Limited Liability and
Contractual Structure in Agriculture *

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Abstract: This paper explores the role of a limited liability clause – which allows a tenant to forego paying rent in the event of a crop failure – with regard to contractual structure in agrarian economies. If a tenant's wealth is sufficient to cover fixed-rent commitments, even if output is low, he will receive a fixed-rent contract. For the landlord, this is preferable to other types of contract because when effort is non-contractible only a fixed-rent contract provides efficient incentives for labor input. If the tenant has little wealth, inefficient share-rent contracts emerge, with the resulting inefficiency varying inversely with the wealth of the tenant. As a result, landlords tend to prefer wealthier tenants.

1. Introduction

The aim of this paper is to study the nature of tenancy contracts taking into account the fact that if a tenant is poor and output is uncertain, situations may arise in which the tenant will not be able to pay his rental obligations. This constraint, stemming from the tenant's small wealth and the small output that he might produce, is generally known in the principal-agent literature as *limited liability*.

I focus on the concept of limited liability as an important factor in determining the contract between a landlord and a tenant, because of its intuitive appeal. Formally, the limited liability axiom states that; *"(…) if i has some financial commitment towards j (for example a loan to be repaid or a rent to be paid) but happens to go bankrupt, then j has to forego his claim."* (Basu, 1992 p. 204).[1] Although the concept of limited liability was originally developed in the field of corporate finance it is also relevant in the context of land and labor relations in poor agrarian economies. The incompleteness or, in most cases, total absence of an insurance market for poor tenants leads naturally toward an implicit clause that limits rent liability to the tenants' wealth. Consider a landowner who cannot be present on his own land in order to directly supervise hired labor. His problem is therefore to devise a suitable tenancy contract (a fixed-rent contract, share-rent contract or a mixture of the two), taking into account the fact that labor input cannot be monitored. Setting aside risk-sharing concerns, a fixed-rent contract is the best option. With a fixed-rent contract, the tenant gets to keep all extra output that any additional effort might yield. This provides efficient incentives for labor input as the tenant bears fully the cost of putting in anything less than the optimal level of effort. However, where certain natural conditions involve sufficiently poor yields and the tenant's wealth is limited, a fixed-rent contract may no longer be feasible. In the event of a crop failure (or two or more successive crop failures) the landlord simply may not be able to claim his full rent. The rent has to be forgiven or advanced as a loan. However, there is no guarantee that the loan will be

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[1] An early theoretical model studying the effects of limited liability on optimal contracts is that of Sappington (1983).

repaid in the future. The landlord must therefore take precaution in order not to lose any rent due to a poor harvest. One solution could be to offer a contract where the tenant pays more when output is high than when it is low. But this reduces the tenant's incentives to put in effort and lowers the expected yield from the land. With a limited liability clause in operation, it is therefore not obvious which type of contract best serves the landlord's interests.

Below we will build upon a framework developed in Banarjee and Ghatak (1996) and Bardhan and Udry (1999 chap. 6) to analyze more formally the interaction of the unobservability of the tenant's effort level and a limited liability clause in the design of tenancy contracts. As we will show, the model can be helpful in interpreting a number of aspects of land and labor relations in poor agrarian economies.

Firstly, it will be demonstrated that the implicit limited liability clause underlying any tenancy contract is important in determining the contract between the tenant and the landlord. Tenants that are not wealth-constrained will enter into fixed-rent contracts that secure an efficient level of effort. Tenants with little wealth will be offered mixed share-rent contracts. This reduces the tenant's incentive to put in effort, with the resulting inefficiency varying inversely with the wealth of the tenants. Secondly, the model provides an explanation for why landlords prefer landed rather than landless farmers as their tenants, as many empirical studies have documented. Since the current wealth position in poor agrarian economies is highly correlated with ownership of land, it follows that a landlord will prefer a landed rather than landless tenant when he decides to lease out his land. Landed tenants are precluded from defaulting on their rental commitments due to their land being used as collateral against it. Thirdly, the model provides a reason for the existence of share tenancy. There exists a large body of literature that addresses this issue.[2] The most dominant view, which dates back to Stiglitz (1974), is that sharecropping results from a trade-off between work incentives and risk-sharing. A fixed-rent contract provides the tenant with good work incentives, but at the same time he has to bear all the risk. A wage contract would shift the risk to the landlord, but the tenant would then have no incentives to work.

