Notes on Theories of Sharecropping Tenancy and their Empirical Implications[1]

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1 Introduction

Ronald Coase argued that in the absence of transaction costs all exchanges could take the form of simple market transactions (like buying a cup of coffee) and one would not need organizational forms like the firm within which transactions do not resemble simple market transactions. For example, some suggest that if monitoring was not a problem one would not need the complex hierarchical organizational forms we usually associate with firms, one could simply buy whatever units of labor, be it simple manual labor or some complex expertise, that needs to be put into the production function. Transaction costs make simple market transactions too expensive and necessitates organizational and contractual forms as substitutes. This forms the philosophical foundation underlying the theory of the firm in industrial organization. In this section we look at agrarian organization from the same perspective. To begin let us note down some major characteristics of agricultural production :

(1) Land and labor are the two major factors of production. Production takes place through a sequence of tasks (e.g., preparing the land, sowing seeds, planting seedlings, applying pesticides, harvesting) and has a seasonal nature with peaks and slumps in labor demand. Fixed capital is not very important - even with advanced techniques of cultivation using tractors, harvesters, threshers and irrigation equipments, a relatively well functioning rental market rules out returns to scale.

(2) Different tasks require different degrees of effort, judgement and, care. For example, fertilizer/pesticide application and water control require a lot of care whereas harvesting is a relatively monitorable manual task.

(3) There is a lot of exogenous uncertainty (e.g., due to the dependence on weather, possibility of pest attacks etc.), at the same time absence of formal insurance markets are absent.

In developing countries small scale family farms is the major form of agricultural enterprise. These are household owning small plots of land which are used mainly

[1]Preliminary and incomplete. Comments welcome.

to produce staple food crops for home consumption and sale. Other than that there exists a class of landless laborers and wealthy non-cultivating landlords. Various arrangements of land-tenancy and labor-employment contracts are used to combine two major factors of production is agriculture, land and labor. In this section we focus on tenancy contracts, and in the next section we talk about forms of labor contracts.

Tenancy involves two transactions: labor and land are exchanged with each other. When a laborer rents in land in exchange for a fixed fee to the land-owner we call that a fixed-rent tenancy contract. If the landlord hires in the laborer in exchange for a fixed-fee we call that a fixed-wage contract. Finally, when a laborer rents in the land in exchange for paying the landlord a fee which is linear in output we call that a sharecropping tenancy contract. That is, denoting output by Y, labor and land inputs as L and $T,$ and the production function as $Y = F(L, T)$, the tenant's income under these alternative contractual forms is:

$$y = sY - R$$

Correspondingly, the landlord's income is

$$Y - y = (1 - s)Y + R$$

If $s = 1, R > 0$ then we have a fixed rent contract, if $s \in (0, 1)$ and $R > 0$ or < 0 we have a sharecropping contract and finally if $s = 0$ and $R < 0$ we have a fixed-wage contract.

The widespread prevalence of sharecropping tenancy in virtually all countries and all times has troubled economists since Adam Smith because the fact that the tenant gets less than the marginal product of his inputs indicates that this agrarian institution is likely to be inefficient. To put it differently, since output is being shared and not profits, a share-contract is like an income tax which has well-known incentive problems. Subsequent work has showed sharecropping tenancy as an optimal contractual response to incomplete markets.

If only the land market was absent (say, due to high transaction costs) then a person who has more land relative to labor would hire in labor in the quantity that is optimal given the plot-size and a person who has more labor than land will sell labor in excess of what he needs for cultivating his own plot. Similarly, if labor was completely immobile (e.g., among some high caste groups among Hindus it is degrading to work *for* somebody) then people would lease in land in line with their labor endowments and marginal factors of products would be equated across farms. Formally, let A and B denote two factors of production and let the production function be $Y = F(A, B)$ which we assume is constant returns to scale (CRS). In particular, we take the Cobb-Douglas form : $Y = A^{\alpha} B^{1-\alpha}$. This can be converted into a function that gives output per unit of factor A as a function of the ratio of input B to input A :

$$y = f(b) = b^{1-\alpha}$$

Suppose that there does not exist a market for factor A, which therefore does not have any price. By factor B has a fully functional market with price p_B. The market for output too is perfect and the price is normalized to 1. Then a person owning $\overline{A}$ units of factor A and $\overline{B}$ units of factor B will solve

$$\max_{B} F(\overline{A}, B) - p_B(B - \overline{B})$$

or, equivalently, dividing the objective function by $\overline{A}$ we get:

$$\max_{b} f(b) - p_B(b - \bar{b})$$

which gives the first-order condition

$$\frac{df(b)}{db} = p_B$$

This implies that factor ratios are equalized across farms:

$$b^* = \left(\frac{1-\alpha}{p_B}\right)^{\frac{1}{\alpha}}$$

If $B^* = b^*\overline{A} > \overline{B}$ then he is a net buyer of factor B and a net seller otherwise. Even though the market for factor A does not exist we can compute its 'shadow price' which is the same for all farms:

$$\frac{\partial F(\overline{A}, b^*\overline{A})}{\partial A}$$

The theories of tenancy that we are going to discuss try to explain various features of these contracts, their variation over time and space based on :

(a) missing market for insurance;

(b) absence or incompleteness off some factor market other than land such as effort (as distinct from labor), managerial ability, bullocks, family labor. The reason for such market imperfection is high cost of quality enforcement and to ensure good quality the factor input has to be bought with the factor owner's time using a self-monitoring contract.[2]

(c) absence of separate markets for the same factor differing in quality.

