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Kaushik Basu

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Delhi School of Economics
Delhi – 110 007
India

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I **INTRODUCTION**

This paper explores the relation between the structure of property rights and output-augmenting activity, like investment and the adoption of new technology.[1] In particular, attention is focused on a specific cause of technological stagnation - that based on the structure of tenurial rights. Though several important writers have addressed this issue (e.g., Mill 1848, Book II, Chapter 8; Johnson 1950; Kalecki 1976), the problem remains largely misunderstood.

The principal weakness of most existing arguments is that they are one-sided. This may be illustrated with Johnson´s (1950) suggestion that technological innovations do not occur in the agrarian sector of many less developed economies because of the landlords´ inability to evict tenants. Because of this inability a landlord cannot expect to reap much of the benefits of new investment since the old tenant will continue to pay the same rent. This makes the landlord reluctant to invest in new technology. The trouble with this line of reasoning is that in making a case for why a landlord would not innovate, it inadvertently provides an explanation of why a rational tenant would innovate. After all, if a tenant is confident of not being evicted, he should be willing to spend on the innovation because he can appropriate the benefits. Thus the validity of this kind of hypothesis hinges on the prior assumption that only landlords may innovate. Such an assumption, however, is difficult to justify.

The converse problem occurs with Kalecki´s (1976, p. 19) argument that it is because tenants fear eviction that they hesitate to sink

their savings into the land they till and this leads to technological
stagnation. If it were true that tenants could be evicted easily in
backward agrarian economies, then we would be hard pressed to explain
why landlords do not innovate more readily. So, implicit in Kalecki´s
argument is the untenable prior assumption that only tenants may
innovate.[2]

A more complete theory of stagnation has to explain simultaneously
why it will not be worthwhile for any agent (that is, the landlord or
the tenant) to innovate. This turns out to be a more difficult and
interesting task and is the subject matter of this paper. It is argued
that if we look sufficiently carefully into the structure of property
rights in less developed economies, we may be able to find some of the
roots of such a theory of technological stagnation. It is to be stressed
that the aim of this paper is not to explain the phenomenon of
innovation or non-innovation observed in a particular country. Such
experience is anyway much too diverse to be captured by some simple
theory. The aim, instead, is to rectify the problem of 'single-sided'
explanations which, as just argued, is wide-spread in the literature,
and to highlight a method which does not use any assumption of
credit-rationing in explaining non-innovation. In addition, the model in
this paper could be viewed as providing a theory of how certain tenancy
laws could be the main factor behind the poor upkeep and maintenance of
urban property, especially houses, in many cities.

II THE PROPERTY-RIGHTS STRUCTURE

An essential feature of property rights is that these are never
"total". Thus I may own this knife but you have the right to stop me
from certain uses of it, for example, placing it between your ribs.
Ownership, therefore, means the possession of a bundle of rights - in
the case of the knife, to cut vegetables, to sharpen it, to throw it
away or to sell all these rights to someone else, that is, to sell the
knife.[3]

A common element of property-rights laws or customs in several countries is that the rights of both the landlords and tenants are circumscribed in important ways. In particular, it is frequently the case that landlords do not have the right to evict tenants. A tenant can occupy the land or house for as long as he wishes. However, he does not have the right to sublet the property or sell the tenancy rights to someone else. These legal axioms play an important motivating role and it is useful to write these down explicitly.

Axiom L(1): It is illegal for a landlord to evict his tenant. At the time of taking on a new tenant, he may negotiate any rent, which thereafter remains fixed.

Axiom L(2): A tenant cannot sublet the land or sell his tenancy rights. If he quits, the freehold land lapses back to the landlord.

