay at least the reservation wage for each type θ which is

$$r(\theta) = V(\theta) + c(1) \tag{3}$$

In the definition of $r(\theta)$ it is assumed that workers involved in wage employment always provide one unit of labour. $V(\theta)$ and $r(\theta)$ are increasing concave functions of θ. The first order condition for the maximization in equation (2) is

$$g_\ell - c' = 0 \tag{4}$$

Differentiating this and V twice respect to θ and eliminating ℓ' one easily obtains

$$V'' = [(g_{\theta\theta}g_{\ell\ell} - g_{\ell\theta}^2) - g_{\theta\theta}c'']/(g_{\ell\ell} - c_{\prime\prime}) \tag{5}$$

This is negative since the numerator is positive due to the concavity of g. Since $V'' = r''$ r is concave as well.

To simplify the analysis assume that there are just two types of worker: those with low ability and those with high ability. It is assumed that workers are paid wages on a daily basis.

[6] c could, in principle, also depend on θ as it does in the much of the literature on incentives. See, for example, Mas-Colell *et al* (1995, p. 450), which is the source of much of the notation employed in this paper.

In the most general case farmers will be able to pay wages that are specific to each type of labour when type can be observed. In this subsection it will be assumed that individual abilities can be observed by the farms which employ them. This may be more general than is required to represent the payments systems that are actually used some in agrarian labour markets. However, it is important to see whether optimizing farms would gain from such a choice and, if this is the case, to understand what the implications are when farmers do not have such a choice.

In the present context ability is synonymous with productivity. Let values of ability or productivity be $\theta_L < \theta_H$ and let n_{iL} and n_i be the number of low and high ability labour hired by farm i at wage rates (w_L, w_H). Assuming that farms have only labour costs, a farm with a total labour requirement measured in efficiency units of q_i has labour costs of $w_L n_{iL} + w_H n_i + s(n_{iL} + n_i)$ where $n_{iL}\theta_L + n_i\theta_H = q_i$. In the expression for labour costs, s is the cost of supervising the labour force. This depends only on total employment and does not depend on ability levels. Clearly, $s' \geq 0$; although, the second derivative of s may be of either sign depending on the particular type of work involved.

The problems of concern in this paper are those involving wage determination when there is "surplus labour" under varying scenarios concerning market structure. The model developed in this section assumes that farms can observe an individual's ability; that is, every worker's value of θ is observable to all employers.[7] The market structure is oligopsonistic; with a finite number of farms bidding for labour. Farms compete with each other in setting wages and employment levels. Labour is passive; workers act as individuals and their strategies consist of either accepting or rejecting daily wage contracts. This is a game of imperfect and incomplete complete information; play is sequential and the order of play is known and accepted by all players and there is no uncertainty, all players are fully aware of other players characteristics and payoffs, and this fact is known to all players.

For comparative purposes the analysis starts by examining competitive equilibria when there are K farms with labour requirements $\{q_1 > q_2 \ldots > q_K\}$. As stated earlier, workers will work as paid labourers if the wage rate for their type is at least as great as their reservation wage. Let N_L and N be the number of low ability and high ability workers, respectively, that are available for potential employment in the market. Assume that $N < \sum_{i=1}^{K} q_i/\theta_H$ so that an

[7] In section (4) the properties of this model are compared to those of model in which θ is unobservable.

excess demand exists for high ability workers if all farms wanted to employ only high ability workers. In all of what follows N_L will be assumed to be large in the sense that any farm will always be able to hire as many low ability workers at $r(\theta_L) = r_L$ as it wishes. This is what is meant by "surplus labour" in this model.

In a competitive market farms minimize costs, taking the wage rate for high ability workers, w, as a parameter. Let $n_i^*(q_i, w)$ minimize

$$C_i(n_i, w) = r_L(q_i - \theta_H n_i)/\theta_L + wn_i + s[(q_i - \theta_H n_i)/\theta_L + n_i] \tag{6}$$

subject to the constraint

$$0 \leq n_i \leq q_i/\theta_H. \tag{7}$$

and define

$$C_i^*(w) = \underset{n_i}{Min}\ C_i(n_i, w) \tag{8}$$

For future reference note that when $n_i^*(q_i, w)$ is an interior solution to the minimization problem above $\partial n_i^*(q_i, w)/\partial q_i > 0$ and $\partial n_i^*(q_i, w)/\partial w < 0$. Interior solutions can only occur when a second order condition, $s''\left(1 - \theta_H/\theta_L\right)^2 > 0$, is satisfied.

