Sharecropping and the Interlinking of Agrarian Markets

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One of the often noted features of less-developed agrarian economies is the existence of interlinkages among the land, labor, credit, and product markets.[1] The landlord is often the supplier of credit; he frequently purchases and markets the output of the tenant farmers; and he often sells raw materials (fertilizers) and even consumption goods to his tenant farmers.

How do we explain this phenomenon? What are the welfare consequences of attempts to restrict these practices, which often seem to constitute restraints on free trade? These are the questions to which this paper is addressed.

In the past, theoretical discussions of interlinked contracts viewed them as a form of exploitation of less-powerful agents by more-powerful agents (for example, see Amit Bhaduri, 1973, 1977). The argument, however, was never very convincing: if a landlord could exploit his tenants to the point of reducing them to their subsistence level (as these arguments often suggested), why could the landlord not do so simply by reducing the share on the share contract? What more could he get through these other devices?

In this paper we present a general set of arguments applicable to both competitive and noncompetitive environments, to situations where all the terms of the contract are determined in an optimal way, as well as to situations where many of the terms are specified institutionally.[2]

Our analysis is based on two features commonly found in less-developed agrarian economies:

(a) Individuals are not paid on the basis of their input (effort) since this, in general, is not observable; and they conventionally do not rent land for a fixed sum since that imposes too much risk on them.[3] Hence the contractual arrangements involve at least some form of sharecropping;[4] as a result, workers do not obtain the full marginal product of their efforts.

(b) The landlord cannot completely specify the actions to be taken by the worker; the worker has considerable discretion both with respect to the level of effort and its allocation, and the choice of technique of production. Some of these decisions may, of course, be easily monitored by the landlord, but there are other actions, perhaps equally important, for which the cost of monitoring would be very high.

These two facts—that the worker has considerable discretion over his own actions, and that, because of the nature of the contractual arrangements between the worker and the landlord, the worker's actions have an important effect on the landlord's expected profits—have, in turn, some further

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[1]For a survey of such phenomena, see Pranab Bardhan (1980) and Hans Binswanger et al., forthcoming. For the nineteenth-century United States, see Joseph Reid (1979).

[2]Other recent studies which have addressed this question include those of Clive Bell and Pinhas Zusman (1980), Pradeep Mitra (1982), Reid (1976), and Braverman-Srinivasan (1981). In particular, Mitra's study raises the central issue discussed, of the relationship between interlinking and moral hazard. For a more general discussion of equilibrium with moral hazard, including implications of moral hazard for the decentralization of the economy, see Richard Arnott and Stiglitz (1980).

[3]Moreover, if there is some probability of their not being able to pay the fixed rent, which can be affected by the actions of the tenant, rental arrangements may not be desirable from the point of view of the landlord (see Stiglitz and Andrew Weiss, 1981), and even with a rental agreement tenants do not obtain the full marginal benefit (or cost) of their actions.

[4]See Alfred Marshall (1920), Steven Cheung (1969), Bardhan and T. N. Srinivasan (1971), Reid (1973), Stiglitz (1974), Bell-Zusman (1976), David Newbery (1977), and Newbery-Stiglitz (1979) for earlier discussions of sharecropping.

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important implications. In particular, it means that the landlord has an incentive to attempt to *induce* workers to behave in the way he would like them to behave. The behavior of the worker is affected, in important ways, by the amount he borrows and the terms at which he obtains credit, and by the goods he can purchase and the prices he pays.

Much of the formal analysis of this paper focuses on showing how the landlord, by altering, say, the terms at which he makes loans available to his tenants, not only can induce the tenant to borrow more but, more importantly, can induce the tenant to work harder or to undertake projects which are more to the liking of the landlord. For instance, if the landlord makes credit less expensive, the tenant (under quite reasonable conditions) will be induced to borrow more; under somewhat more restrictive conditions the tenant will be induced to increase his borrowing to such an extent that the amount which he must repay (including interest) increases. If there are severe penalties associated with default (for example, the tenant is put into bonded labor), the tenant will then need to work harder to avoid this contingency.[5]

Similarly the landlord may observe that his tenants are employing techniques of production which are too safe; the landlord's income might be increased if his tenants would be willing to employ techniques with higher means but higher variances. Again, he may note that his tenants are acting in a particularly risk-averse manner because they are concerned about the consequences of defaulting on outstanding loans. Thus, the landlord may require that his tenants only borrow from him. He will charge them an interest rate which is above the market rate and this will induce them to restrict their borrowing. As a result, he may be able to offer a tenancy contract which is much more attractive in some other dimensions.

The arguments for interlinkage with product markets are similar. The tenants may purchase less of inputs, such as fertilizer, than the landlord desires; some of the increased return to the input is appropriated by the landlords. As we show elsewhere (1981a), conventional cost-sharing rules, where the landlord pays a share of the cost equal to the share he receives of output, alleviate but do not fully correct for this distortion. When an increase in fertilizer induces tenants to increase their effort, there is an incentive for the landlord to encourage the utilization of fertilizer by contributing a higher share of the cost.

Similarly, consumption of certain commodities serves to increase effort while the consumption of other commodities (alcohol) may reduce it. It may be worthwhile for the landlord to subsidize the consumption of the former class of commodities, and to attempt to restrict the consumption of the latter class (either by charging high prices for these commodities at the landlord's store or by providing wages in kind).

Thus we establish that:

(*i*) Interlinking markets can increase the expected utility of both landlords and workers; it unambiguously shifts the utility possibilities schedule outward;

(*ii*) Accordingly, both competitive and monopoly markets will, in general, be characterized by interlinkages;

(*iii*) Although interlinkage shifts the utility possibility frontier outwards, the competitive equilibrium with interlinkage *may* (but need not) entail tenants being worse off;

(*iv*) While even with a monopoly landlord, interlinkage *may* (but need not) entail tenants being better off.

In providing a general analysis of interlinkage of markets, we are able at the same time to obtain answers to several questions concerning the design of contractual arrangements between landlords and tenants. In particular, we show that:

(*v*) A monopolist gains nothing from controlling the markets for inputs and outputs, if he is unrestricted in adopting cost

[5]It is important to note that in our analysis, the worker is not myopic; at the time he undertakes the loan, he knows that he will want ("need") to work harder next period, and takes this into account in determining his demand for loans. If workers are myopic, the case for interlinkages may be even stronger than that presented here.

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and crop sharing rules; if he is restricted, controlling the market for inputs and outputs can be a valuable additional instrument for the monopolist;

(*vi*) A monopolist only gains from controlling the consumption goods market to the extent that he uses it to change relative prices of different consumption goods.

It should be emphasized that our analysis applies equally well to situations where the terms of the tenancy contract (the share, plot size, etc) are endogenous as well as institutionally determined.[6] The employment of sharecropping arrangements need not, however, be viewed (as interpreters of Marshall did)[7] as an inefficient contractual arrangement, even where it gives rise to the variety of problems which are the subject of this paper. When information is costly and there are significant risks, sharecropping provides a method by which some of the risks are borne by the landlord, and which, at the same time, maintains incentives for the tenant.[8]

This paper is divided into the following: Section I examines interlinked credit and tenancy contracts; Section II examines interlinked marketing and tenancy contracts; Section III points out the possible interlinking between labor contracts and consumption goods markets; and Section IV presents the different equilibrium frameworks discussed in this paper, that is, monopoly, monopsony, competition, and equilibria with surplus labor.

I. Interlinked Credit and Tenancy Contracts

In this section we establish that whenever there is not a pure rental system so that the landlord's income depends, in part, on the actions of the tenant, and the actions of the tenant cannot be perfectly monitored,[9] the returns to the landowner are affected by the borrowing decisions of the tenant.[10] In the following discussion we will be concerned both with the tenant's allocation of effort and his choice of technique of production, for example, when and how often he weeds, when he plants and harvests, the type of seed he plants, the amount and kind of fertilizer he uses, when and how he applies it, etc. Some of these decisions may be easily monitored by the landlord, but there are other actions, perhaps equally important, for which the cost of monitoring would be very high. The fact that the tenant has some discretion over his effort and choices, and that his behavior can thus affect the returns to the landlord, is referred to as the moral hazard problem.

[6]This applies to the situations which were previously discussed in the literature where interlinkage provides a mechanism by which legal restrictions (such as limits on usurious interest rates) and conventions (such as "fair" division of output between landlords and tenants) may be evaded (for example, Braverman-Srinivasan, 1981). Such situations can be viewed as special cases of the analysis provided here.

[7]Marshall recognized the importance of share contracts in a world dominated by market imperfections and the absence of certain markets (see Christopher Bliss and Nickolas Stern, 1981, ch. 3; and Jerald Jaynes, forthcoming.