2 Theories of Tenancy

In the following sections we present variants of a simple principal-agent model to capture the essence of different theories of tenancy. The set of models we present are

[2] Existence of special skills or apparently indivisible factors of production such as a tractor or a tube-well *per se* can not explain the need to have sharing arrangements because with complete markets special skills and services of indivisible factors can be bought in or sold out.

well known but not exhaustive. Also, we focus on static models - there are important dynamic issues in the context of tenancy. In addition, we take the match of the landlord (or the land) and the tenant as exogenously given. There is a more recent literature that looks at endogenous matching (such as

We take the preferences and endowments of landlords and tenants, market wages and rental rates, and the characteristics of the production function as the given economic environment and endogenously derive the optimal contract. We will evaluate these theories by listing their predictions in terms of the following issues:

1. Contractual diversity : Does the theory imply that only one form of contract is going to emerge irrespective of the differences in the underlying economic environment, say, fixed-rental contracts, or does it allow for contractual diversity reflecting differences in the underlying economic environment.

2. Efficiency of various contractual forms: Does theory predict any difference in productive efficiency associated with various contractual forms, such as fixed wage contracts, sharecropping contracts and fixed-rent contracts? If so what elements of the underlying economic environment does the extent of differential efficiency depend on?

3. Effect of variations in technology : what happens to the optimal contract when

(a) Riskiness in production goes up?

(b) The relative importance of various inputs changes (e.g., production becomes more sensitive to managerial inputs as opposed to labor supervision) ?

4. Effects of variations in preferences : what happens to the optimal contract when the attitudes towards risk or the disutility of work of the landlord or the tenant varies?

5. Effects of variations in reservation payoffs : what happens to the optimal contract when the reservation payoffs of either the landlord or the tenant varies (say, due to an exogenous shock to supply of labor or a tenancy reform program)?

6. Rents and eviction threats : can any of the parties earn rents in the relationships, i.e., even if one of the parties, say, the landlord, has all bargaining power and *can* make take-it-or-leave-it offers to the tenant, would he *choose* to do so? Consequently, do eviction threats, a reason often cited for tenancy reform laws, have any contract-theoretic foundation?

2.1 A Risk Sharing Model

Suppose, for whatever reasons, the market for insurance is absent. Then one could argue, as Steven Cheung (1968,1969) does, that sharecropping leads to better risk sharing if both landlord and tenant are risk averse. This is demonstrated using the following simple model.

Production Function : We are going to take a production function which is linear in the tenant's effort. However, we want to output to be stochastic (otherwise there is no reason to share risk!) and so we propose the following simple production function :

$$q = e + \theta$$

where q is output, e the effort put in by the cultivator, and θ, a random shock with zero mean and variance σ^2. Note that the tenant controls only the mean and not the variance of the production function.

Preferences: All agents are risk-averse with a mean-variance *expected* utility function of income:

$$U(y) = E(y) - \frac{r(w)}{2} Var(y)$$

The coefficient of absolute risk-aversion is denoted by $r(w)$ and is assumed to be declining in w.The utility for income level y is $u(y) = y - \frac{1}{2} r(w) (y - E(y))^2$. The first two derivatives of this function at income level y are $u'(y) = 1 - r(w) (y - E(y))$ and $u''(y) = -r(w)$.Evaluated at the mean of y we get $\rho = -\frac{u''(Ey)}{u'(Ey)} = r(w)$.[3] The preferences we propose are convenient because the utility is linear with respect to the choice of effort (which given our production technology does not affect variance) while it is non-linear with respect to the choice of the contract which does affect the variance in income faced by a party.

Endowments: We consider two agents: Agent L (the 'landlord') who owns a piece of land, monetary wealth w_L and no labor and Agent T (the 'tenant') who owns no land, monetary wealth w_T and a unit of labor.

Markets : The insurance markets are missing. Land, labor and goods markets are perfectly competitive. This means, if the landowner wants he could buy the tenant's labor services at the market wage rate $\underline{u}$ and if the laborowner wanted he could buy the landlord's land at the market rental rate ρ. Here let us note that in a static economy leasing in land for a fixed fee ρ and buying it for good is the same thing since everyone lives for one period.

Contracting: We are going to distinguish between labor and effort, the former being the potential to work and the latter being the actual intensity of work. Therefore if someone puts in an effort level of $e = 0.5$ we will say the person is utilizing 50% of his labor power. It is costly to exert effort and this cost will be assumed to be $\frac{1}{2} ce^2$. The marginal cost of effort, c, can be taken as an inverse index of productivity. The competitive wage rate in the labor market is assumed to be net of the effort cost. In this model we assume that e is observable and contractible which is the case if monitoring is costless. We restrict ourselves to linear contracts, that is the tenant's income, y_T, is going to be a linear function of output

$$y_T = sy - R$$

where

$$0 \leq s \leq 1 \text{ and } w_T \geq R \geq -w_L.$$

[3]You could verify that this model is equivalent to a model where θ is normally distributed and the utility function takes the $CARA$ form: $u(x) = -e^{-\beta x}$, $\beta > 0$.

In the contract s will be referred to as the 'share' component and R as the 'fixed-rent' component.. We are going to ignore the restrictions on R imposed by the wealth levels of the landlord and tenant and assume that the equilibrium value of R satisfies these constraints. In a subsequent section we explore the implications of a binding limited wealth constraint. The contract also specifies an effort level e to be put in by the tenant. Under this contract the expected utilities of the tenant and the landlord are :

$$\begin{aligned} U^T(e,s,R) &= E(sy-R) - \frac{r(w_T)}{2} Var(sy-R) - \frac{1}{2}ce^2 \\ &= se - R - \frac{r_T}{2}s^2\sigma^2 - \frac{1}{2}e^2 \end{aligned}$$

$$\begin{aligned} U^L(e,s,R) &= E[(1-s)y+R] - \frac{r(w_L)}{2} Var[(1-s)y+R) \\ &= (1-s)e + R - \frac{r_L}{2}(1-s)^2\sigma^2 \end{aligned}$$

Note that social surplus is

$$\begin{aligned} \mathcal{S} &= U^T(e,s,R) + U^L(e,s,R) \\ &= e - \frac{r_T}{2}s^2\sigma^2 - \frac{r_L}{2}(1-s)^2\sigma^2 - \frac{1}{2}ce^2 \end{aligned}$$