Theorem

When $s'' > 0$ a competitive equilibrium exists and satisfies the equation

$$\sum_{i=1}^{K} n_i^*(q_i, w^*) = N \tag{9}$$

Proof When $s'' > 0$, $C_i(n_i, w)$ is convex in n_i which makes $n_i^*(q_i, w)$ continuous in w. The concavity of the reservation wage function makes $n_i^*(q_i, r_H) = q_i/\theta_H$. If $w_i^+ = r_L\theta_H/\theta_L - s'[q_i/\theta_L]\left(1 - \theta_H/\theta_L\right)$ then $n_i^*(q_i, w_i^+) = 0$. For any $w > \underset{i}{Max}\ \{w_i^+\} = w_1^+$ aggregate labour

demand is zero but aggregate labour demand is equal to $\sum_{i=1}^{K} q_i/\theta_H$ when $w = r_H$. This is greater than the supply, N so there exists some $w^* \in [r_H, w_1^+)$ which equates the two. The smallest farm will employ both types of labour but there may be some large farms which only employ high ability workers.

A competitive equilibrium also exists when $s'' \leq 0$. When $C_i(n_i, w)$ is concave in n_i the labour demand function is discontinuous and each farm wants to hire all high ability workers or none depending on the wage. In this case there is a pivotal farm p which determines the wage. It is indifferent between employing $n_p = N - \sum_{i=1}^{p-1} q_i/\theta_H$ high ability workers at w^* or not hiring any high ability workers at all. Here w^* satisfies

$$C_p(n_p, w^*) = r_L q_i/\theta_L + s(q_p/\theta_L) \tag{10}$$

In both cases $w^* > r_H$.

Having defined a competitive equilibrium and demonstrated its existence for this model the question arises of how, in the absence of an auctioneer or other mechanism, a competitive wage rate would actually be generated. In the setting considered here farms set the wage rates that they pay workers. Given that they set wages would they find it in their interest to choose w^* as the wage? The answer turns to this question turns out to be no. When farms can choose what wage to pay they will take advantage of their size and offer a wage that minimizes their labour costs while at the same time prevents smaller farms from taking their high ability workers away from them. Instead of a single wage the labour market is characterized by a sequence of farm specific wages that constitute a subgame perfect Nash equilibrium. The largest farm is assumed to move first and sets its wage and employment requirements. The rest of the farms follow in order of their size. After all wages are posted all high ability workers visit farms sequentially looking for work and are allocated randomly across farms. Whether all farms would prefer this order of play will be discussed later.

For expositional purposes it is simpler to derive these results when there are only two farms. When farm 1 is the first mover its objective is to set a wage and level of employment which minimizes its costs and also deters the second farm from hiring the high ability labour that it wants to employ. Formally this type of behaviour solves

$$\underset{n_1,w_1}{Min}\, C_1(n_1, w_1) \tag{11}$$

subject to the constraints

$$C_2^*(w_1) \geq C_2(N - n_1, r_H), \quad n_1 \leq q_1/\theta_H, \quad w_1 \geq r_H \tag{12}$$

The first constraint makes it more expensive for the second farm to have unlimited choice over the quantity of high ability labour than to take what farm 1 does not want and pay them their reservation wages. If farm 2 observes that farm 1 is paying w_1 it has two choices; it can pay a wage higher than w_1 and hire all the high ability workers it wants or it can pay a wage below w_1 and hire the high ability workers that farm 1 does not want at r_H since the high ability workers that are not employed by farm 1 have no other alternative. But w_1 is constructed in such a way to make the second choice the preferred one for farm 2.

When $s'' > 0$, $C_1(n_1, w_1)$ is convex in its arguments and the constraint set is convex so the Kuhn-Tucker conditions

$$\partial C_1(n_1, w_1)/\partial n_1 + \lambda_C \left[\partial C_2(N - n_1, r_H)/\partial n_1\right] - \lambda_{n_1} = 0 \tag{13}$$

$$\partial C_1(n_1, w_1)/\partial w_1 + \lambda_C \left[\partial C_2^*(w_1)/\partial w_1\right] + \lambda_{w_1} = 0 \tag{14}$$

are necessary and sufficient for the problem The λ variables are the Lagrange multipliers associated with the three constraints.

Unfortunately, these are not particularly revealing except for the important result that $w_1 > r_H$, since $w_1 = r_H$ does not satisfy the incentive compatibility constraint. When both farms want to employ positive amounts of high ability labour the incentive compatibility constraint will bind making $\lambda_C > 0$. However, it is not clear whether farm 1 employs q_1/θ_H or fewer high ability workers.