[8]The optimal linear contractual arrangements are discussed in Stiglitz (1974) and Newbery (1977); the optimal nonlinear contract is discussed in Stiglitz (forthcoming); in these studies the only variable which the worker alters is effort; in this paper, we also consider the problem of the choice of technique.

[9]Although our results only require that the actions of the tenant not be perfectly monitored (and that the contractual arrangements, which could accordingly specify compensation based on the observed actions be perfectly enforced), in our model we will assume that these actions (effort or the choice of technique) cannot be monitored at all. Clearly, some actions (such as what crop is planted) are easily monitored, and thus there would, presumably, be little difficulty in enforcing deviations from the contract. Other actions, however, are more difficult to specify (either implicitly or explicitly) in a contract, to monitor and to enforce; for example, the "optimal" time to harvest will, in general be a complicated function of the weather conditions during the growing season as well as the expectations concerning weather during the harvest season. By harvesting earlier, the mean harvest may be smaller but there is likely to be less risk (of the crop being destroyed before it is harvested).

[10]The argument is, in fact, even stronger; these moral hazard problems arise even with rental tenancy arrangements, if renters have insufficient capital to pay the rent in advance, and if there is sufficient variability in output that it may not be feasible for the renter to repay the promised rent.

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A. *A General Model*

We begin our discussion by presenting a general model. The following subsections focus on a number of special, but important, specializations of this model.

We assume that there is a pure sharecropping agreement.[11] The tenant receives a share α of the gross output, the landlord receives $1-\alpha$. Output, Y, is a function of: (a) the effort of the tenant, which we denote by e;[12] (b) environmental factors (the weather) denoted by θ; and (c) the choice of technique, denoted by Ω. We let an increase in Ω represent an increase in risk (see discussion below). Thus

$$(1) \qquad Y = Y(e, \theta, \Omega).$$

It will greatly simplify the analysis, however, if we write

$$(1') \qquad Y = gf(e),$$

where g is a positive random variable with a density function ($Eg \equiv \bar{g}$): $h = h(g, \Omega)$.

The tenant's utility[13] can be expressed as a function of his income $y = \alpha Y$, his effort e, his technique of production, Ω, of the other variables which are under his control, z, and of a set of variables which are under the control of the landlord which we denote by q:

$$(2) \qquad u = u(y, e, \Omega, z, q).$$

In the subsequent analysis, we shall investigate several special cases of this general specification. For instance, if z is the individual's consumption of some commodity purchased from the landlord, q is the price charged by the landlord, and c is the individual's consumption of other commodities, we can write

$$(2') \quad U = U(c, e, \Omega, z) = U(y - zq, e, \Omega, z).$$

Similarly, consider an individual with initial wealth W_0 who wishes to borrow to finance current consumption. Assume the landlord charges an interest rate r and the tenant borrows an amount B; denote the ith period consumption by c_i. We can then write

$$(3) \quad U = U(c_0, c_1, e, \Omega) = U(W_0 + B, y - (1+r)B, e, \Omega),$$

(which is of the form (2)).[14]

The tenant chooses e, z, and Ω to maximize his expected utility, taking into account the production relationship (1),

$$(4) \quad \max_{\{e,z,\Omega\}} Eu(y, e, \Omega, z, q) \equiv V(\alpha, q),$$

where α, the tenant's crop share, can be determined in a variety of ways, it may, for instance, be directly controlled by the landlord. From the first-order conditions for this maximization problem, we can solve for the level of effort, the choice of technique, and the level of z as a function of the control variables at the disposal of the landlord, that is: $e = e(\alpha, q)$, $z = z(\alpha, q)$, $\Omega = \Omega(\alpha, q)$.

For simplicity, we shall assume that the landlord is risk neutral. His expected income, $\bar{P}$, has two parts: the direct receipts from the sharecroppers, $(1-\alpha)f(e)Eg$, and the return from the interlinked activities (which may be negative), $\pi(q, z)$. Hence

$$(5) \qquad \bar{P} = (1-\alpha)f(e)\bar{g} + \pi(q, z),$$

Thus, for instance, in the first example where the landlord sold, say, alcohol to his tenants at a price of q,

$$(6) \qquad \pi(q, z) = (q - q_0)z(q),$$

[11] The model, however, is far from being the most general one for which our conclusions are valid. Thus, although we limit ourselves to discussing pure sharecropping contracts, the results apply for virtually any contractual arrangement other than fixed rental contracts when there is no possibility of bankruptcy.

[12] It should also be clear that e could represent a vector of inputs, including fertilizer, machinery, etc.

[13] As the following discussion will make clear, this is a *derived* utility function, analogous to the indirect utility function.

[14] In these two examples "q" is the price at which the landlord makes goods or credit available to his tenant. The landlord need not, however, restrict himself to linear price systems; he may impose a variety of restrictions on his tenants, employ a nonlinear price system, etc. See fn. 21 below.

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where q_0 is the price at which the landlord can purchase (or produce) the given commodity. In the second example, where the tenant borrows at the rate of interest r, the return to the interlinked activity is simply the difference between the rate of interest charged and what the landlord could obtain from his funds lent elsewhere, times the amount borrowed.[15]

The problem of the landlord is now simple: he chooses q and α (if α is a control variable; q may in fact represent a vector of control variables) to maximize his expected income, subject to the constraint of being able to obtain workers; that is:

$$(7) \qquad \max_{\{q,\alpha\}} \bar{P} \text{ ; such that } V(\alpha, q) \geq \bar{U}.$$

The first-order conditions for this problem (for q) can be written as

$$(8) \quad d\bar{P}/dq = (1-\alpha) \times \left[\bar{g}f'(e)\frac{de}{dq} + f(e)\frac{d\bar{g}}{d\Omega}\frac{d\Omega}{dq}\right] + \pi_q + \pi_z\frac{dz}{dq} - \lambda\frac{\partial V}{\partial q},$$

where λ is the Lagrange multiplier associated with the constraint in (7). What is critical about (8) is that the landlord realizes that changing q has not only a direct effect (an effect on his return as a lender or as a shopkeeper), but an indirect effect on his income, through its effect on the level of effort or the choice of technique of the tenant. It is this which provides the fundamental motivation for interlinkage in our analysis.

The subsequent sections attempt to analyze in greater detail this argument, to ascertain, in particular, the conditions under which the landlord is likely to subsidize, say, borrowing, or those under which he will attempt to restrict it.

[15] The returns from interlinked activities may be random; π then denotes the mean value, also π may be a function of e and Ω. This would necessitate only minor modifications to the analysis.

Although there is a kind of formal similarity between those cases where the landlord wishes to induce borrowing and thus subsidizes the rate of interest, and those cases where he wishes to restrict borrowing activity, there are important asymmetries in the costs of implementation. The latter requires a kind of monitoring of the tenant which the former does not.

The analysis proceeds in a number of steps. First, we analyze how the behavior of the tenant is affected by the presence of outstanding loan commitments. We analyze separately the effect on the level of effort (Parts B and C) and on the choice of technique (Part D). We then use these results to determine the optimal policy of the landlord (Parts E and F). Part G considers the particular problems raised by default clauses (bonded labor). Part H argues that there is a symmetric argument, when there is a positive probability of default, for why lenders would wish to effect borrowers behavior in the land-tenancy market, thus strengthening the argument for interlinkage.

Although most of our discussion is couched in partial equilibrium terms, Part I shows how it may be extended to a general equilibrium framework.

B. *The Impact of the Tenant's Borrowing on his Effort Supply*

In this section, we ask: How does the fact that the individual must repay an amount, $(1+r)B$, to a lender affect his supply of effort?

To analyze this question we specialize the general model presented earlier by assuming separability between consumption and effort at one date, and those at any other date. This enables us to address the question of the effect of outstanding loans, without asking how the outstanding debt was determined. We focus here only on effort, taking the choice of technique of production as given.

Defining $\hat{B} = (1+r)B$ as the fixed amount the tenant must pay to the landlord and letting c denote the tenant's consumption, then

$$(9) \qquad c = \alpha Y - \hat{B},$$

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and the individual now chooses effort to maximize

$$(10)\quad \max EU(c,e) = \max_{\{e\}} EU(\alpha g f(e) - \hat{B}, e),$$

where U is a concave function of c and e. We obtain the first-order condition[16]

$$(11)\qquad \alpha f'(e) EU_c g + EU_e = 0.$$

By total differentiation of (11) and using the concavity of U, it is evident that $de/d\hat{B} \gtrless 0$ as

$$(12)\quad d\left[\int (U_c \alpha g f' + U_e) h\, dg\right]/d\hat{B} = -E(U_{cc}\alpha g f' + U_{ec}) \gtrless 0.$$

Since $U_{cc} < 0$, condition (12) implies the following proposition:

PROPOSITION 1: *Increased borrowing will increase the effort of tenants, and hence, the return to landlords provided that* $U_{ec} \leqslant 0$.