It is being assumed that these legal tenets hold no matter what individuals may agree to among themselves. In other words, a landlord and a tenant who enter into a contract which violates these axioms cannot expect the country´s judiciary to uphold their contract by penalizing the agent who violates it. This is certainly true in India. If a tenant promises to quit his landlord´s house or land after a certain period and then at the end of the period refuses to go, the landlord has little hope of appealing to the law and evicting the tenant because the tenant´s prior right to continue to occupy a house or land for as long as he wishes virtually nullifies their subsequent contract, even though it was voluntarily agreed upon by both parties.[4]

What has been attributed to law so far, could alternatively be achieved through social customs (Sismondi 1827, Book III, Chapter 5). Customs, enforced by a network of social sanctions (Akerlof 1976; Basu 1986) or via "oaths" and "ordeals" (Posner 1981, Chapter 7), could have similar effects to a formal law enforced by the state;[5] and in the context of the present model there is no need to distinguish between these. Some primitive societies, for instance, have the concept of a "possessory right" to land (Herskovits 1952; Posner 1981) which is

similar to our legal axioms. Also, while this paper studies a particular legal structure, its conceptual basis is broader: It shows how economic progress may depend on legal and customary structures and suggests that laws, even those different from the one considered here, could have the same kind of regressive effect. For instance, North and Thomas (1973, p. 4) have observed for Spain: "As land became scarce ..., the social rate of return on improving the efficiency of agriculture rose, but the private return did not, because the Crown had previously granted to the shepherds' guild (the Mesta) exclusive rights to drive sheep across Spain in their accustomed manner. A landowner who carefully prepared and grew a crop might expect at any moment to have it eaten or trampled by flocks of migrating sheep". In yet another set-up, Hirschman (1963) has demonstrated the close connection between law and economic stability. In the context of Columbia's Law 200 passed in 1936 to reform the land-rights structure, Hirschman illustrates how a law or even the anticipation of a law (if it is long in the making, as Law 200 was) can disrupt productive activity.

The idea that will be pursued in the next two sections is that in the presence of laws or customs similar to axioms $L(1)$ and $L(2)$, technological stagnation is likely. This is because in a situation characterized by $L(1)$ and $L(2)$ no agent may be able to fully appropriate the fruits of his investment.[6] Moreover, given some additional complications, it is shown (in Section IV) that landlords and tenants may fail to adopt innovations even on a cost-sharing basis.

Throughout this paper I consider a fixed-rent tenancy. That is, the tenant is committed to paying the landlord a fixed amount of rent (in real terms). It is possible to do the same kind of analysis for share tenancy. We would simply have to change the assumption of absolute rent remaining fixed in axiom $L(1)$ to the share (of the output given as rent) remaining fixed. This would mean that, as a consequence of innovation, the output accruing to both the landlord and the tenant will go up but by the shares fixed in advance. While such an assumption would complicate our algebra a little the main results will remain unchanged.

In brief, the approach of this paper is applicable to fixed rental systems and sharecropping.

The innovation that I shall be considering is a "sunk" investment in land, that is, once it has been adopted, it cannot be separated from the land and sold off. Soil improvement, a new irrigation facility, a deep tube-well which cannot be taken out once it has been installed are examples of such innovation. In fact, any machinery, e.g., tractors, would, in part, be a sunk investment because - thanks to asymmetric information - secondhand prices are less than what can be explained in terms of depreciation. In this paper the terms "innovation", "technology", or simply "investment" are used interchangeably to mean a sunk investment in land.

III A FIRST ARGUMENT

An innovation or investment opportunity is formally characterized as an ordered pair (X, C), with the restriction

$$X - C > 0,$$

where C is the cost of adopting this innovation which has to be incurred "now" and X is the benefit that will accrue subsequently, i.e., after a time-lapse. The restriction ensures that what we call an innovation in this paper is economically viable.

In between the adoption of a new technology and its bearing fruits (i.e., after C has been incurred and before X accrues) the tenant may quit. If he does so, the landlord gets X. If he stays, the tenant gets X. This is our "basic axiom", and it may be stated as follows, following the convention that when we talk of a tenant quitting we mean his quitting after the adoption of technology and before its benefits appear:

Axiom A: If the tenant quits, then X accrues to the landlord. If the tenant stays, the tenant gets X.