The general case has the same features with farm k posting w_k to deter the next largest farm from taking its high ability labour and $w_k > w_{k+1}$ for all k. The proof is inductive. Consider the case where there three farms. For any strategy (n_1, w_1) that farm 1 plays farm 2 has to decide how to split $N - n_1$, the high ability labour that is not used by farm 1, between itself and

the third farm conditional on this strategy. It can either follow the procedure outlined above and have first choice over $N - n_1$ or it can pay a sufficiently high wage to have an unrestricted choice over all high ability labour. Farm 1 then selects (n_1, w_1) to minimize its costs insuring that farm 2 selects its first alternative. Proceeding inductively generates a sequence of strategies where each farm minimizes its labour costs and deters the farm below it from taking its high ability labour.

High ability workers get a wage premium which is determined by how valuable high ability is to the farm employing the worker and not by the individuals own characteristics. Thus, identical workers get different wages. In this sense it might be said that some high ability workers are involuntarily underemployed since they are willing at wage rates for which others with the same abilities have jobs but there are no jobs for them.

However, there is nothing that individual workers can do about this. Suppose a high ability worker from farm k offered to work for farm $k-1$ at a wage at a wage below w_{k-1}. Farm $k-1$ would not hire this worker since having agreed to pay it high ability workers w_{k-1} it has no incentive to hire labour at any wage. Even when farm $k-1$ anticipates such a possibility it has no incentive to offer a different wage rate. When $N < \sum_{i=1}^{K} q_i/\theta_H$ all high ability workers are employed at wages above their reservation wage except those who are employed on the smallest farm. If this inequality is reversed all high ability workers get their reservation wage. Finally, in the slack season some low ability workers can find employment at r_L while others will not.

Intuitively it would appear that the largest farm would benefit from moving first since this the farm for which high ability labour has the highest value. It is more costly for smaller farms to deter larger farms than the reverse so it is a reasonable conjecture that farms actually prefer this order of play. Unfortunately, there is, as yet, no proof of this result so the order of play has to be assumed.

4 Comments and Discussion

This section starts with a brief summary of the properties of supervision cost models. While both competitive and Nash equilibria were discussed it is the latter which deserve our attention. While there may be a fairly large number of employers bidding for labour even in the slack season it is quite clear that it is the farmers themselves who actually set wages. Since Nash

behaviour is a description of this process it seems to be more relevant than an abstract unspecified market equilibrating process. The Nash equilibria display considerable wage dispersion which arises through differences in farm specific valuations of ability rather than differences in ability. Premium wages have an interesting property; they are above $r_L\theta_H/\theta_L$, which is what high ability workers would be paid if farmers priced high ability labour purely on arbitrage principles. In models where there are no supervision costs and slack season output is a function of labour in efficiency units, competition for high ability labour would lead to a constant cost per efficiency unit. The wage for high ability workers, w_H, would therefore satisfy the condition, $w_H/\theta_H = r_L/\theta_L$. Even in this case high ability workers get more than their reservation wage since $r(\theta)$ is concave in θ. However, numbers matter and competition between farmers causes the wage to rise above this level. The model also makes predictions about who works where, but that depends on the shape of the supervision cost function.

The equilibria in the model have been referred to a subgame perfect Nash equilibria. That is correct, of course, but the model is perhaps best seen as an example of mechanism design. In the two farm case subgame perfection is achieved directly in the traditional way by the large farm imposing an incentive compatibility constraint on the smaller farm. In the general case subgame perfection is obtained by each farm imposing an incentive compatibility constraint on the farm below it. Thus, the equilibria are generated as a sequence delegated mechanisms where each farm assumes the farms below it will protect their interests by deterring even smaller farms from taking their high ability labour.

The competitive model discussed at the beginning of the previous section serves a bench mark to which other outcomes can be compared. It should come as no surprise that wage paid to high ability workers are lower when farms can set them as opposed to the case where farms have to be price takers in the labour market. Looking at the two farm example, at w^*, the competitive wage, $C_2^*(w^*) > C_2(N - n_1^*, r_H)$ and $n_2^* = N - n_1^*$. As result farm 1 can prevent farm 2 from taking its high ability labour at a lower wage than w^*. All workers will earn less and both farms will have lower costs.

There are two features of the model that might appear restrictive to some readers. One of the characteristics of the model is the inelasticity of demand for labour. In all versions of the model q_i is a constant and, in particular, it does not depend on the wage or piece-rate that farm i has to pay. This assumption is designed to capture the reality of the situation. In

the slack season certain tasks have to be performed at certain times otherwise there will be no crop at harvest time. Farmers have very little flexibility and the constancy of q_i reflects that. Secondly, slack season decisions are determined independently of what happen over the rest of the crop cycle once q_i has been determined. In a more complex model these decisions could be considered in a more general framework where all of the farms activities are modelled simultaneously taking into account of the sequential nature of employment decisions and as well as potential complimentary objectives across the two seasons.