The condition $U_{ec} \leqslant 0$ is a very reasonable one. It states that increased consumption increases or leaves unchanged the marginal disutility associated with effort.[17]

C. *Effort and Default*

Now consider the impact of two opposite institutional arrangements regarding the consequences of default: bonded labor and bankruptcy. A *bonded labor* clause in the loan agreement is an arrangement which states that if the tenant fails to repay his loan, he must provide certain labor services to the moneylender. We assume this to be an undesirable outcome for the tenant; hence, this implies that he will try to avoid situations or decisions which would increase the probability that his output will fall below a certain level such that he would no longer be able to repay his debt and would have to offer bonded labor services. Clearly, therefore, the impact of adding a bonded labor clause to the loan agreement is to *increase* the tenant's effort.

One formal way to model the bonded labor clause for a risk-averse tenant (Figure 1(a)) is by assuming that the tenant's marginal utility of consumption, (or, alternatively, of income, for a given level of debt), U_c, is very high, that is, approaching infinity for very low values of c. (See Figure 1(b).) In the extreme, we can depict the tenant as choosing the minimum level of effort required to avoid bondage. Thus, e is chosen so that

$$(13)\qquad \alpha f(e) g_{min} = \hat{B},$$

when g_{min} = minimum value of g. Thus

$$(14)\qquad de/d\hat{B} = 1/\alpha f' g_{min} > 0.$$

A *bankruptcy clause* is an arrangement whereby the borrower is allowed to default on his loan whenever his income is sufficiently low, and when he defaults he is guaranteed a level of consumption, $\hat{c}$, in excess of the starvation level.

The effect of adding a bankruptcy clause to the loan agreement is to *decrease* the tenant's effort since he does not have to bear fully the consequences of "bad" events. Formally, if the tenant utility function is not "too strictly" concave, the bankruptcy clause causes the utility function to become convex for certain regions (see Figure 1(c)). This change from a concave utility function to a convex function, implies that the bankruptcy clause changes the tenant's attitude towards risk from risk averter to risk lover.[18]

When bankruptcy is a possibility we can write

$$(15)\qquad c = max\{\alpha g f(e) - \hat{B}, \hat{c}\}.$$

[16] We ignore corner solutions throughout this paper.

[17] In the absence of uncertainty, normality in income of consumption and leisure suffice for the proposition. An alternative condition is that in addition to the normality condition, the variance of income be small enough.

[18] This issue will be discussed in Part D to follow.

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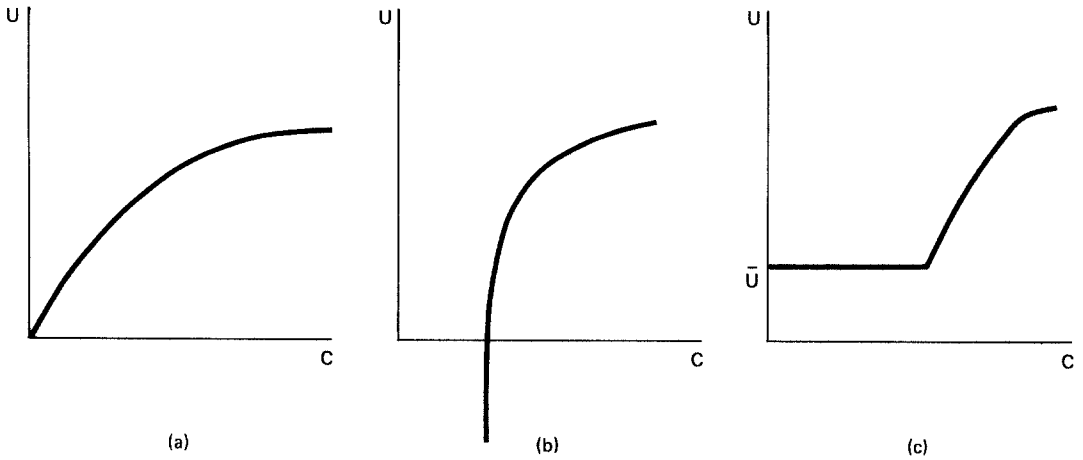

FIGURE 1. UTILITY AS FUNCTION OF INCOME (FOR GIVEN LEVEL OF DEBT) UNDER ALTERNATIVE DEFAULT CLAUSES

Let

$$\hat{g} = (\hat{c} + \hat{B})/\alpha f(e) \tag{16}$$

be the critical value of g below which bankruptcy occurs. Then the tenant's objective function (10) becomes

$$\max_{\{e\}} \left\{ \int_0^{\hat{g}} U(\hat{c}, e) h\, dg + \int_{\hat{g}}^{\infty} U(\alpha g f(e) - \hat{B}, e) h\, dg \right\}, \tag{10'}$$

which leads to the first-order condition

$$\int_{\hat{g}}^{\infty} [U_c \alpha g f' + U_e] h\, dg + \int_0^{\hat{g}} U_e h\, dg = 0, \tag{11'}$$

and hence to

$$\frac{de}{d\hat{B}} \gtrless 0 \text{ as } -U_c \alpha \hat{g} f' \frac{1}{\alpha f(e)} - \int_{\hat{g}}^{\infty} [U_{cc} \alpha g f' + U_{ce}] h\, dg \gtrless 0. \tag{12'}$$

An increase in borrowing makes bankruptcy more likely. This effect reduces the marginal return to effort and is expressed by the first term of (12') which is always negative. The sum total effect of increased borrowing on tenants' effort can still be positive only if the second set of terms dominates the first term. The following proposition and remark summarize this subsection.

PROPOSITION 2: *If the tenant's loan agreement includes a bonded labor clause, increased borrowing will increase the effort of tenants and, hence, the return to the landlords.*

Remark: If the tenant's loan agreement includes a bankruptcy clause instead of a bonded labor clause, increased tenant borrowing may not increase his effort supply.

Since landlords' expected returns are clearly dependent on the tenants' level of effort, it is clear that, in general, tenants' borrowing has an effect on landlords' expected returns; this effect is beneficial under the bonded labor system, but if bankruptcy is possible then increased borrowing may have a deleterious effect on landlords' returns.

D. *The Impact of the Tenant's Borrowing on His Choice of Technique of Production*

Now, let us assume that the only set of decisions available to the tenant is the choice of technique, Ω. Effort is fixed (for example, to obtain any output requires a given level of effort; increased effort beyond that point bears little fruit). Since our main concern

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here is with risk taking, let us first consider a set of projects, all of which have the same mean, that is,

$$(17) \qquad \int_0^\infty gh\,dg = \text{constant},$$

or

$$(18) \qquad \int_0^\infty gh_\Omega\,dg = 0.$$

Therefore, riskier projects represent mean-preserving spreads (*MPS*)[19] of less-risky projects, that is, letting H represent the distribution function, riskier projects are described by

$$(19) \qquad \int_0^x H_\Omega\,dg \geqslant 0 \text{ for all } x > 0;$$

$$(20) \qquad \int_0^\infty H_\Omega\,dg = 0.$$

In Figure 2 we graphically express an *MPS* of the H distribution, that is, the shifting of weight from the center to the tails. It is expressed both in terms of densities and cumulative distributions.

Making the same kind of separability assumption employed in Part B, the first-order condition for the tenant's choice of technique is given by

$$(21) \qquad \int Uh_\Omega\,dg + \int U_\Omega h\,dg = 0,$$

and assuming $U_{c\Omega} = 0$,[20] it immediately follows that

$$(22) \quad d\Omega/d\hat{B} \gtrless 0 \text{ as } -\int_0^\infty U_c h_\Omega\,dg \gtrless 0.$$

Integrating twice by parts, and using (18)

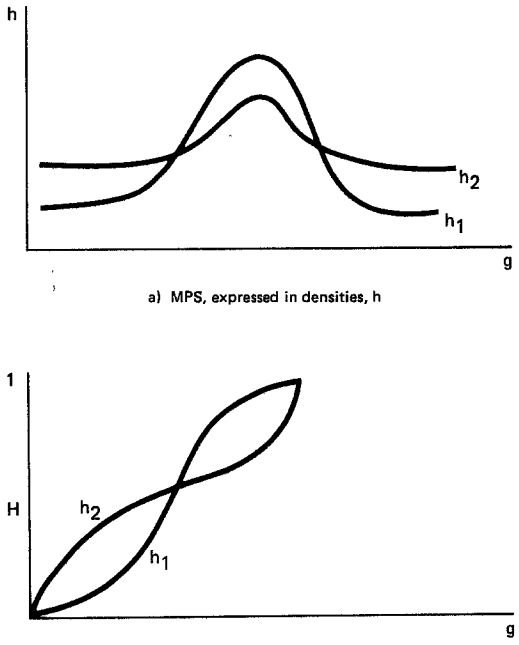

FIGURE 2. MEAN-PRESERVING SPREAD IN DISTRIBUTION OF g

and (20), we obtain

$$(23) \quad d\Omega/d\hat{B} \gtrless 0$$

$$\text{as } -\int_0^\infty U_{ccc}\left[\int_0^x H_\Omega\,dg\right]dx \gtrless 0.$$

Using (19), it is thus apparent that

$$(24) \qquad d\Omega/d\hat{B} \gtrless 0 \text{ as } U_{ccc} \lesseqgtr 0.$$

From (24) it is clear that an increase in borrowing will leave risk taking unaffected if and only if the utility function is quadratic, so $U_{ccc} = 0$. Otherwise, risk taking may either increase or decrease.