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[2] See Singh (1989) and Hayami and Otsuka (1993) for reviews of this literature.

Sharecropping represents a compromise, a way of inducing effort by risk-averse tenants. In this paper we show that sharecropping may also arise in the absence of tenants' risk-aversion. If tenants' are wealth constrained, coupled with the unobservability of labor input, sharecropping arise as the optimal contract.

Although studies of tenancy have paid little attention to the fact that tenant's may default on rent obligations, this paper is not the first to use the concept of limited liability to explain structural characteristics of poor agrarian economies. A contribution that is close to this paper is Shetty (1988). In Shetty's model the contract terms the tenants receive depend on wealth, with wealthier tenants being preferred and are receiving fixed-rent contracts.[3] This is the same result as in this paper. But there are also some differences. Shetty considers a situation in which landlords compete for prospective tenants. In contrast, this paper considers an environment with one dominant landowner confronting an elastic supply of potential tenants who differ only in their initial wealth level. This simplifies the analysis a lot and, as will be shown, some results that are different from those found by Shetty are achieved.

In a recent paper, Basu (1992) also uses the concept of limited liability to explain the existence of sharecropping, but his argument is very different from the one set out in this paper.[4] In Basu's model the tenant does not have to decide on the intensity of labor use, but chooses from techniques or projects with differing levels of risk. Assuming that the landlord is unable to monitor the tenant's choice of technique, coupled with a limited-liability clause, Basu shows that the landlord will offer the tenant a share contract. The logic is as follows: Under a fixed-rent contract, because of the limited liability clause, the income of the tenant does not fall by a corresponding amount if the yield turns out to be low. However, the tenant gets to keep a larger share with higher realizations of yields. As a consequence, the tenant will prefer risky projects, even though such projects produce a lower expected surplus. Under a share contract the income of the tenant moves in proportion with the yield realized. This directs the tenant's choice of project

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[3] See also Laffont and Matoussi (1995) who provide empirical evidence for the idea that financial constraints are important in explaining which type of contracts that are employed.
[4] See also Sengupta (1997) who extends Basu's model.

towards the kind that the landlord prefers. The tenant will thus be offered a share contract. It is interesting to note that Basu reaches essentially the same result as this paper – when a limited liability clause is in operation, a share contract is the preferred choice of the landlord – though his argument is very different.

The rest of the paper is organized as follows. In section two, the basic model is formulated. In section three, the nature of tenancy contracts between a landlord and a wealth-constrained tenant is analyzed. Section four offer a brief discussion of landlords' selection of tenants, while concluding remarks are provided in section five.

2. The Model

I consider a non-cultivating landlord leasing out a given plot of land. He can choose tenants from a pool of laborers with the same set of alternative employment opportunities. Tenants differ only in their initial wealth w, which is observable for the landlord. The landlord cannot observe the tenant's choice of effort e, but does observe the output level. To simplify the analysis, I follow Banarjee and Ghatak (1996) and assume that output can take only two values, $H = 1$ (high) or $L = 0$ (low), where the probability of the H-output is $e \in [0,1]$. Both the tenant and the landlord are assumed to be risk neutral. Effort has disutility $c(e)$ to the tenant, assumed to be a quadratic function, $c(e) = ce^2/2$, where $c > 1$.

The total expected return from the plot is $e - ce^2/2$. This is maximized for $e = \frac{1}{c}$, which implies that although cultivation is socially profitable (in that the expected return exceeds the opportunity cost of the tenant's labor input), it is also risky because the total return is negative if the low output is realized.