The optimal effort level and the share are the solutions of the first-order conditions:

$$\begin{aligned} \frac{\partial \mathcal{S}}{\partial e} &= 1 - ce = 0 \\ \frac{\partial \mathcal{S}}{\partial s} &= -r_T s\sigma^2 + r_L(1-s)\sigma^2 = 0 \end{aligned}$$

which yields:

$$\begin{aligned} e^* &= \frac{1}{c} \\ s^* &= \frac{r_L}{r_T + r_L} \end{aligned}$$

The maximized value of the social surplus is:

$$\begin{aligned} \mathcal{S}^* &= e^* - \frac{r_T}{2}(s^*)^2\sigma^2 - \frac{r_L}{2}(1-s^*)^2\sigma^2 - \frac{1}{2}c(e^*)^2 \\ &= \frac{1}{c} - \frac{1}{2}\frac{r_T r_L}{r_T + r_L}\sigma^2 - \frac{1}{2c} \end{aligned}$$

$$
\begin{aligned}
U^T(e,s,R) &= se - R - \frac{r_T}{2}s^2\sigma^2 - \frac{1}{2}ce^2 \\
&= \frac{r_L}{r_T+r_L}\left(\frac{1}{c} - \frac{1}{2}\frac{r_T r_L}{r_T+r_L}\sigma^2\right) - \frac{1}{2c} - R
\end{aligned}
$$

$$
\begin{aligned}
U^L(e,s,R) &= (1-s)\alpha e + R - \frac{r_L}{2}(1-s)^2\sigma^2 \\
&= \frac{r_T}{r_T+r_L}\left(\frac{1}{c} - \frac{1}{2}\frac{r_T r_L}{r_T+r_L}\sigma^2\right) + R
\end{aligned}
$$

So long as $\mathcal{S}^* > \underline{u} + \rho$ there are gains to be made from trade between the landowning and labor-owning agents.

$$
\frac{1}{c} - \frac{\sigma^2}{2}\frac{r_T r_L}{r_T+r_L} - \frac{1}{2c} > \underline{u} + \rho
$$

The precise division of the gains would depend on the bargaining regime.

If there was a competitive insurance market then the premium would have been zero and the total surplus to be distributed between the landowner and the laborowner would have been $e - \frac{1}{2}ce^2 = \frac{1}{2c} > \frac{1}{2c} - \frac{\sigma^2}{2}\frac{r_T r_L}{r_T+r_L}$.

If we adopt the bargaining protocol that is usually adopted in the contract-theory literature, namely the principal can make take it or leave it offers to the agent subject to providing the latter with his reservation utility, $\underline{u}$, then the optimal contracting problem is

$$
\begin{aligned}
& \max_{\{s,R,e\}} U_L \\
\text{subject to } U_T &\geq \underline{u}
\end{aligned}
$$

It is easy to verify that e and s will be as before and the fixed-rent component would be

$$
\begin{aligned}
R^* &= \frac{r_L}{r_T+r_L}\left(\frac{1}{c} - \frac{\sigma^2}{2}\frac{r_T r_L}{r_T+r_L}\right) - \frac{1}{2c} - \underline{u} \\
&= s^* S^* - (1-s^*)\frac{1}{2c} - \underline{u}
\end{aligned}
$$

The profits the landlord is making in this model is partly a return for the land's productivity and partly for providing insurance services to the tenant - the rest is pure rent. In this model the participation constraint (PC) of the tenant would always bind because if λ is Lagrangian multiplier associated with the PC then the firs

If the tenant happened to own the land then he would maximize:

$$\max_{e} e - \frac{r_T}{2}\sigma^2 - \frac{1}{2}ce^2$$

and the effort choice would be the same, $e = \frac{1}{c}$, and the equilibrium surplus would be

$$\mathcal{S}' = \frac{1}{c} - r_T\frac{\sigma^2}{2} - \frac{1}{2c}$$

which is smaller than $\mathcal{S}^*$ and this shows why risk-sharing is an improvement over autarchy. In other words, even if the tenant owned the land he would be willing to enter into a sharecropping relationship in order to reduce the amount of risk he has to bear.

The following predictions of this model are easily established:

1. Share contracts ($r_L, r_T > 0$), fixed-rent contracts ($r_T = 0$) and pure wage contracts ($r_L = 0$) could all coexist and their forms depend only on the attitudes towards risk of the parties (of which wealth is a good instrument). Therefore this model has a purely preference-based explanation of contractual forms.

2. The effort is at an 'efficient' level irrespective of the contractual form. Moreover it is at the same level that would be chosen if all markets existed and operated perfectly.[4] So in a more general model, effort level and hence average productivity would depend on the contractual form because both are correlated with the degrees of risk-aversion of the landlord and the tenant. Controlling for wealth (a proxy for risk-aversion) however one should not get any correlation. The reason why people usually associate the risk-sharing model of sharecropping with efficiency is that there is no conflict of interest between the landlord and the tenant regarding the effort choice presumably because monitoring costs are zero.

3.

(a) As riskiness of production goes up (i.e., σ^2 increases), the fixed-rent component R^* goes down, the share and the effort level are unchanged. Again this is a consequence of the assumption that the effort level affects the mean and not the variance of the distribution of output. But elimination of exogenous uncertainty removes the reason for existence of contractual forms in this model and so the resulting contract would be indeterminate.

[4] This however is a consequence of the production function and the utility function chosen for this model. As an exercise you might want to solve out the model with the same preferences but a different production function : output takes two values, H and $L, H > L \geq 0$ and the tenant's effort, e, is the probability of output being H. It is easy to show that if the tenant's effort affected variance of output too then without an insurance market the optimal contract would take that effect into account while with a perfect insurance market the effort choice should not be taking its effect on variance - it should maximize the mean. But if the land is transferred to the tenant, the effort choice would again be different because now it affects variance and the tenant has to bear all the risk.