It is worth noting several special cases:

(a) Assume a *bonded labor* clause in the loan agreement, so that U_c for very low values of c is very high, that is, approaching infinity. Then from (22) it is apparent that an increase in borrowing reduces risk taking: individuals are concerned with only the lower tail of the distribution where U_c is very high

[19] Consult Rothschild-Stiglitz (1970) and Diamond-Stiglitz (1974) for discussions of mean-preserving spreads.

[20] Throughout the remainder of the paper we assume $U_{c\Omega} = 0$; if we write $U = U(c, e) - V(\Omega)$, $V(\Omega)$ can be thought of as the "cost" of technology Ω. Furthermore, if all available technologies have the same mean, then for an interior solution (i.e., $\Omega > \Omega_{min}$, where Ω_{min} is the least risky technology), we require that $V'(\Omega)$ be sufficiently large.

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and h_Ω, the shift in the density, is positive (see Figure 2(a)). Hence an increase in borrowing induces tenants to be more conservative.

In the limiting case described earlier, Ω^* is the largest value of Ω such that

$$\alpha g_{min}(\Omega^*) = \hat{B}, \tag{25}$$

where $g(\Omega^*)$ is the minimum value of g for the technique Ω^*. Thus,

$$d\Omega^*/d\hat{B} = 1/\alpha g'_{min} < 0, \tag{26}$$

since $g'_{min}(\Omega)$ is negative; increasing Ω means an increasing spread of risk which implies that the smallest value of g for given Ω declines.

(b) Assume that the individual has *decreasing absolute risk aversion*. Absolute risk aversion is defined by

$$A \equiv -\frac{U_{cc}}{U_c} \text{ so } A' = -\frac{U_{ccc}}{U_c} + \frac{U_{cc}^2}{U_c^2}.$$

Thus, decreasing absolute risk aversion implies $U_{ccc} > 0$. Therefore, from (24), risk taking is reduced by an increase in borrowing.

(c) Assume a *bankruptcy* clause in the loan agreement. If the individual's utility function is linear in consumption (in the absence of bankruptcy, he would be risk neutral) he now becomes a risk lover; this holds more generally, provided he is not "too" risk averse (see Figure 3 below). Then the increase in borrowing may induce more risk taking.

According to our analysis, in which we focus on choices of techniques that leave the mean output unchanged but increase the spread of distribution, these changes in the choice of technique leave the risk-neutral landlord unaffected. However, in many cases techniques which are riskier also have higher means. This is true, for instance, of some of the HYV seeds of the "green revolution," which are more vulnerable to rain falls, under which circumstances their output is actually lower than that of more traditional seeds (see fn. 9 for another example).[21] If mean output is not increased too much, it will still be true that if tenants have decreasing absolute risk aversion (or if there is bonded labor), an increase in tenant's borrowing will result in a reduction in risk taking. This reduction in risk taking, however, will now have an effect on landlords; their expected income will be lowered.

Formally, we postulate that

$$Y = g\lambda(\Omega) f(e) \tag{27}$$

with $\lambda' > 0$ (recall that we have adopted the convention that an increase in Ω represents an increase in risk). Now the first-order condition for the tenant's modified objective function will be (instead of (21))

$$\int [Uh_\Omega + U_\Omega + U_c g\lambda'(\Omega) f(e)]\, dg = 0, \tag{28}$$

and then,

$$d\Omega/d\hat{B} \gtrless 0 \quad \text{as} \quad -\int [U_c h_\Omega + U_{cc} g\lambda' f]\, dg \gtrless 0. \tag{29}$$

Thus our earlier results are unaffected, provided λ' is sufficiently small (the bounds on λ' are determined by the magnitude of U_{ccc}). We can summarize this subsection with the following proposition and remark.

PROPOSITION 3: *With a bonded labor clause in the loan agreement or with decreasing absolute risk aversion, an increase in the tenant's borrowing will reduce his risk taking. He will therefore not select some techniques*

[21] Presumably, the choice of seed as a decision variable which could be specified by the contract between landlord and tenant. But as we noted in fn. 9, there are many other decisions concerning techniques which could not be so easily specified, or if specified, monitored and enforced. A fuller analysis would, of course, not simply dichotomize the actions into "observables" and "nonobservables." There are costs of observation, as well as costs entailed in decision making, contract specifications, monitoring and enforcement; these costs will for the landlord, depend, for instance, partly on whether he is an absentee landlord. Thus, what is specified in the contract should be treated as an endogenous variable.

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which allow for higher mean output as well as higher risk. This reduces the returns of the risk-neutral landlord.

Remark: With a bankruptcy clause in the loan agreement the tenant may increase his risk taking with increased borrowing and, thus, may select riskier and higher mean output techniques than he would have chosen under a bonded labor clause. This choice increases a risk-neutral landlord's returns.

The above arguments establish clearly that the return to the landlord will depend critically on whether his tenant has borrowed, and if so, how much. Formally, the landlord could effect the same behavior by charging a rent paid at the end of the production period and equal to $\hat{B}$, in addition to the share. What is important is that the individual's behavior is affected by the total magnitude of the sum of rents and loan repayments, and that it is of value to the landlord to know their magnitude. In other words, although the form which the tenants' commitments take (whether rents or loans) may make little difference, it is important for the landlords to control the total and it is this which provides the motivation for interlinking. (Indeed, rent paid at the end of the production period can be viewed as a rent paid at the beginning of the period plus a loan from the beginning of the period to its end; in a sense, then, rent and loan commitments are equivalent.)

E. *The Equilibrium Terms of Loans from Landlords to Tenants*

Let us first consider the case where an increase in borrowing reduces the expected return to the landlord—a negative externality. While he would like to restrict the amount of borrowing, he would not want to eliminate it altogether. The restriction on the amount of borrowing obviously reduces the expected utility of the tenant; thus, in a competitive environment, the tenant will require an alteration in some other provision of the contract to compensate for any such restriction. He might, for instance, be able to induce his tenants to accept a borrowing restriction by lending to the individual a given amount at a "favorable" interest rate, but beyond that point, charging a prohibitively high interest rate. Even if the landlord cannot directly monitor loans from the other creditors such a scheme may be very effective. To borrow supplementally from other lenders may then be very expensive: since the loan from his landlord has seniority over any supplemental loan, any potential lender would have to charge a very high interest rate.

If the amount which an individual borrows from other lenders is observable, then the competitive equilibrium contract will make the share (or other provisions of the contract) a function of the size of loans the worker has undertaken. In this case there would be no difference between the equilibrium which would emerge if the two markets were linked together, or if they were separated. If there are costs of monitoring and collection, however, there is a natural advantage for the landlord to undertake the loan.

In the case where there is a *positive externality*, there will be an incentive for the landlord to subsidize loans and to encourage the tenant to become indebted to him, so that he will work harder to repay the loan. (Bardhan and Rudra, 1978, report that in West Bengal landlords quite often offer tenants loans at interest rates below the market rate, sometimes even offering interest-free consumption loans.)

We now analyze formally the landlord's optimal contract. We write the tenant's utility function as $U^*(c_0, c_1, e)$ where $c_0 \equiv$ consumption in the Oth period $= W_0 + B$, W_0 denotes the individual's initial wealth[22] and B denotes the amount borrowed, $c_1 = \alpha f(e)g - B(1+r)$ where c_1 is consumption in the first period, and r denotes the interest charged to the tenant.[23] In general, r will be a function of B; the landlord specifies the "loan function" $r(B)$ and the tenant chooses

[22] For simplicity, we take W_0 here as simply a parameter. It represents, for instance, the amount the tenant has been able to save. Clearly, in a more general model, W_0 would be affected by the terms of the contract.

[23] We ignored here the direct effect of borrowing on production. See Part G below.