The landlord's problem is to design a tenancy contract that induces the tenant to take the best action from the landlord's point of view. Since the landlord can not observe the tenant's effort, he has to offer the tenant a contract where the payment is based on observable output. The

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landlord offers the tenant a contract (h, l), which pays h if the high output is realized and l if the low output is realized. However, the tenant will only accept an offer from the landlord if it yields at least his outside option, which will be normalized to zero. This yields the following *participation constraint*

$$(1) \qquad U = eh + (1-e)l - \frac{c}{2}e^2 \geq 0$$

The tenant responds to the contract offered by the landlord by choosing effort so as to maximize his payoff U. The tenant's problem is therefore

$$(2) \qquad \max_e \left(eh + (1-e)l - \frac{c}{2}e^2 \right)$$

which is the *incentive compatibility constraint*. This restriction reflects the moral hazard problem involved: Once l and h has been decided and the contract accepted, the tenant will choose the level of effort that maximizes his objective function. This gives the tenant the following first order condition

$$(3) \qquad e = \frac{h-l}{c}$$

for $h - l > 0$ and $e = 0$ for $h - l \leq 0$.

Since the tenant's liability is limited to his wealth w, the landlord must also take account of the fact that the maximum amount of rent the tenant can pay is bound by the tenant's wealth and output realized. For any contracts that specify a fixed-payment to the landlord, the tenant is assumed to pay the entire amount only if the tenant's income from the leased land and his initial wealth exceeds his rental obligation.[5] If realized output is such that the tenant's income from the land and his initial wealth is less than his rental obligation, the landlord will not be paid the entire fixed amount. In order not to lose any rent, the landlord's output-contingent payments must

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[5] It is assumed that the landlord may appropriate part or all of the tenant's wealth, free of cost, to cover rental obligations.

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therefore satisfy the constraints $h + 1 + w \geq 0$ and $l + w \geq 0$. Only the latter inequality matters, however, since h must be greater than l in order to provide the tenant with incentives to work. We will refer to this restriction as the *limited liability constraint*.

Before we analyze more closely the nature of the optimal tenancy contract under limited liability and unobservable effort, note that it is common in the literature on tenancy contracts to express the payment to the tenant by the following linear function

(4) $$y = \alpha x + \beta$$

where x is output, α is a parameter representing an output sharing rate, and β is a parameter representing a fixed payment that corresponds to a fixed-wage contract if $\beta > 0$ and to a fixed-rent contract if $\beta < 0$. A pure share-rent contract is characterized by $0 < \alpha < 1$ and $\beta = 0$. A mixed share-rent contract is associated with $0 < \alpha < 1$ and $\beta \neq 0$.

The contract in our model is defined by two variables (h, l) which is the tenant's payment in the high and low output stages respectively. Since the output can take only two values, high and low, with probability e and $1 - e$, the expected payment to the tenant is $y = eh + (1 - e)l$. If we rewrite this as

(5) $$y = (h - l)e + l$$

we see that instead we could have conducted our analysis in terms of the linear contract expressed in (4) where $\alpha = (h - l)$ is the share of the crop that goes to the tenant and $\beta = l$ is the fixed component, with $\beta = l < 0$ representing a fixed-rent contract. This observation will be used in the reasoning that follows.

3. Contracting with Unobservable Effort and Limited Liability

As a benchmark, let us first consider the case where the tenant's effort is fully observable. The landlord will then choose an effort level so as to maximize his own expected return $e - eh - (1-e)l$ subject to the tenant's participation constraint. If we denote the first best effort level as $e*$, it is easy to see that the optimal level of effort is that which satisfies

(6)
$$e* = \frac{1}{c}$$

which says that the marginal disutility of effort (ec) should equal the expected marginal product of effort, which is equal to one by assumption. If the tenant's choice of effort is observable, then the landlord can simply instruct the tenant to provide labor input $e*$ in return for a fixed-wage, chosen so that the tenant's participation constraint is satisfied with equality i.e. $h = l = \frac{1}{2c}$. If labor input is observed to be anything else, the tenant (who is now actually a wage laborer) is paid nothing.