(b) An increase in the productivity of labor (i.e., c goes down) will increase the effort level, leave the share unchanged and will decrease the rent component if the landlord is less risk-averse than the tenant and increase it otherwise.

4. An increase the wage rate $\underline{u}$ only reduces the fixed rent. This is a consequence of the fact that the PC always binds in this model. This is a general result and holds so long as there isn't a binding limited wealth constraint. Intuitively, the only role that the fixed-rent component plays here is to transfer utility from the landlord to the tenant and since utility is linear for both in any non-random component of income, the PC has to bind.

5. The more risk-averse the tenant compared to the landlord, the lower is his share. If we assume that the landlord is very rich so that he is risk-neutral (i.e., $r_L = 0$) then the share of the tenant is 0 and the fixed-rent is $R^* = -\frac{1}{2c} - \underline{u}$ which is the wage rate plus the cost of effort by the tenant. If instead the tenant is risk-neutral while the landlord is risk-averse we get a share of 1 and a fixed rent of $\frac{1}{2c} - \underline{u}$ which is the expected social surplus less the wage rate.

6. For the same reason as in 4, there are no rents and hence so eviction threats would not be effective.

Some criticisms of the risk-sharing model of tenancy are:

1. There is no endogenous explanation of why either the land or the insurance market is absent.

2. David Newbery (1975) and Joseph Reid (1976) pointed out that if there is constant returns to scale (CRS) then risk sharing can be achieved by dividing the land into two subplots and cultivating one using a pure wage contract and the other using a pure rental contract. Let L and T be the amounts of land and labor needed for the whole plot, let $Q(L, T, \theta)$ be the stochastic production function and r and w be the rental and the wage rate. If a fraction k of the land is rented out and the remainder cultivated at a fixed wage then the tenant's total income from the rental and the wage contract is,

$$\begin{aligned} & Q(kL, kT, \theta) - rkT + w(1-k)L \\ = \ & kQ(L, T, \theta) - rkT + w(1-k)L \end{aligned}$$

because of CRS. Now if k is chosen such that $rkT - w(1-k)L = 0$ then the tenant's income is $kQ(L, T, \theta)$ which is like a pure share contract with the share equal to k . However, if there is an additional source of risk, say because the wage rate in the spot labor market is uncertain, then the sharecropping contract may achieve better risk-sharing than a portfolio of wage and fixed rent contracts. If $\widetilde{w}$ is the uncertain wage then the tenant's income from mixing fixed rent and wage contracts in proportions $k : 1-k$ with L units of labor and T units of land is

$$k\widetilde{Q} - rkT + \widetilde{w}(1-k)L$$

Since there are two random variables, this expression is a linear function of Q only if $k = 1$ which is dominated by a sharecropping contract $s\widetilde{Q} - R$.

3. Another problem with this argument is that it is highly implausible that the share would be 50:50, which seems to be the most commonly observed practice across time and space, given the often widely different wealth levels of the landlord and the tenant and the consequently different attitudes towards risk that it entails. In other words, if tenants are more risk averse then the landlord should insure the tenant by offering him a wage contract.

2.2 Risk Sharing Vs Incentives Model

If effort is non- monitorable then it can't be bought in a market and the tenant would need incentives to put in effort. Introduction of moral hazard in effort decisions by the tenant in the model provides a solution to the problem and in addition provides an explanation why insurance markets are likely to imperfect. Then fixed-rental contracts will be optimal from the point of view of incentives but that would put too much risk on the tenant and a share-cropping contract will achieve the right balance between risk-sharing and incentive provision. Even if insurance markets were otherwise perfect would purchase of insurance by the tenant along with fixed rental contracts solve the risk-incentives trade-off problem ? No, because then the tenant would shirk and if output is low collect insurance so the brunt of the moral hazard problem would be merely transferred from the landlord to the insurance firm. This is essentially the story of Joseph Stiglitz (1974).

Consider the pure risk-sharing model of sharecropping and make the following modification: now the landlord cannot observe e and hence it cannot be contracted on. The landlord has to try to influence it through the choice of s and $R.$ This adds an incentive-compatibility constraint into the optimal contracting problem:

$$\begin{aligned} e &= \arg\max[se - R - \frac{r_T}{2}s^2\sigma^2 - \frac{1}{2}ce^2] \\ &= \frac{s}{c} \end{aligned}$$

The maximized value of total social surplus in this case is

$$\mathcal{S}^* = s\frac{1}{c} - \frac{r_T}{2}s^2\sigma^2 - \frac{r_L}{2}(1-s)^2\sigma^2 - \frac{s^2}{2c}$$

Differentiating with respect to s we get the first-order condition:

$$\frac{1}{c} - r_T s\sigma^2 + r_L(1-s)\sigma^2 - \frac{s}{c} = 0$$

which yields

$$s^* = \frac{1 + cr_L\sigma^2}{1 + c(r_T + r_L)\sigma^2}$$

and consequently,

$$\begin{aligned} e^* &= \frac{s^*}{c} \\ R^* &= s^*e^* - \frac{r_T}{2}(s^*)^2\sigma^2 - \frac{1}{2}c(e^*)^2 - \underline{u} \\ &= \frac{(s^*)^2}{2c}(1 - cr_T\sigma^2) - \underline{u} \end{aligned}$$

The following predictions of this model are easily established:

1. Share contracts and fixed-rent contracts ($\sigma^2 = 0$ and/or $r_T = 0$) could coexist. For fixed wage contracts to be seen the tenant has to be infinitely risk-averse though. The contractual form depends on the attitudes towards risk of the parties (r_L, r_T), the variance of output (σ^2) and the marginal cost of effort (c). In contrast, in the previous model the share depended only on the attitudes towards risk of the contracting parties.