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the loan size, B. However, since in our analysis we assume that all tenants are identical, they will all choose the same value of $\{r, B\}$.[24] There are a large variety of loan functions which will induce the same choices of $\{r, B\}$ (and indeed, any $\{r, B\}$ which makes the tenant better off than he would be with $B=0$, can be generated by some loan function). Hence, we analyze the behavior of the landlord assuming he controls r and B (or equivalently $B(1+r)$ and B) directly.[25] If ρ is the cost of capital to landlords, we can describe the optimal loan as the solution to the landlord's problem.[26]

$$(30)\quad \max_{\{B,\,B(1+r)\}} \bar{P} \equiv (1-\alpha)f(e)+(1+r-(1+\rho))B,$$

where, without loss of generality, we have assumed $Eg=1$, subject to

$$EU^*(W_0+B,\alpha f(e)g-(1+r)B,e)\geq \bar{U}.$$

As before, we assume that U^* is separable in c_0 and c_1, that is, $U^*=u(c_0)+U(c_1,e)$. Then we obtain the following by using the envelope theorem and recalling $\hat{B}\equiv B(1+r)$:

$$(31)\quad -(dU^*/d\hat{B})/(dU^*/dB) = \frac{EU_c(c_1,e)}{u'(c_0)} = \frac{(1-\alpha)f'(e)\,de/d\hat{B}+1}{1+\rho} = -(d\bar{P}/d\hat{B})/(d\bar{P}/dB).$$

[24]See Braverman-Guasch (1981) for a discussion of a self-selection separating equilibrium, where heterogeneous tenants choose different pairs of $\{r, B\}$ from a loan function $r(B)$, offered by the landlords.

[25]If the population is heterogeneous, then the precise specification of the loan function becomes more important. Even then, provided that there are only a finite number of types of borrowers, the same sets of choices can be induced by a large variety of loan functions. Only in the limiting case of a continuum of types, does the optimal loan function become determinate.

[26]In the calculation below, we take the share and the plot size as exogenously given; alternatively, we could view them as having been optimally chosen. For purposes of the ensuing analysis it makes no difference. See the Appendix.

In contrast, in a competitive loan market, if the tenant and landlord had equal access to the capital market (an admittedly dubious assumption),

$$(32)\quad \frac{u'(c_0)}{EU_c(c_1,e)}=1+\rho.$$

Comparing (31) and (32) we obtain the following proposition:

PROPOSITION 4: *The optimal contract offered by the landlord will entail farmers borrowing more (borrowing less) than they would in an unlinked market with equal access to capital, if* $de/d\hat{B}>(<)\,0$, *that is, if increased borrowing induces more (less) effort.*

In order for the landlord to control simultaneously both the amount borrowed (B) and the amount owed ($\hat{B}$), he must use a nonlinear loan function.[27] In footnote 27 we discuss the case where the landlord is restricted to charging a simple interest rate. (Clearly, intermediate cases, for example,

[27]The contract described in the preceding analysis entailed the landlord specifying B, the amount borrowed, and $\hat{B}=(1+r)B$, the amount paid back. The landlord does not, however, allow the tenant to borrow as much as he would like at the interest rate $r=(\hat{B}/B)-1$. Effectively the landlord is employing a nonlinear interest rate schedule to maintain the individual on the same expected utility curve. In Section V, below, we consider what happens if the landlord is not allowed to use such schedules, and cannot decrease α or plot size to compensate for lowering in the interest rate. (Thus, the expected utility constraint will not be binding.) Note that if the landlord cannot restrict the level of credit or "force" credit, but can announce an r different from ρ, and can alter α, then instead of (31) we obtain

$$EU_c g/EU_c=\left[1-\frac{1-\alpha}{\alpha}\frac{f'e}{f}\frac{\partial lne}{\partial ln\alpha}-\frac{(r-\rho)}{f}\frac{\partial B}{\partial \alpha}\right] \div\left[1+\frac{(1-\alpha)}{\alpha}\frac{f'e}{f}\frac{\partial lne}{\partial ln\hat{B}}\frac{\partial ln\hat{B}}{\partial lnr}\frac{f}{rB}+\frac{dB}{dr}\frac{(r-\rho)}{B}\right].$$

Whether the landlord will set $r\lesseqgtr\rho$ depends on tenants' risk aversion, as well as the elasticity of effort with respect to share (α) and with respect to indebtedness ($\hat{B}$), and the elasticity of indebtedness with respect to the interest rate.

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where the landlord can restrict the maximum borrowing, can be treated within the same framework.)

In all of the above cases, notice that the tenant could have elected to keep some of his initial wealth in savings, or could have elected to borrow less to ensure adequate consumption in period one; yet the landlord manages to induce him to borrow the amount B even though the tenant is fully aware of the consequences.[28]

F. *Default Clauses*

The discussion in Section I.E did not cover default clauses. As previously discussed, a bonded labor clause increases the tenant's effort but reduces his risk taking. Thus, the two effects go in opposite directions in their impact on the return to the risk-neutral landlord. The bankruptcy clause produces the opposite result: it reduces effort and increases risk taking. Hence the landlord's preference for one clause over another depends on the extent of the significance of the moral hazard problem regarding effort supply compared with the tenant's choice of technique. For example, if effort can be relatively easily monitored and enforced, and the moral hazard problem mainly involves the tenant's choice of technique, then a risk-neutral landlord will tend to prefer a bankruptcy clause to a bonded labor clause. On the other hand, if the moral hazard problem is more significant in the tenant's effort supply than in his choice of technique, then a bonded labor clause will be preferred by the landlord.

G. *Production Loans*

For simplicity, the analysis to this point has assumed that loans are only used for consumption purposes. There is no interaction between the amount lent in the previous period and output in the current period. The modifications required to take this into account are straightforward;[29] we let output be a function not only of effort but of the amount borrowed:[30]

$$Y = gf(e, B). \tag{33}$$

Then, the first-order condition for the (appropriately modified version of the) maximization problem (30) can be written as

$$EU_c/EU_c\alpha g f_B = \frac{(1-\alpha)f_e \partial e/\partial \hat{B} + 1}{(1-\alpha)[f_e \partial e/\partial B + f_B] + (1+\rho)}. \tag{34}$$

Thus the landlord takes into account that (a) he appropriates a fraction of the return from the increased input ($(1-\alpha)f_B$); (b) the increased inputs alter the level of effort; and (c) an increase in the amount lent increases the expected utility of the tenant (and thus enables him to alter some other term of the contract more to his liking while still being able to recruit tenants). The effect of increased inputs on effort is ambiguous;[31] if

[28]It is possible, of course, that

$$\frac{EU_c(\alpha f g, e)}{u'(W_0)} > \frac{(1-\alpha)f'(e)\left.\frac{de}{d\hat{B}}\right|_{B=\hat{B}=0} + 1}{1+\rho}.$$

In that case the landlord would like to induce the tenant to lend to him, but if this is not feasible, then $B = \hat{B} = 0$. Notice that it is still possible that

$$\left.\frac{EU_c(c_1, e)}{u'(c_0)}\right|_{B=\hat{B}=0} < \frac{1}{1+\rho}$$

in which case the tenant may attempt to borrow elsewhere. The landlord will attempt to restrict this borrowing, if he can. If he cannot, he may still lend to the tenant. In either case, there is a kind of interlinking, although in the first case, no transactions occur in the interlinked market.

[29]Similar modifications need to be made in the analysis of the consumption loan model when the utility function is not separable, so that changes in c_0 affect effort, e.

[30]This formulation assumes that the marginal increment in input from a marginal increase in borrowing is unity. More generally, if output is a function of effort and an input, z, $f(e, z)$ and z is a function of B, $z(B)$, then $f(e, B) \equiv \hat{f}(e, z(B))$. Equation (34) below is unaffected, although the interpretation of f_B needs to be modified.

[31]Differentiating the first-order condition for effort with respect to B (keeping $\hat{B}$ fixed) yields

$$\partial e/\partial B = -\{\alpha f_{Be} EU_c g + \alpha^2 f_B f_e [E(U_{cc} g + U_{ec})g]\} \div \{\alpha f_{ee} EU_c g + \alpha f_e E[(U_{cc}\alpha f_e + U_{ce})g] + EU_{ee}\}.$$

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effort and other inputs are complements ($f_{eB} > 0$), as we might expect, the increased inputs increase the marginal return to effort. But the increased output has an additional income effect which normally decreases the level of effort.

In the absence of subsidization, the tenant would have set

$$(35) \qquad EU_c(1+\rho) = EU_c \alpha g f_B.$$

Thus, whether the landlord prefers to subsidize or to restrict borrowing depends on whether

$$(36) \quad f_e \partial e/\partial B + f_B \gtrless \frac{EU_c \alpha g f_B}{EU_c} \cdot f_e \frac{\partial e}{\partial \hat{B}}.$$

Clearly either is possible, depending on the degree of complementarity (f_{eB}) and the specifics of the utility function.