However, when the landlord cannot observe the tenant's choice of effort, the landlord has to devise an output contingent contract. His problem is therefore to decide h and l so that the tenant puts in the effort level that maximizes the landlord's expected income $e - eh - (1-e)l$, taking into account the incentive compatibility constraint, the participation constraint, and the limited liability constraints.

The incentive compatibility constraint must always hold as an equality, so it can be replaced by its corresponding first order condition, given in (3). If we substitute for e, using the incentive compatibility constraint, in the landlord's objective function and the participation constraint, the landlord's maximization problem can be reduced to

(7)
$$\max_{h,l} \quad \pi = \frac{h-l}{c} - \frac{(h-l)^2}{c} - l \quad \text{subject to}$$

$$\frac{(h-l)^2}{2c} + l \geq 0$$

$$l + w \geq 0$$

To solve the problem, we form the Lagrangian

(8)
$$L(h,l,\lambda,\mu) = \frac{h-l}{c} - \frac{(h-l)^2}{c} - l + \lambda(l+w) + \mu\left(\frac{(h-l)^2}{2c} + l\right)$$

The first-order conditions with respect to h and l are

(9)
$$1 - 2(h-l) + \mu(h-l) = 0$$

(10)
$$-\frac{1}{c} + \frac{2(h-l)}{c} - 1 + \lambda - \mu\frac{(h-l)}{c} + \mu = 0$$

Let us relate the first-order conditions to the case most commonly assumed in the tenancy literature – that the tenant's liability is unlimited. There is then no upper limit for how much the tenant may pay the landlord in rent, i.e. $\lambda = 0$. From (9) and (10) we then have that the multiplier for the participation constraint μ must be equal to one, i.e. the participation constraint is binding. From (9) we get $(h-l) = 1$ and from the participation constraint $l = -\frac{1}{2c}$. The tenant is, in other words, offered a pure fixed-rent contract where the tenant pays a fixed-rent equal to $\beta = l = -\frac{1}{2c}$ to the landlord and $\alpha = (h-l) = 1$. The incentive compatibility constraint determines the effort level $e = \frac{1}{c}$, which is equal to the first best level $e*$ given in (6). This is the usual result: Under risk neutrality, the tenant who provides the unobservable input becomes the residual claimant, i.e. he bears all the output risk. The tenant receives the full marginal product of his effort and hence effort is at the first-best level. Since the participation constraint is binding under this contract, the landlord secures the entire surplus from the relationship.

Let us now introduce the limited liability constraint again. Adding (9) and (10) we get $\lambda + \mu = 1$. Ruling out the case already considered, namely $\lambda = 0$ and $\mu = 1$, we must either have a situation where the limited liability constraint is a binding constraint and the participation constraint is

not binding ($\lambda = 1$ and $\mu = 0$) or a situation where both the limited liability constraint and the participation constraint bind ($\lambda > 0$ and $\mu > 0$).

Case 1: Let us first focus on the case where the limited liability constraint is a binding constraint and the participation constraint is not binding ($\lambda = 1$ and $\mu = 0$). When the limited liability constraint is binding we get $l = -w$, and from (9), $(h - l) = \frac{1}{2}$. This means that the tenant is offered a (mixed) sharecropping contract where he gets a share $\alpha = (h - l) = \frac{1}{2}$ of the output, and has to surrender his entire wealth to the landlord if the low output is realized, i.e. $\beta = l = -w$. The incentive compatibility constraint then determines an effort level e_1 such that

$$(11) \qquad\qquad e_1 = \frac{1}{2c}$$

Comparing (11) and (6) we see that $e_1 < e*$. The tenant's effort level is fixed at $e = e_1$ (independent of the tenant's wealth), and is lower than the optimal effort level. The participation constraint must also not be violated, i.e. $\frac{1}{8c} - l \geq 0$ or, since $l = -w$, $w \leq \frac{1}{8c}$. The tenant earns rents since the participation constraint does not bind. This establishes the following result.