This axiom follows from our legal axioms in Section II. If a tenant stays, given the fixed-rental system, he gets the additional output, X, that emerges from the land. If he quits, given that he cannot sell his tenancy rights, the landlord gets back full possession of his land. He can now rent it out again and charge his new tenant an additional rent of X. This assumes, of course, a competitive supply of tenants. This explains axiom A.

Two cautionary notes are useful. First, it is worth nothing that the temporal structure of my model is very simple. A more realistic model would allow for many periods over which the benefits of the innovation appear and instead of the extreme axiom A, it would be based on the less polar assumption that the longer a tenant stays, the more of the fruits of innovation accrue to him. Fortunately, these complexities do not affect the essential results of this paper. Secondly, it ought to be emphasized that the formal model which is about to follow is based on axiom A and not on axioms L(1) and L(2). The purpose of the legal axioms is to motivate axiom A. Concerning how well they do motivate this, there may be room for controversy, but since that does not affect my main argument, I return to this in Section V.

The first argument as to why no individual may wish to innovate in an economy characterized by the kind of legal institutions described in Section II is simple. Suppose, as a first step, that the landlord has one tenant and q is the exogenously given probability of the tenant choosing to quit after the adoption of technology. The exogeneity of q is a temporary assumption. Given axiom A, if the tenant adopts an innovation (X, C), his expected profit is

$$(1-q)X - C.$$

If the landlord adopts the technology, his expected profit is

$$qX - C.$$

Now, even though X - C is positive, both $(1-q)X - C$ and $qX - C$ may be

negative. Hence, neither the landlord nor the tenant may be ready to accept the innovation.

This explanation of suboptimal adoption of new technology is more powerful than the popular arguments discussed in Section I because here we allow for the fact that anybody may adopt the innovation and then show that nobody finds it worthwhile to do so. Despite this, this argument is far from adequate because a simple cost-sharing arrangement can get the landlord and his tenant out of this problem. Suppose the landlord offers to pay qC of the cost of innovation and asks the tenant to pay (1-q)C. Then clearly both will profit from this innovation.

One may try to defend against this criticism by pointing out the difficulties of finding cost-sharing arrangements which are acceptable to both parties and which are easy to enforce. Fortunately, more compelling reasons arise once we append to the above framework some fairly realistic assumptions.

Two lines of enquiry are pursued in this paper. Section IV models the determination of q. It is shown that q may depend on whether the technology is adopted or not. In the former event, not-quitting becomes more attractive from the tenant's point of view and, thus, q falls. If this happens, it is shown that innovation may not be feasible even on a cost-sharing basis. In Section V I consider the case where the landlord has more than one tenant, each tenant's quit probability q_i (which may be endogenous) may be different from that of another tenant's, and while each tenant knows his quit probability, the landlord does not know this. In this case adverse selection occurs and there may be severe under-adoption of new technology.

IV ENDOGENISING THE DECISION TO QUIT

A tenant may quit his tenancy for many reasons: He gets a more paying offer elsewhere; his son migrates to the city and he wants to live with his son; and there can be other reasons. For simplicity I

shall take the case where the tenant has a probability of getting an offer of a job elsewhere.[7] Of course this can happen at any point of time. But nothing, excepting some algebra, is lost by assuming he gets his alternative job offer after the time when the decision to adopt (or not adopt) the technology is taken and before the benefits of the new technology appear. The job offer that he gets could be thought of as one chosen from the following lottery:

<u>Lottery</u>: $(y_1, p_1; y_2, p_2; \ldots; y_n, p_n)$

where p_i is the probability that he will get an offer from elsewhere of earning y_i (above his current reservation income). Of course we assume $p_i \geq 0$, for all i, and $p_1 + \ldots + p_n \leq 1$. Note that $p_1 + \ldots + p_n$ is the probability of getting offers from elsewhere. Thus it may be less than 1. The probability of getting no offers is $1 - (p_1 + \ldots + p_n)$.