H. *Externalities from the Landlord to the Lender in the Absence of Linkages*

Our previous discussion emphasized the externality associated with the lending activity on the income of the landlord. There is also a reverse externality in situations where there is a positive probability of default, so long as the return to the lender is affected by default. (Normally, we would assume that default reduces the expected income of the lender, but it is possible that, with bonded labor, it increases his expected income.) The analysis is similar to that presented earlier. What is relevant now, however, is not the mean output of the farm, but the probability that the income of the tenant, after paying the landlord's share, is sufficiently low so that the tenant goes into default. This is clearly affected by the terms of the contract (the share, the plot size, the supply of complementary inputs), but the landlord, in choosing the optimal contract, ignores the impact on the lender. Since the landlord who lends funds to his own tenants can internalize this externality, he can obtain a higher return from lending to his own tenants than he can obtain lending elsewhere. This, then, provides a further motivation for interlinking the two markets.

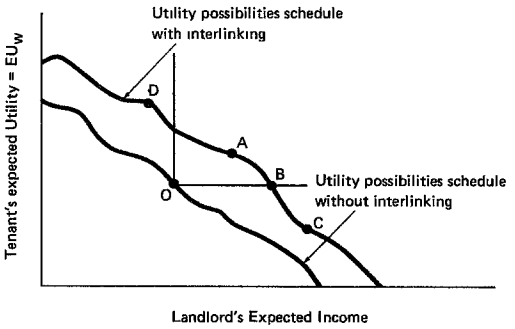

FIGURE 3. WELFARE COMPARISON OF EQUILIBRIUM WITH INTERLINKING TO EQUILIBRIUM WITHOUT INTERLINKING

I. *General vs. Partial Equilibrium*

The preceding analysis shows that, for any fixed level of expected utility of workers, the landlord can increase his expected income by simultaneously controlling the credit market. This argument establishes that the utility possibilities schedule, in an economy in where the two markets are linked together, will be above that of an economy where (for example, as a result of legal restrictions) the two are kept separate, and it establishes that in a competitive equilibrium such linkages will, in fact, exist. However, it does not necessarily imply that landlords are the only beneficiaries, or indeed, in general equilibrium, that landlords will be better off at all. The new equilibrium with linkages may lie to the northeast of the one without linkages (point *A*, Figure 3), making both workers and landlords better off, but it need not.

In Figure 3 we depict four possible situations: in *A*, the landlords and workers are both better off; they share in the gains from interlinking markets; in *B*, tenants have a subsistence utility level to which they are always driven; thus all the gains from interlinking accrue to landlords; in *C*, tenants are worse off as a result of interlinking markets; all the gains accrue to landlords—and then some; while *D* is the converse situation, where landlords are worse off as a result of interlinking; all the gains accrue to tenants.

Under competitive conditions, we can ascertain the conditions for *C* or *D* to occur. The effect of interlinkage on the welfare of

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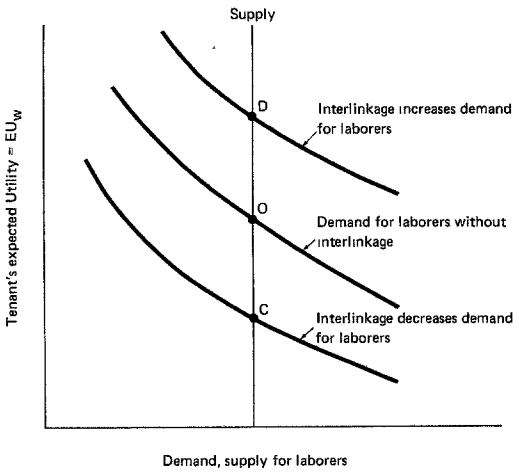

FIGURE 4. COMPETITIVE EQUILIBRIA IN THE TENANCY MARKET WITH AND WITHOUT INTERLINKAGE

tenants is, in principle, easy to ascertain. We can derive a pseudo demand curve for labor. There is now not a simple price of labor (the wage); but we can, instead, summarize the contract in terms of the expected utility that it generates to the tenant. At higher levels of expected utility, there will be a lower demand for labor, as depicted in Figure 4 where the supply of *tenants* is assumed perfectly inelastic.[32] The competitive equilibrium is just the intersection of the demand and supply schedules (point 0 in Figure 4). Interlinkage may shift the demand schedule upwards, in which case the tenants will be better off (point *D* in Figure 4). If it shifts up the demand schedule enough, landlords will compete for tenants so fiercely that landlords will be worse off. However, it is possible for the demand curve to shift down, in which case tenants are worse off (point *C* in Figure 4). If at a particular level of expected utility of tenants, the optimal "interlinked" contract entails a plot size for each tenant which is smaller (larger) than in the noninterlinked contract, then, at that level of expected utility of tenants, there is an excess supply (demand) for tenants; hence, in the competitive equilibrium with interlinkage the expected utility of tenants must be lower (higher) than in the equilibrium without interlinkage. The calculations of the relationship between the optimal plot size and interlinkage are complicated, and are presented in the Appendix. There we show that interlinkage can, under not implausible conditions, increase plot size (at a given level of utility of tenants) and make tenants worse off.

Consider, for instance, an economy with a Cobb-Douglas production function. It is known (see Stiglitz, 1974) that in the optimal contract, the share of the tenant α equals the implicit share of labor S_w (where S_w is the exponent on labor in the Cobb-Douglas function). This share is optimal for all levels of borrowing. Changes in the credit terms, thus, must be offset by changes in plot size. If interlinkage attempts to restrict credit (as it would if the conditions of Propositions 1 and 4 are satisfied) then tenants will be worse off; to compensate them (leave them at the same level of expected utility as they would have without interlinkage) plot size must be increased; this reduces the demand for tenants, and hence the general equilibrium effect corresponds to the partial equilibrium effect.

Conversely, if interlinkage attempts to encourage borrowing (see Propositions 1 and 4) then tenants will be better off as a result of interlinkage; to leave them at the same level of expected utility, plot size must be reduced, and this increases the demand for labor, and, again, the general equilibrium effect conforms to the partial equilibrium effect. In more general cases, the partial and general equilibrium effects need not be qualitatively the same.[33]

[32] The case with elastic supply of laborers may be handled analogously. There is one critical difference: if the supply schedule of tenants is upward sloping (as one might expect), and interlinkage increases plot size at a fixed level of expected utility, then in equilibrium, when land area is fixed, plot size will increase. The number of tenants will accordingly decrease. Conversely, if interlinkage decreases plot size the equilibrium number of tenants will increase. One can, thus, infer the welfare impact from observing the equilibrium effect on plot size.

[33] This is a general property which arises in variety of situations where risk is involved. See, for instance, Newbery-Stiglitz (1982).

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In Section IV below we analyze the effects of interlinkage in noncompetitive environments.

II. Interlinking Marketing and Tenancy Contracts

In the discussion above, we assumed that output and raw material prices are exogenously given to both landlords and tenants. Landlords and tenants therefore face identical prices; quite often, however, one observes that the landlord undertakes the marketing activity for his tenant and is involved in the provision of raw material inputs.[34] Is there an explanation for this interlinkage between marketing and tenancy contracts which is analogous to that presented earlier, for the interlinkage between credit markets and tenancy.[35] In this section, we focus on inputs, while in the next we consider interlinkages with consumption goods markets. Here we show: (*i*) if there is a single input, and if the contract can specify the cost and output sharing formula without restriction, then interlinkage provides no advantages; but (*ii*) if there are restrictions on the cost-sharing formula (and, in particular, if the same cost-sharing formula must be employed for a variety of inputs), then there will be interlinkages.

It is widely believed that by marketing the output, the landlord may explicitly (by buying the product from the tenant at a lower price than at the market price) or implicitly (by charging high marketing costs), extract further surplus from the tenant. However, in a utility equivalent contract equilibrium framework where the landlord both possesses sufficient controls and gains from pushing the tenant down to his reservation utility, there is no possibility to extract further surplus from the tenant. Hence, in such a world the following question arises: Does the control of output and raw material prices provide an *additional* instrument for the landlord to motivate the tenant (and extract surplus) besides those already discussed?

Consider the tenant's problem in the absence of uncertainty. Assume that both the tenant and landlord face the same price for the raw material fertilizer, P_x (for example, the fertilizer purchased from the village cooperative). For notational convenience, we shall define the fertilizer units such that $P_x = 1$. However, the landlord buys the output from the tenant at the price P_T which is different from the market price at which the landlord sells the output, P_L. Thus, the tenant's income is

$$Y_T = \alpha P_T f(e, x) - \beta x, \tag{37}$$

where α and β denote the tenant's output share and cost share, respectively, and he maximizes

$$\max_{(e,x)} U(Y_T(e, x), e). \tag{38}$$

From the first-order conditions we obtain

$$f_x = \beta/\alpha P_T; \tag{39}$$

$$f_e = -U_2(Y_T, e)/U_1(Y_T, e).\alpha P_T. \tag{40}$$

Hence, the tenant's decisions are fully determined by the set of controls $\beta, \alpha P_T$. Let us therefore define $\hat{\alpha} \equiv \alpha P_T$, and write the tenant's effort and input supply functions $e = e(\hat{\alpha}, \beta)$, $x = x(\hat{\alpha}, \beta)$.