PROPOSITION 1

When labor input is non-contractible, the tenant is liable only up to his initial wealth w, and $w \leq \frac{1}{8c}$,

(i)   the tenant is offered a (mixed) sharecropping contract;
(ii)   the tenant chooses effort $e_1 < e*$ independently of w;
(iii)   the tenant earns rents

The logic behind this result is that when the tenant's wealth is very low the only way the landlord can capture the entire surplus from the relationship is by reducing the tenant's income when output is high. But this reduces the tenant's incentives to put in effort. When the landlord makes an offer to the

tenant he therefore has to balance two effects working in opposite directions. An increase in the success wage enhances the tenant's effort, raising output on the land. But at the same time, an increase in the success wage reduces the landlord's income. When $w < \frac{1}{8c}$, the indirect gains from an increased success wage exceed the direct loss in income of the increase. The landlord will not extract the entire surplus and the tenant earns more than his reservation payoff.[6]

Case 2: The remaining possibility in (10)-(11) is that both the limited liability constraint and the participation constraint bind ($\lambda > 0$ and $\mu > 0$).

We have shown that it is possible for the landlord to induce the tenant to put in the efficient level of effort, and capture the entire surplus from the relationship, by offering the tenant a fixed-rent contract where the tenant pays the landlord $\beta = \frac{1}{2c}$ independent of the level of output. However, this contract is only valid as long as the tenant's wealth exceeds his rental obligations if the bad outcome is realized, i.e. if $w \geq \frac{1}{2c}$. If $w < \frac{1}{2c}$, the landlord's ability to extract the full surplus out of the relationship via a fixed-rent contract is restricted because of the limited liability clause. If, on the other hand, $w < \frac{1}{8c}$ we are back to the case analyzed above, where only the limited liability constraint binds. Hence, when both the limited liability constraint and the participation constraint bind, (10)-(11) represents a solution to the landlord's maximization problem for $\frac{1}{8c} < w < \frac{1}{2c}$.

When the limited liability constraint is binding, we get $l = -w$, and from the participation constraint we get $h = \sqrt{2cw} - w$. Again, the tenant is offered a (mixed) sharecropping contract where the tenant gets a share $\alpha = (h - l) = \sqrt{2cw}$ of the output, and has to surrender his entire wealth to the landlord if the bad outcome is realized, i.e. $\beta = -w$. But this contract differs from the contract offered when $w \leq \frac{1}{8c}$, in that the fixed-rent component is increasing with the tenant's wealth, together with a

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[6] Another way of formulating this is to say that it is better for the landlord to take a small share of a large cake than to take a larger share of a smaller cake. This result is somewhat analogous to the efficiency wage literature, where the worker is paid a rent to prevent him from shirking, see for example Shapiro and Stiglitz (1984).

compensating increase in the tenant's share, leaving the tenant's expected income unchanged and equal to his reservation position. From the incentive compatibility constraint we get

$$(12) \qquad\qquad e = \sqrt{\frac{2w}{c}}$$

which shows that the tenant's effort is increasing with his wealth. Comparing (12) and (11) we also get $e = e_1$ if $w = \frac{1}{8c}$. Comparing (12) and (6) we get $e = e*$ if $w = \frac{1}{2c}$. Hence e increases from e_1 to $e*$ as w moves from $\frac{1}{8c}$ to $\frac{1}{2c}$. This establishes the following result

PROPOSITION 2

When labor input is non-contractible, the tenant is liable only up to his initial wealth w, and $\frac{1}{8c} < w < \frac{1}{2c}$,

(i)   the tenant is offered a (mixed) sharecropping contract;
(ii)   the tenant's effort is rising in w, from e_1 to $e*$;
(iii)   the tenant's expected return equals his reservation position

We have already shown that when $w \geq \frac{1}{2c}$, the landlord can induce the tenant to put in the efficient level of effort, and capture the entire surplus from the relationship, by offering the tenant a fixed-rent contract where the tenant pays the landlord $\beta = \frac{1}{2c}$. When $w < \frac{1}{2c}$ this contract is no longer feasible since the tenant will not be able to pay his rental obligations when output is low. In order to be able to extract the full surplus from the relationship the landlord instead has to offer a contract where the tenant pays more when output is high than when it is low, together with a compensating decrease in the fixed rent component. This is necessary in order to keep the participation constraint intact. But "punishing" the tenant when output is high obviously has bad incentive effects, leading to a reduction in the tenant's effort. This problem becomes more severe the less the wealth of the tenant (since the limited liability constraint tightens and his

ability to pay fixed-rents reduces). When $w \leq \frac{1}{8c}$ it is more profitable for the landlord not to extract the full surplus out of the relationship because this distorts work incentives too much. But then we are back to the situation discussed in case 1 above.