2. The effort level e is different from the surplus maximizing level, $\frac{1}{c}$. In contrast in the risk-sharing model effort is at an 'efficient' level, that is at the same level that would be chosen if all markets existed and operated perfectly. The difference, which can be called 'agency costs' associated with sharecropping tenancy is $(1 - s^*)\frac{1}{c}$. Sharecropping is less efficient than fixed-rental tenancy which would obtain if $r_T = 0$ and $r_L > 0$.

3.

(a)As uncertainty goes up (i.e., σ^2 goes up) the share of the tenant, the effort level and the fixed-rent component goes down. Thus reduction in exogenous uncertainty would imply a movement towards fixed-rental tenancy.

(b)An increase in the productivity of labor (i.e., c goes down) will increase the share, effort level and the fixed-rent component.

4. As the wage rate $\underline{u}$ goes up the fixed rent goes down but nothing else is affected. This is again a consequence of the fact that we take mean-variance utility functions and effort does not affect the variance of output. See note 1 in the appendix for a counter-example.

5. The more risk-averse the tenant compared to the landlord, the lower is his share. If we assume that the landlord is very rich so that he is risk-neutral (i.e., $r_L = 0$) then the share of the tenant is:

$$\frac{1}{1 + cr_T\sigma^2}$$

which is different from the previous model where the share would be 0 in this case. If instead the tenant is risk-neutral while the landlord is risk-averse we get a share of 1 and only in this case we get full efficiency. Notice that if there was a perfectly functioning insurance market then there would be an improvement in welfare when both landlord and the tenant are risk-averse. However, agency costs would remain as in the case when the landlord is risk-neutral.

6. Since the PC binds there are no rents and scope for effective use of eviction threats.

Some criticisms of the risk-sharing vs. incentives model of sharecropping are:

1. The basic inefficiency proposition has been challenged by some (see Johnson, 1950 for an early influential paper) who argue that the close-knit and stable nature of rural society implies that informational asymmetries and costly monitoring are as plausible as they are in more anonymous urban settings. In game theoretic terms, the landlord and tenant are seen as playing a repeated game where over time observation of output can yield very close approximations of effort. Also the landlord has many other instruments, such as threat of eviction, adjusting land size, interlinking contracts being and direct monitoring, to mitigate the lower efficiency due to moral hazard. My opinion on this is it is a matter that has to be settled empirically - controlling for land-quality, characteristics of the landlord and the tenant, do an increase in share lead to higher output?

2. Another criticism is that if the credit market is perfect then the tenant should be able to buy the land and this should happen given the potential gains in efficiency. This criticism is misguided as the landlord could offer the same set of contracts as a bank can do: if it is optimal to set $s = 1$ and $R > 0$ (which in a static model is equivalent to selling the land to the tenant) the landlord would do it himself. Put differently, if a bank decides to step in buying out the landlord then it will be in no different position than the landlord after this transaction. Even if it offers better terms than the landlord, i.e., gives the tenant all the net surplus, which in this model is equivalent to a rise in $\underline{u}$, e will remain unchanged. This, again, is the consequence of the nature of the production and utility functions assumed here.

2.3 A Limited Liability Model

Now consider the same model as in the last section but with the following two modifications: first, both the tenant and the landlord are risk-neutral and second, there is a limited liability constraint which requires that the amount of money that could be taken away from the tenant as a fixed-rent is bound above by his wealth w_T. Such models have been applied in the context of tenancy by Dutta, Ray, and Sengupta, 1989, Laffont and Matoussi, 1995, Mookherjee, 1997, and Banerjee, Gertler and Ghtatak, 2002.

We are assuming the fixed-rent component has to be paid in advance - otherwise, even if a tenant has lower wealth, when output is high he will be able to pay the fixed rent. Formally,

$$R \leq w_T$$

As before the incentive-compatibility constraint is:

$$e = s\frac{1}{c}$$

Substituting the ICC in the optimal contracting problem we have:

$$\max_{(s,R)} s(1-s)\frac{1}{c}+R$$

subject to the participation and limited-liability constraints:

$$\begin{aligned} s^2\frac{1}{2c}-R &\geq \underline{u} \\ -R &\geq -w_T \end{aligned}$$

The first-order conditions with respect to s and R are

$$\begin{aligned} (1-2s)\frac{1}{c}+\lambda s\frac{1}{c} &= 0 \\ 1-\lambda-\mu &= 0 \end{aligned}$$

where λ is the Lagrangian multiplier associated with respect to the PC and μ that with the LLC. If the LLC does not bind then from the previous case we know that $s = 1$ and from the PC, $R = \frac{1}{2c} - \underline{u}$. But suppose $\frac{1}{2c} - \underline{u} = w_T$. In this case the LLC is just about satisfied. If w_T is lower than $\frac{1}{2c} - \underline{u}$ then from the previous section we know that the landlord would want to maintain $s = 1$ and keep R equal to $\frac{1}{2c} - \underline{u}$, but that is not feasible anymore. The landlord has two options. One is to let go, that is keep $s = 1$ and allow the PC not to bind, i.e., set $R = w_T < \frac{1}{2c} - \underline{u}$. In that case effort remains at the efficient level. The other option is to reduce s and secure some of the rents the tenant is earning (since the PC does not bind, the tenant earns rents by definition) at the cost of reducing effort via the ICC. In that case, s can be solved out from a binding PC :

$$s = \frac{\underline{u}+w_T}{\frac{1}{2c}}$$

Notice that by assumption $w_T < \frac{1}{2c} - \underline{u}$ (otherwise $s = 1$ is still profitable) and so $s < 1$. Thus we see a sharecropping contract even when both parties are risk-neutral arising from the fact that because of limited liability the maximum amount that the agent will be able to pay to the principal as a fixed fee is just w_T which may be small in which case if might not be possible for the principal to squeeze as much as possible out of the agent, especially when his reservation payoff, $\underline{u}$, is low. In this case it is easy to see that redistribution or subsidized loans to tenants would eliminate inefficiency - but the point is some one, be the landlord or some anonymous taxpayer Tom is going to be worse off. Because, as pointed out earlier, the landlord can replicate anything that a bank can do - if giving subsidized loans to the tenant raises efficiency he would have done so by setting $R < 0$.