Now let us move to the landlord's problem and determine whether P_T plays a separate role for him, in addition to its role in determining $\hat{\alpha}$. The landlord who faces the output price, P_L, at the market place maximizes his income subject to the utility equivalence constraint, that is,

$$\max_{\{\alpha, \beta, P_T\}} (1-\alpha)P_L f[e(\hat{\alpha}, \beta), x(\hat{\alpha}, \beta)] - (1-\beta)x(\hat{\alpha}, \beta), \tag{41}$$

[34] For simplicity we will focus in this section on interlinking of marketing of output and tenancy contracts while similar reasoning applies to discussion regarding marketing raw materials by the landlord to the tenant.

[35] There are several other reasons why the landlord might market the tenant's output. If the landlord requires the tenant to market his output solely through himself (the landlord), then he creates a simple way to monitor the output and guarantee that he obtains the agreed share. Another reason is that marketing activity exhibits increasing returns to scale; hence, it is efficient for a specialized agency to market output of many productions units together. The landlord may provide such an agency.

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subject to

$$U[Y_T(\hat{\alpha}, \beta, P_T), e(\hat{\alpha}, \beta)] = \bar{V}.$$

Equation (41) can be rewritten as

$$(42) \qquad \max_{\{\alpha, \beta, P_T\}} P_L f - x - Y_T.$$

The last term is the tenant's income. By inverting the constraint in (41) we obtain

$$(43) \qquad Y_T = \phi[\bar{V}, e(\hat{\alpha}, \beta)].$$

Substituting (43) into (42) we obtain

$$(44) \qquad \max_{\{\hat{\alpha}, \beta\}} P_L f(\hat{\alpha}, \beta) - x(\hat{\alpha}, \beta) - \phi(\bar{V}, \hat{\alpha}, \beta) = \Pi(\hat{\alpha}, \beta),$$

from which it is clear that the landlord cares only about $\hat{\alpha}$ rather than about α and P_T separately. Hence

PROPOSITION 5: *In a utility equivalence world where shares are not restricted, the landlord can pay the tenant the market price for his output, that is, $P_T = P_L$. However, if shares are restricted either by social norms or laws, the landlord can extract the tenant's surplus by paying him a price lower than the market place, that is, $P_T < P_L$, without any loss in efficiency.*

A similar analysis suggests why it may be in the interests of a monopsonist marketing agent to attempt to interlink the credit markets with his marketing activity. Assume that he pays a single price for the output which he purchases from farmers. He sets this price so the marginal cost of purchasing an additional unit equals the marginal revenue he obtains from selling the good. But since the price he pays is, in general, less than the marginal cost, the tenants have (from his point of view) insufficient incentives to produce. If he can induce them to produce more at the given price, this will increase his profits. Thus it may, for instance, be worthwhile for him to subsidize credit.

A similar argument establishes that if there are many inputs, and if P_i is the price at which the landlord sells the ith input to the tenant (we normalize the units so the purchase price of all inputs by the landlord is unity), and β_i is the share of the ith input's cost borne by the tenant, then the tenant's behavior is fully determined by the set of controls $\{\beta_i P_i, \alpha P_T\}$. Similarly, the profits of the landlords are a function of the same variables. Thus, any equilibrium can be supported by the landlord setting $P_i = 1$ for every i, (the price the landlord must pay for the inputs). But again, if there are restrictions on β_i (in particular, if the same cost-sharing formula must apply to all inputs), since the optimal value of $\{\beta_i P_i\}$ will differ from one input to another, so, too, must the optimal price. However, note that it is only through changes in the relative prices of inputs that the landlord achieves the advantages of interlinkages.

III. Interlinking of Labor and Consumption Good Markets

The argument of the previous section suggested that providing the landlord with additional instruments for exploiting workers through control of the product market would not, in fact, enable him to do so any better than he could have done by simply altering the "contract" which he imposed on his workers.[36] This is not true for the landlord's control of the consumption good market. We represent the typical worker by his indirect utility function $V = V(C, p)$. By the usual arguments, V and e are both homogeneous of degree zero in C and p: so long as the monopolist does not change *relative prices*, the fact that he may also own the store at which his workers buy their goods has no effect on his ability to exploit his workers.

The landlord will, however, wish to change the relative prices of goods, to encourage the consumption of goods which are complementary to effort, and discourage the consumption of goods which are complementary

[36]This is Newbery's (1975) point in response to Bhaduri's (1973) assertion that interlinked credit and tenancy contracts are an obstacle to technological innovation. See Srinivasan (1979) and our (1981b) paper on this issue.

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to leisure.[37] Thus, giving the landlord this extra degree of control will increase his return. In addition, this argument provides a rationale for landlords providing workers with meals and some in-kind payments, rather than full money wages.[38]

IV. Monopoly, Monopsony, Competition, and Equilibrium with Surplus Labor

For most of the analysis in this paper, we have not had to distinguish between a monopoly landlord and a competitive landlord. In either situation, the contract should be designed so as to maximize the expected profits of the landlord, given whatever level of expected utility the workers attain. The only distinction is the determination of the level of expected utility of workers. In the monopoly solution, it is at the subsistence level of workers; in the competitive equilibrium, it is at whatever level equates demand and supply of tenants.

There is, however, another quite different regime, in which, in equilibrium there is unemployment (surplus labor). In our earlier discussion, we characterized the equilibrium by having the landlord maximize his expected profits subject to the constraint of being able to obtain workers, that is, offering tenants a contract which generated a level of expected utility at least as great as the worker could obtain elsewhere. In a variety of situations, this constraint turns out not to be binding. For instance, in the efficiency wage model analyzed by Harvey Leibenstein (1957), James Mirrlees (1976) and Stiglitz (1976), there is a wage which minimizes labor costs per efficiency unit. Even though labor could be obtained at a lower wage, a landlord would not do so, since that would increase his labor costs. At a lower wage, workers are not only less efficient, but are sufficiently less efficient that wage costs per unit of effective labor are actually larger than they would have been at the "efficiency wage." Similarly, a landlord might be able to reduce the share or the size of plot he provides workers, but it would not pay him to do so, since his expected profits might be reduced as a result of such a move. In this case, even in a competitive market there may exist equilibrium in which the supply of labor exceeds the demand—that is, there is nonvoluntary unemployment. (For such an unemployment equilibrium to occur it is required that output per hectare increase with plot size. Braverman-Srinivasan (1981) have shown that with production functions with constant returns to scale in land and labor this can never occur.)

In such situations, interlinking has some interesting implications. Interlinking may increase the expected profits of landlords (in either competitive or noncompetitive situations) if, for instance, the landlord can induce a higher level of effort by providing loans at a subsidized rate. Although the welfare implications for landlords in this situation are clear, the implications for workers are ambiguous: (*i*) The number of workers employed may increase or decrease, depending on the effect of interlinkage on the optimal plot size; and (*ii*) Those workers who do succeed in getting land may be better or worse off.

Consider a case where the worker divides his consumption between alcohol, which decreases effort, and food, which increases it. Assume that by changing the relative price of alcohol to food, the landlord is able to induce a significant change in the relative proportion of income spent on the two goods (the elasticity of substitution between the two goods is very high). Then, not only may this increase the level of effort, but it may also increase the *marginal* return to increas-

[37]We omit the details of the calculations describing the optimal pricing policy of the monopolist. That analysis is exactly parallel to the standard analysis of the optimal set of commodity taxes. There, the problem for the government is to maximize the welfare of consumers, subject to a given budget constraint; here, we are concerned with the dual problem, the maximization of the revenue (of the monopolist) subject to the subsistence level of utility of workers, where the constraint may not be binding.

[38]There is an alternative argument for interlinking the consumption good market that is based on consumers misperception of their "real" income associated with the whole interlinked contract, i.e., they may perceive certain subsidies which they receive immediately (for example, credit, food), more intensely than the disadvantageous terms, the impact of which will be felt only later.