4. Landlords Selection of Tenants

The model presented can also be helpful in interpreting some empirical regularities concerning the land lease market in less developed countries. Several empirical studies have documented that it is almost impossible for a landless farmer to obtain land on a rental basis. Tenants are drawn mainly from the group of farmers possessing some land of their own (see Bell and Zusman (1976), Ahmed and Taslim (1992), Sharma and Dreze (1996), among others). These studies view the landlord's choice of tenants as determined by imperfections in input markets other than land. When inputs such as draught animals are non-marketed, landlords will lease their land to those with superior endowments of these inputs – and they are typically landed tenants. In addition, land-owning farmers may have a comparative advantage over landless farmers in the acquisition of the skills necessary to cultivate the rented land properly (e.g. choice of crops, proper land and water management, selection and timely application of inputs etc.). We do not question the importance of these factors, but the model analyzed above suggests that increased productivity because of land ownership is not the only explanation for why landlords prefer land-owning tenants. In less developed countries, ownership of land is highly correlated with current wealth position. The key feature of the model analyzed above is that a landlord's ability to provide the tenants with contracts that give good incentives to work, depends on the tenant's wealth – and therefore indirectly on land ownership.

If the tenant's wealth is greater than $\frac{1}{2c}$ he is able to cover fixed-rent commitments even if output is low, and he is offered a pure fixed-rent contract. The tenant bears fully the cost of putting in less than the optimal level of effort on the land. Hence labor input is at the first-best level

($e = e*$) and the total expected surplus is maximized. If the tenant has little wealth (less than $\frac{1}{2c}$) the tenant's ability to pay his rental obligation if output is low is restricted. Because of the limited liability clause, the landlord has to offer a contract where the tenant pays more when output is high than when it is low. This reduces the tenant's incentives to put in effort, and the expected outcome is less than under a fixed-rent contract. It follows from this reasoning that the landlord would prefer wealthier tenants when he decides to lease out his land, since expected return from the land increases as the wealth of the tenant increases. This is illustrated in figure 1.

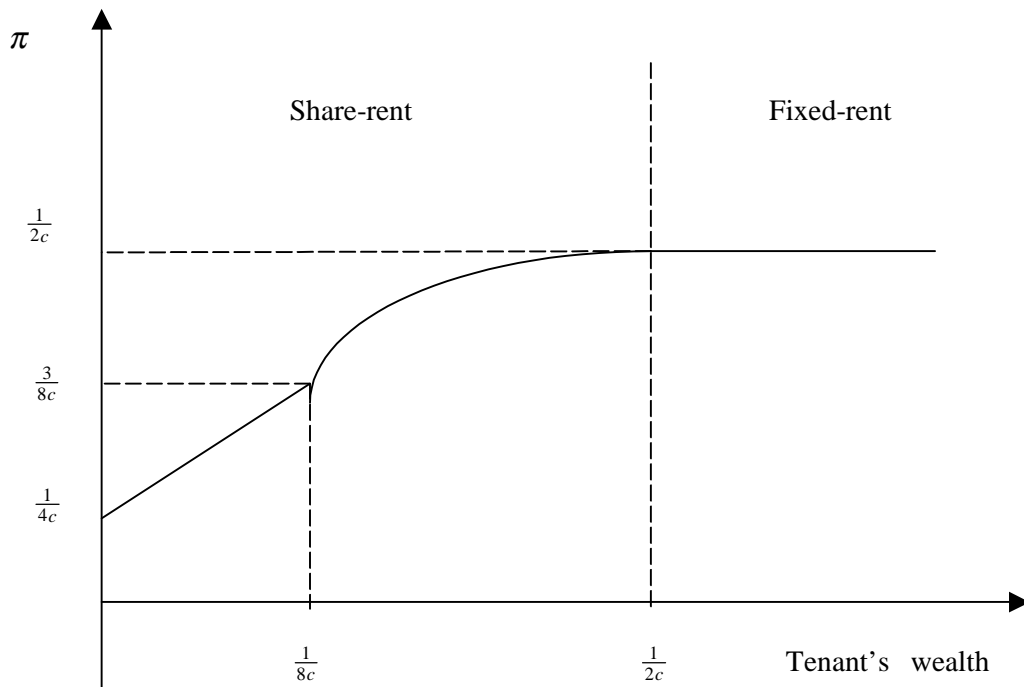Figure 1   *Relationship between tenant wealth and expected income π of the landlord.*