Can this process continue as w_T becomes smaller and smaller? The answer is no, because suppose the landlord did not have to bother about the PC at all . The share that he would choose in that case should maximize his profits $(1-s)s\frac{1}{c}+R$ and is $s=\frac{1}{2}$. That is, if

$$\frac{\underline{u}+w_T}{\frac{1}{2c}} \leq \frac{1}{2}$$

that is if,

$$w_T \leq \frac{1}{4c} - \underline{u}$$

then the landlord would not bother reducing the tenant's payoff down to the reservation level as the cost in terms of incentives would be too much.

The following predictions of this model are easily established:

1. Share contracts and fixed-rent contracts could coexist but not pure wage contracts. The contractual form would depend on the tenant's reservation payoff ($\underline{u}$), his wealth level (w_T) and the marginal cost of effort (c).

2. The effort level e is different from the surplus maximizing level, $\frac{1}{c}$. The difference, which can be called 'agency costs' associated with sharecropping tenancy is $(1-s^*)\frac{1}{c}$. Sharecropping is less efficient than fixed-rental tenancy which would obtain the tenant's wealth exceeds $\frac{1}{2c}-\underline{u}$.

3.

(a)As uncertainty goes up (i.e., σ^2 goes up) nothing changes as by assumption both parties are risk-neutral.

(b)An increase in the productivity of labor (i.e., c goes down) will decrease the share, leave the effort level unchanged. The fixed-rent component would go up if the limited liability constraint was not binding.

4. As the wage rate $\underline{u}$ goes up effort and the share goes up and the rent remains unchanged if the LLC is binding. Otherwise it affects nothing.

5. The higher the wealth of the tenant the greater the landlord's profit and higher is efficiency and the share. This implies a tenancy ladder : richer tenants are preferred are by the landlord and are given higher shares.

6. The tenant could be earning rents which might make eviction threats useful.

2.4 A Screening Model

An alternative theory of sharecropping based on adverse selection is provided by Hallagan (1978). In his story output depends on the ability of the tenant but ability can not be observed because output is also affected by an exogenous shock. That is, output depends on the ability e of the tenant, and a random shock:

$$Y = e + \theta$$

where $e = H$ or L with $H > L$ and θ is a zero-mean random variable. The landlord and the tenants are all risk-neutral. Assume that the wage rate in the best alternative occupation is $\underline{u}$ for both high and low ability individuals. The landlord is a monopolist in the land rental market and both types of tenants are willing to accept a contract that gives them an expected payoff of $\underline{u}$.

If the landlord could charge different rental rates from different types of tenants, he would want to charge a higher rent from the high-ability tenants. But given that he cannot tell a tenant's type from his appearance this contract would not work as the higher-ability tenant will claim that he is a lower-ability tenant. Similarly charging too high a rent so that only high-ability tenants are attracted will involve the loss of driving the low-ability tenants away, who though less able, produced a positive surplus and if the landlord has many plots of land and there are not that many high-ability tenants, the landlord's potential profits are lower. Hallagan argued that the landlord could offer a menu of contracts so that different types of tenants will self-select. In particular he argued that the landlord could offer a share contract and a fixed rental contract such that the high-ability tenant will choose the fixed rent contract and the low ability tenant will choose the share-contract. The intuition is that the more able tenant would rather pay a fixed fee and be the full residual claimant of the result of his superior talent, while the low ability tenant is happier be a partial residual claimant of the result of his lesser talents than pay a high fixed fee and stand in splendid isolation. In other words they would self-select.

As before we restrict attention to linear contracts. The optimal menu of contracts, (s_L, R_L) and (s_H, R_H) has to satisfy the incentive-compatibility or truth-telling constraints:

$$\begin{aligned} s_L L - R_L &\geq s_H L - R_H \\ s_H H - R_H &\geq s_L H - R_L \end{aligned}$$

At the same time the participation constraints of the two types of agents have to be satisfied:

$$\begin{aligned} s_L L - R_L &\geq \underline{u} \\ s_H H - R_H &\geq \underline{u} \end{aligned}$$

Since $s_i H - R_i > s_i L - R_i$ for $i = H, L$ because $H > L$ the set of contracts that satisfy both type's ICC can be written as:

$$s_H L - R_H \leq s_L L - R_L < s_L H - R_L \leq s_H H - R_H$$

This immediately tells us that the PC of both types cannot bind because then $s_L L - R_L = \underline{u} < s_H H - R_H = \underline{u}$, a contradiction. However, at least one PC must bind, because otherwise the landlord could raise both R_H and R_L by the same amount so that the $ICCs$ would be unaffected. Then it must be the PC of the low-ability tenant that binds:

$$s_L L - R_L = \underline{u}$$

Thus the high type tenant will earn a rent.

Notice that both $ICCs$ cannot bind because then we would have:

$$(s_H - s_L)L = R_H - R_L = (s_H - s_L)H$$

a contradiction as $H > L$. If none of the $ICCs$ bind then the landlord could play around with R_H and s_H only as he would not be able to reduce s_L or raise R_L any further (and going in the other direction reduces his profits). He could reduce s_H or raise R_H until the ICC of the high type was binding as this would not violate the PC of the high type and strengthen the ICC of the low type. Thus only the ICC of the high type would bind:

$$s_L H - R_L = s_H H - R_H$$

This implies

$$R_H - R_L = (s_H - s_L)H$$

so that either $s_H > s_L$ and $R_H > R_L$ or $s_H < s_L$ and $R_H < R_L$. To keep the ICC of the low type satisfied we need

$$(s_H - s_L)L \leq R_H - R_L$$

This can only be true if $s_H > s_L$ and $R_H > R_L$.