It was pointed out in the introduction that one of the one of the crucial issues in the determination of employment decisions by farmers was the amount of information they had on the workers that were available for hire. In this model farmers are assumed to know all the characteristics of all workers. This may not be a particularly appropriate assumption in all circumstances since the amount of information that farmers have concerning the abilities of individuals in the work force is one of the more important answered question in the field. While it is not clear what farmers actually know it is possible to model their actions when they have varying amounts of information on their workers and to confront the predictions about wages and employment that arise from these models with what is actually observed.

5 Acknowledgment

The author wishes to thank Efrosini Diamantudi, Jean Dréze, Debraj Ray, and the participants of a seminar given at The Economic Policy Research Unit of the University of Copenhagen Business School for their comments on an earlier version of the paper. This research was supported by Concordia University and the Institute of Economics, University of Copenhagen. To them go my sincere thanks.

References

[1] Bardhan, P.K. and Christopher Udry, (1999). *Development Microeconomics*. Oxford University Press Oxford U.K.

[2] Basu, K. (1994) "Efficiency Wage Theory with Monopolistic Landlords", Ch. 8 in *Capital, Investment, and Developmen*t, Edited by Kaushik Basu, Mukul Majumdar, and Tapan

Mitra, Blackwell, Oxford, U.K.

[3] Bliss, C. J. and Stern, N.H. (1978), "Productivity, Wages, and Nutrition I: The Theory". *Journal of Development Economics*, Vol. 5, p330-362.

[4] Dasgupta, P., Ray, D. (1986), "Inequality As A Determinant of Malnutrition and Unemployment: Theory", *Economic Journal*, Vol. 96, p. 1011-1034.

[5] Dréze, J. P and Mukherjee, A. (1989), "Labour Contracts in Rural India: Theories and Evidence" Ch. 10 in Vol. 3 of *The Balance Between Industry and Agriculture in Economic Development,* edited by S. Chahravarty for the international Economic Association. MacMillan Press, Basingstoke England.

[6] Dréze, J. P and Sen, A.K. (1989), *Hunger and Public Action,* Clarendon Press, Oxford, U.K.

[7] Foster, D.,and Rosenzweig, M. (1993), "Information, Learning, and Wage Rates in Low-Income Rural Areas", *Journal of Human Resources*, Vol. 28, p759-90.

[8] Foster, D., and Rosenzweig, M. (1996), "Comparative Advantage, information and The Allocation of Workers To Tasks: Evidence From An Agricultural Labour Market", *Review of Economic Studies,* Vol. 63, p 347-374.

[9] Frisvold, G. (1994), "Does Supervision Matter? Some Hypothesis Tests Using Indian Farm-Level Data", *Journal of Development Economics,* Vol. 43, p 217-238.

[10] Leibenstein H. (1957). *Economic Backwardness and Economic Growth.* John Wiley, New York.

[11] Mas-Colell, A. Whinston, M.D. and Green, J.R. (1995), *Microeconomic Theory,* Oxford University Press, Oxford England.

[12] McIntosh, J. (1984), "An Oligopsonistic Model of Wage Determination in Agrarian Societies", *Economic Journal*, Vol. 94, p 569-579.

[13] Mukherjee, A. Ray, D. (1992), "Wages and involuntary Unemployment in The Slack Season of A Village Economy", *Journal of Development Economics,* Vol. 37, p 227-264.

[14] Osmani, S.R. (1991), "Wage Determination in Rural Labour Markets", *Journal of Development Economics,* Vol. 34, p 3-23.

[15] Pal, Sarmistha (1999) "Task-Based Segmentation of Rural Labour Contracts: Theory and Evidence" *Bulletin of Economic Research* 51, 67-94.

[16] ———- (2002) " Segmentation of Rural Labour markets: Further Evidence" *Bulletin of Economic Research* 54, 151-180.

[17] Stiglitz, J. E. (1974), "Alternative Theories of Wage Determination and Unemployment in LDC's: The Labor Turnover Model", *Quarterly Journal of Economics* Vol. 88, p 194-227.

[18] Walker, W., Ryan, J. (1990), *Village and Household Economies in India's Semi-arid Tropics,* The Johns Hopkins University Press, Baltimore, USA.

[19] Weiss, A. (1980), "Job Queues and Layoffs in Labor Markets With Flexible Wages", *Journal of Political Economy*, Vol. 88, p 526-538.