Figure 1 shows that the landlords expected income π is an increasing function of the tenant's wealth as long as $w < \frac{1}{2c}$. When $w \le \frac{1}{8c}$, π increases from $\frac{1}{4c}$ to $\frac{3}{8c}$ as the tenant's wealth moves from 0 to $\frac{1}{8c}$. When

$\frac{1}{8c} < w \leq \frac{1}{2c}$, π increases from $\frac{3}{8c}$ to $\frac{1}{2c}$ as the tenant's wealth moves from $\frac{1}{8c}$ to $\frac{1}{2c}$. When $w \geq \frac{1}{2c}$, π is invariant with respect to the tenant's wealth. This establishes the following result

PROPOSITION 3

> *When labor input is non-contractible and the tenant is liable only up to his initial wealth w, the landlord's expected return from the leased out land increases as the wealth of the tenant increases up to $\frac{1}{2c}$. For $w \geq \frac{1}{2c}$ the landlord's expected return is invariant with respect to the tenant's wealth*

It follows from this that when the supply of land is limited relative to the supply of prospective tenants, only the wealthiest (in particular land-owning) farmers are chosen as tenants.

5. Concluding Remarks

We have examined the nature of tenancy contracts explicitly taking into account the fact that the maximum rent the tenant can pay the landlord is restricted by the tenant's wealth. It was shown that if the tenant's wealth is sufficient to cover fixed-rent commitments even if output is low, he is offered a pure fixed-rent contract. This is preferable to other contracts because when effort is non-contractible, only a fixed-rent contract provides efficient incentives for labor input. If the tenant does not have sufficient wealth to cover fixed-rent commitments the tenant is offered a share-rent contract. But such a contract distorts the tenant's labor input decision. As a result, the expected total return from cultivation is lower compared to a situation where a fixed-rent contract is used. A landlord will therefore prefer wealthier farmers as tenants.

Since Shetty's (1988) paper is closely related to ours, we need to provide a short comment to clarify the difference between the two. A restriction in Shetty's analysis is that he does not consider the precise contract form received by tenants that have insufficient wealth to cover

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fixed-rent commitments. He argues that in this case a share-contract will be used, but the precise contract terms are not spelled out. In this paper we have not only demonstrated that a pure fixed-rent contract will not be used for tenants below a certain wealth level, we have also demonstrated that the actual contract will be a mixed share-rent contract. The assumptions underlying Shetty's model are also slightly different from ours. This paper considers an environment with one dominant landowner confronting an elastic supply of potential tenants who differ only in their initial wealth level. In contrast, Shetty considers a set-up in which landlords compete for prospective tenants whose expected return is higher in equilibrium. We reach completely the opposite result. In our model it is only the poorest tenants that earn rents. The logic behind this result is that if a tenant has little or no wealth, the only way the landlord can extract the entire surplus from the relationship is by making the tenant pay more when his output his high than when is output is low. But this distorts the tenant's choice of effort so much that the landlord's return is lower compared with a situation where he does not try to press the tenant completely down to his reservation utility level.

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