There are two equations in four unknowns and hence there is a variety of contracts that are optimal all of which have the common feature that the higher the ability of a tenant, the higher is his share and his fixed rent.[5]

In particular one could set $s_H = 1$ and $R_L = 0$ to get:

$$\begin{aligned} s_L &= \frac{\underline{u}}{L} \\ R_H &= H(1 - \frac{\underline{u}}{L}) \end{aligned}$$

Let p be the fraction of low ability tenants in the population of tenants, say N. Let T be the number of plots of land the landlord owns. If the landlord offered a pooling contract with the same R that satisfies the PC of both tenant, then his profits per plot of land would be

$$\pi^P = (L - \underline{u})$$

If he charged a R high enough to draw only the high type then his profits per plot of land would be

$$\begin{aligned} \pi^{S'} &= (1-p)(H - \underline{u}) \text{ if } (1-p)N < T \\ &= (H - \underline{u}) \text{ otherwise.} \end{aligned}$$

[5] Notice that if we had assumed different reservation payoffs for the two types of tenants, so long as $m_H > m_L$, the only difference to the previous analysis would be we would have an extra equation, namely the binding PC of the high-ability tenant and this would enable us to pin down three terms of the contracts given any feasible value of one.

Whereas his profits per plot of land from screening are

$$\begin{aligned}\pi^S &= p(L-\underline{u})+(1-p)H(L-\underline{u})/L \\ &= \{p+(1-p)\frac{H}{L}\}(L-\underline{u})\end{aligned}$$

If the number of high ability tenants in the population was higher than the number of plots of land the landlord has then obviously screening makes no sense and only high type tenants should be attracted. If p is high and L not too low compared to H then screening dominates the strategy of having only high ability tenants but leaving some plots uncultivated to be able to charge high rents from them. However, screening always dominates pooling.

Now let there be two periods and suppose the principal cannot commit to a long-term contract. High type will want to pretend to be low type in the first period because after the principal observes him choosing the contract meant for high-ability agents, will expropriate all his rents in the second period. In particular, the rent earned by the high-type is $H - R_H - \underline{u} = H - H(1-\frac{\underline{u}}{L}) - \underline{u} = (H-L)\frac{\underline{u}}{L} < H - L$. If he selected a contract meant for a low type

This model implies there is a 'learning' phase when contracts matter and hence are observed in diverse forms because they reveal information but after that they do not matter unless other forces like that of risk-sharing and incentive provision are present. This has the implication that there should be contractual change over the life-cycle of the same person (unless he is too patient and always pools). Since sharecropping and fixed-rental contracts are observed *only when* agents are impatient they should not be observed more than once (if one ignores convention or pure coincidence) and if they are, they should be accompanied by some *extra transfer* to the landlord in some form (which represents the captured information rent). None of these implications are backed up by any formal or informal evidence.

The following predictions of this model are easily established:

1. Share contracts and fixed-rent contracts could coexist but not pure wage contracts. The contractual form would depend on the tenant's reservation payoff ($\underline{u}$), the distribution of abilities (H, L) and the marginal product of ability (α).

2. Sharecropping is inefficient than fixed rental tenancy though not if one controls for the tenant's ability.

3.

(a)As uncertainty goes up (i.e., σ^2 goes up) nothing changes as by assumption all parties are risk-neutral.

(b)An increase in the productivity of labor (i.e., α goes up) will decrease the share and increase fixed rents. Also it will increase the attractiveness of screening as opposed to only attracting higher ability tenants.

4. As the wage rate $\underline{u}$ goes up the share goes up and the fixed rent goes down.

5. Preferences and wealth of tenants do not matter.

6. High ability tenants would be earning rents which might make eviction threats useful.

Some criticisms of the screening model of sharecropping are:

1. Most people object to adverse-selection based stories when applied to the rural context where the parties to contract live close to each other and have a lot more information about each other than in an anonymous urban setting.

2. Another basic criticism against this story is that once the tenants self-select they reveal their types and the landlord can take advantage of that in future periods. The tenants will however realize this and may not choose the contracts aimed at them. In particular, the high-ability tenants earn a rent in this story (i.e., they get an expected payoff which is higher than their reservation payoff) so they might pretend to be low types in the first period and choose the share-contract.[6]

2.5 Double Moral Hazard Model

Another theory of sharecropping has been put forward by Eswaran and Kotwal (1985). They argue that sharecropping enables pooling non-contractible (and therefore obviously non-marketable) inputs and resources of both the landlord and the tenant. In particular the landlord may be better in providing managerial effort (making production decisions based on market information and technical know-how) whereas the tenant be better in providing supervisory effort. At the same time both needs to be given incentives to provide these inputs and this is precisely what a share contract does. That is, there model is based on a double-sided moral hazard problem.

To model their theory we modify the production function which now requires two inputs, e_1 and e_2, the former denoting effort spent on supervision and the latter on providing managerial inputs:

$$q = e_1 + e_2 + \theta$$

Both the landlord and the tenant are risk-neutral. These inputs are non-observable and the supplier incurs a private disutility cost for providing them. The reservation payoffs of the tenant and

the landlord are respectively u and v. Both the tenant and the landlord can provide both inputs but the tenant has a relative advantage in providing the supervisory input and the landlord in providing the managerial input. This is modeled by setting the costs of supplying the supervisory and managerial inputs to be $\frac{1}{2}c_1e_1^2$ and $\frac{1}{2}c_2e_2^2$ for the tenant and $\frac{1}{2}\gamma_1e_1^2$ and $\frac{1}{2}\gamma_2e_2^2$ for the landlord respectively with $c_1 < \gamma_1$ and $c_2 > \gamma_2$.