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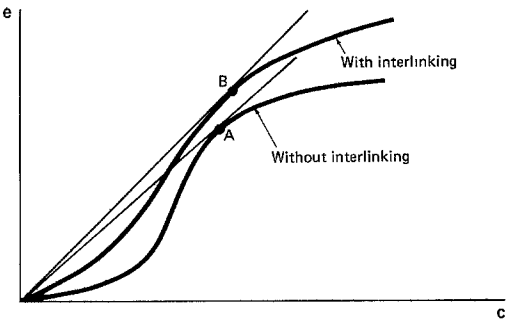

FIGURE 5. EXAMPLE WHEN INTERLINKING GOODS AND LAND/LABOR MARKETS RESULTS IN HIGHER LEVELS OF CONSUMPTION FOR WORKERS

ing plot size, share, etc.; if, for instance, the efficiency wage increases significantly, as depicted in Figure 5, the individual who succeeds in getting land may be *better off*. (Clearly, although the level of effort might increase, the marginal return to increasing wages might decrease; the monopolist may thus reduce the wage of his worker and the interlinking of the consumption market and the labor market would then *lower* the welfare of the worker.) Similarly, if the optimal plot size increases, the level of unemployment will increase; likewise if optimal plot size decreases so will unemployment.

We have argued in this section that there is no fundamental difference in the structure of the analysis of interlinkage of markets between a competitive market and a market with a single landowner, but that there is a significant difference between those situations where the expected utility constraint of workers is binding and those where it is not. It is important to recognize, however, that whether the expected utility constraint is or is not binding, is itself affected by the market structure, that is, by whether there is a single landlord, or by the instruments for exploitation which are at the disposal of the landlord. In our earlier discussion, we suggested, for instance, that the landlord might like to employ a nonlinear lending schedule, where the rate of interest was a function of the amount borrowed. If, however, there is a secondary loan market so individuals can re-lend to each other, the landlord may be forced to lend at a single rate. Then, if he lowers the rate to induce workers to borrow more and is either restricted from decreasing the share or plot size, or finds it undesirable to do so, workers will enjoy an expected utility level exceeding their subsistence constraint. If the landlord could impose a lump sum tax on his workers, he could again drive them back to their subsistence constraint.

V. Conclusion

This paper has provided an economic rationale for interlinking contracts in situations where there are important moral hazard problems. The analysis has focused on the case where the terms of the tenancy contract are determined optimally, but the argument for interlinkage is even stronger in those situations where convention or law restricts certain contractural arrangements (for example, usury laws which forbid or restrict interest rates).[39]

We also note that our analysis did not address the implications of heterogenous population of landlords and tenants for interlinking. The interlinkages of credit and tenancy contracts, for example, may serve landlords as a screening device to identify more able potential tenants (see Franklin Allen, 1980, and Braverman-Guasch, 1981). Furthermore, our analysis has focused on interlinkages within a set of markets at a given time; similar arguments can be put forward for interlinkages across markets over time. This may lead to the signing of long-term contracts between tenants and landlords-cum-lenders. In this case, although, there may be *ex ante* competition (before the contract has been signed), there is only limited *ex post* competition.[40] The implications of this are important, but unfortunately cannot be pursued here.

Although we have argued that the presence of interlinkages need not be taken as evidence that agrarian markets in less-devel-

[39]In such situations, it is obvious that interlinkage provides one way of effectively circumventing these restrictions. Thus, interlinkages would occur even in the absence of the moral hazard problems, which we have focused on here. (See Braverman-Srinivasan, 1981.)

[40]See Stiglitz-Weiss (1980) on the question of *ex ante* vs. *ex post* competitivity in credit markets.

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oped countries are noncompetitive, it seems clear that such linkages have both distributive as well as allocative effects. Attempts to reduce the landlord's "power" by restricting his marketing or credit activities may, in certain circumstances, lower agrarian output and make tenants worse off. In other circumstances,[41] total agrarian output might increase, tenants could be better off, and only the landlords suffer. Further empirical work is clearly needed to distinguish which of the various possibilities is relevant in any particular situation. Yet, one of the conclusions of our study is that in many situations competitive and noncompetitive markets may look quite similar (say, with respect to the kinds of interlinkages employed). Thus, distinguishing among the various possibilities may require greater subtlety than is frequently employed in empirical and policy work in this area. We hope our study has shown that simplistic models (whether competitive or noncompetitive) which involve anonymous market places, homogeneous goods and perfect monitoring of inputs are likely to be very misleading.

APPENDIX: DETERMINATION OF THE EQUILIBRIUM PLOT SIZE, WITH VARIABLE SHARES IN UTILITY EQUIVALENT CONTRACT EQUILIBRIUM

Let $f(el)$ = output per hectare, so f/l = output per worker. Let α and l be variable. Let $Eg = 1$. The landlord must choose $\{\alpha, l\}$ to yield

$$\text{(A1)} \qquad EU\left(\frac{\alpha f(el)}{l}g - \hat{B}, e\right) = \bar{U}.$$

We thus obtain

$$\text{(A2)} \qquad d\alpha/dl|_{\bar{U}} = \alpha(f - f'el)/lf$$
$$= \alpha(1 - S_w)/l,$$

where $1 - S_w = (f - f'el)/f$ = implicit share of landlord. Moreover, recalling the first-order condition for effort

$$\text{(A3)} \qquad EU_c\alpha f'g + EU_e = 0,$$

we observe that along the iso-utility contract, assuming for simplicity an additive utility function,

$$\text{(A4)} \qquad \frac{l}{e}\frac{de}{dl}\bigg|_{\bar{U}} = -\frac{\alpha f'[1-\gamma-S_w]EU_c g}{elEU_c\alpha f''(el)g + EU_{ee}e}$$
$$= \frac{1-S_w-\gamma}{\gamma+\nu},$$

where $\gamma = -f''el/f'$ and $\nu = EU_{ee}e/EU_e$, which is the elasticity of effort supply.

Expected profits (per hectare) of the landlord are $(1-\alpha)f(el)$. Hence, the optimal contract is such that

$$\text{(A5)}$$
$$f\left[(1-\alpha)S_w\left(1 + \frac{d\ln e}{d\ln l}\bigg|_{\bar{U}}\right) - \alpha(1-S_w)\right] = 0,$$

that is,

$$\text{(A6)} \qquad \frac{\alpha}{1-\alpha} = \frac{S_w}{1-S_w}\left(1 + \frac{d\ln e}{d\ln l}\bigg|_{\bar{U}}\right).$$

For example, if $d\ln e/d\ln l|_{\bar{U}} = 0$, $\alpha = S_w$, and from (A4), if there is a Cobb-Douglas production function, that is, $\gamma = 1 - S_w$, then $d\ln e/d\ln l|_{\bar{U}} = 0$. Hence, for a Cobb-Douglas production function, the optimal share remains unchanged, as we change $(1+r)B$. Thus, to obtain the same level of expected utility, as we increase the interest rate charged on a fixed level of borrowing, we increase plot size. Therefore, interlinkage reduces the demand for labor; and it leads tenants to be worse off.

More generally, we observe that $\sigma \equiv$ elasticity of substitution $= (1-S_w)/\gamma$. Substituting back into (A4), we obtain

$$\text{(A7)} \qquad \frac{d\ln e}{d\ln l}\bigg|_{\bar{U}} = \frac{(1-S_w)(1-1/\sigma)}{(1-S_w)/\sigma + \nu}$$
$$= \frac{(1-S_w)(\sigma-1)}{(1-S_w)+\nu\sigma} \gtrless 1 \text{ as } \sigma \gtrless \frac{2(1-S_w)}{1-S_w-\nu}.$$

[41] When there is a single landlord, and the expected utility constraint is not binding.

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Hence

$$(A8)\quad \alpha/(1-\alpha) = S_w/(1-S_w) + S_w(\sigma-1)/(1-S_w+\nu\sigma).$$

Although (A8) always characterizes the equilibrium, it is important to note that γ, α, S_w, σ, and ν are all endogenous variables (except in some special cases). We can still use (A8), however, to obtain certain results concerning the effects of interlinking. First, let us assume that B is unchanged, but the rate of interest charged is increased. (The borrowing was for an emergency which occurred the preceding period.) Assume l were unchanged to keep U at the same level, then α must be increased. Thus, e will be increased, both because of the increased α and the increased value of $(1+r)B$. If the elasticity of substitution exceeds unity, this increases S_w. Both the left-hand and the right-hand sides of (A8) have thus increased. If the right-hand side has increased more, it means that at the contract which generates equal expected utility with unchanged plot size, α is too small; thus α must be increased, and plot size decreased. Therefore the demand for tenants will increase and their expected utility will also increase. This will occur if the elasticity of substitution is very large. But if the elasticity of substitution is just slightly greater than unity, the left-hand side will exceed the right, and hence α will need to be reduced and plot size correspondingly increased (if individuals are to be at the same level of expected utility). These changes will increase effort, but less than proportionately to the increase in plot size; hence, el will be reduced, which will reduce the right-hand side of (A8); α will continue to be reduced until the left- and right-hand sides of (A8) are equal. In this case, therefore, interlinkage has resulted in a decrease in the demand for labor and tenants expected utility is decreased. (Other cases are left as exercises to the reader.)

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