If the landlord decides to lease out the land to the tenant who would provide both inputs the maximum rent he would be able to charge:

[6] Also, if there is competition for different types of tenants the role of a screening device disappears because the extra surplus from a tenant that screening allows to squeeze will be bid away by competition from other landlords. It is implicitly assumed that two markets are absent : labor markets accrding to types and land markets.

$$\Pi^{FR} = \max_{s,t}\left(e_1 + e_2 - \frac{1}{2}c_1e_1^2 - \frac{1}{2}c_2e_2^2 - u\right)$$

which yields

$$\begin{aligned} e_1 &= \frac{1}{c_1} \\ e_2 &= \frac{1}{c_2} \\ \Pi^{FR} &= \frac{1}{2}\left(\frac{1}{c_1} + \frac{1}{c_2}\right) - u \end{aligned}$$

If the landlord decides to cultivate the land on his own providing both inputs his profits net of his opportunity cost are:

$$\Pi^{FW} = \max_{s,t}\left(e_1 + e_2 - \frac{1}{2}\gamma_1e_1^2 - \frac{1}{2}\gamma_2e_2^2 - v\right)$$

which yields

$$\begin{aligned} e_1 &= \frac{1}{\gamma_1} \\ e_2 &= \frac{1}{\gamma_2} \\ \Pi^{FW} &= \frac{1}{2}\left(\frac{1}{\gamma_1} + \frac{1}{\gamma_2}\right) - v \end{aligned}$$

If instead a share contract (s, R) is used then the tenant's choice of e_1 depends on his share s and similarly the landlord's choice of e_2 depends on his share $(1-s)$:

$$\begin{aligned} e_1 &= \arg\max_{e_1}\left(s\{e_1 + e_2\} - R - \frac{1}{2}c_1e_1^2 - u\right) = \frac{s}{c_1} \\ e_2 &= \arg\max_{e_2}\left((1-s)(e_1 + e_2) + R - \frac{1}{2}\gamma_2e_2^2 - v\right) = \frac{(1-s)}{\gamma_2} \end{aligned}$$

The payoffs of the tenant and the landlord as functions of s and R are:

$$\begin{aligned} \Pi_T^S &= \frac{s^2}{2c_1} + \frac{s(1-s)}{\gamma_2} - R - u \\ \Pi_L^S &= \frac{(1-s)^2}{2\gamma_2} + \frac{s(1-s)}{c_1} + R - v \end{aligned}$$

The fixed-rent component is adjusted to reduce the tenant's payoff to the reservation level:

$$R = \frac{s^2}{2c_1} + \frac{s(1-s)}{\gamma_2} - u$$

Anticipating these Nash best-response functions the landlord moves like a Stackelberg leader and sets s to maximize his profits net of his opportunity cost:

$$\begin{aligned} s &= \arg\max_s \left(\frac{(1-s)^2}{2\gamma_2} + \frac{s(1-s)}{c_1} + \frac{s^2}{2c_1} + \frac{s(1-s)}{\gamma_2} - u - v \right) \\ &= \frac{\gamma_2}{c_1 + \gamma_2} \end{aligned}$$

His maximized profits are

$$\Pi_L^S = \frac{1}{2}\left(\frac{1}{c_1} + \frac{1}{\gamma_2} - \frac{1}{c_1+\gamma_2}\right) - u - v$$

The following predictions of this model are easily established:

1. Share contracts, fixed-rent contracts and wage contracts could coexist. If c_1 is very low then fixed rent contracts would emerge to exploit the absolute advantage of tenants in providing supervisory inputs. If instead γ_2 is very low, fixed wage contracts should arise to take advantage of the landlord's absolute advantage to supply managerial inputs. Share contracts emerge only when *both* $\frac{c_1}{\gamma_1}$ and $\frac{\gamma_2}{c_2}$ are low.

2. Sharecropping is more efficient than fixed-rental or wage contracts when there is gains from resource pooling, that is, both the landlord and the tenant have comparative advantages in supplying managerial and supervisory effort respectively. Also sharecropping is chosen only when it is efficient. Moreover even if the tenant gets to own the land he will revert to the old sharecropping contract with the landlord except that now he will realize the gains of a greater bargaining power in the form of side payments. However it is always more inefficient compared to the hypothetical world where all inputs are perfectly contractible.

Eswaran and Kotwal assume that the landlord has all bargaining power he chooses the contractual form and the tenant gets the same reservation payoff under all contractual forms (there is no limited liability in their model). Then, if the tenant's contribution to the production process is a lot, he has to be given a large share. To reduce the tenant down to his reservation level the landlord can then add a fixed-rent component to the share contract. Thus Eswaran and Kotwal's basic argument is that if the landlord is relatively good at managing whereas the tenant is at supervising then the optimal contract is a share contract with the shares reflecting the relative importance of the two effort inputs in the production function.

3.

(a) Change in uncertainty does not affect anything.

(b) A change in technology that raises the importance of managerial inputs in the production process relative to that of supervisory inputs can be interpreted as an increase in both c_1 and γ_1 relative to c_2 and γ_2 . This would tend to move contracts away from fixed rent or sharecropping towards wage contracts. Conversely, the more supervision-intensive the production technology the more likely fixed-rent contracts are. Finally, a decrease in c_1 relative to γ_1 and that of γ_2 relative to c_2 implies the gains from resource pooling should be higher and raise the profitability of sharecropping relative to fixed rent or wage contracts.

4. As the tenant's opportunity cost u goes up there will be a movement away from fixed-rent and sharecropping to fixed-wage contracts. As the landlord's opportunity cost v goes up there will be a movement away from fixed-wage and sharecropping to fixed-rent contracts.

5. The risk-attitudes of the parties or the wealth of the tenant has no effects on contracts.

6. There are no rents earned and eviction threats are therefore not effective.

An obvious criticism of this argument is an empirical one - there exists share contracts when the landlord is completely uninvolved in the production process - here the risk-incentives argument seems to be more important.