A tenant chooses to quit if his offer from elsewhere is as large as his present income. The use of weak preference here is for the purely technical reason that it ensures the upper semi-continuity of the landlord's profit function thereby ensuring the existence of a maximum.

If the innovation is adopted the tenant's income in his present occupation rises by X. Hence the probability of his quitting, denoted $q(X)$, is given by adding up the probability that his offer elsewhere matches or exceeds X. This may be written formally as follows: For any real number r define

$$M(r) = \{i \mid y_i \geq r\}$$

Then
$$q(X) = \sum_{i \in M(X)} p_i$$

If the innovation is not adopted, the probability of the tenant quitting, denoted $q(0)$, is:

$$q(0) = \sum_{i \in M(0)} p_i$$

Recall that y_i denotes the <u>excess</u> of the offer elsewhere above his current reservation income (which equals his current income in the absence of innovation).

Clearly $q(X) > q(0)$, i.e. if the innovation occurs, he is less likely to choose to quit his present occupation (i.e. the tenancy).

We shall assume that at the time of decision whether to adopt the technology or not the tenant is unaware of what offer elsewhere he will get but he is aware of the lottery from which the offer is picked.

Consider now a cost-sharing arrangement whereby the landlord offers to pay fraction d of the cost of innovation. The tenant will accept this arrangement if

$$(1 - \sum_{i \in M(X)} p_i)X + \sum_{i \in M(X)} p_i y_i - (1-d)C \geq \sum_{i \in M(0)} p_i y_i$$

This may be rewritten as

$$(1-q(X))X - (1-d)C \geq \sum_{i \in M(0) \backslash M(X)} p_i y_i \qquad (1)$$

The landlord will find this cost-sharing arrangement acceptable if

$$q(X)X - dC \geq 0 \qquad (2)$$

Since the right-hand side of (1) may be positive it is easy to see that even though $X - C > 0$, there may not exist any d which satisfies both (1) and (2). In other words, US innovation may not be acceptable even on a cost-sharing basis.[8]

Note that the variability of the quit probability plays a critical role in this argument. If the quit probability does not depend on the adoption decision, i.e. $q(X) = q(0)$, then clearly

$$\sum_{i \in M(0) \backslash M(X)} p_i y_i = 0 \qquad (3)$$

Then there does exist d (eg., d = q(X)) for which both (1) and (2) hold and the innovation is adopted.

Suppose now, in order to consider the case most adverse the point of view of this paper, that (3) is in fact true. Thus q(X) = q(0) =, say, q. Can we still explain non-innovation? As we have just seen, in the simple framework of this section, the answer to this must be in the negative. However, if there are many tenants and they are heterogenous (in a sense made clear later) then even when (3) is true, under-adoption of innovation can be explained. This is the subject matter of the next section. So in the next section we shall assume that for each tenant

$$q(X) = q(0) = q$$

It should be clarified that this does not mean q is exogenously given. It is endogenous but invariant because (3) holds. Further, this assumption is the most adverse for explaining non-innovation.

V ADVERSE SELECTION AND SUBOPTIMAL INVESTMENT

There is one landlord who owns many plots of land. On each plot he has a tenant. Tenants may have different probabilities of quitting. An innovation, (X, C), is suddenly available which can be adopted on each plot. It is assumed that the landlord announces the fraction of the cost he is willing to incur. It is then up to each tenant to accept the innovation or reject it. Of course each acceptor has to bear the remaining cost. Suppose a very high cost-share is unprofitable for the landlord. If, then, he offers to pay a smaller fraction, the tenants who are likely to quit soon will reject the innovation. Hence the acceptors will be the less desirable tenants from the landlord's point of view, and the landlord may continue to find the innovation unprofitable. This adverse selection of tenants as the landlord's cost-share is lowered may result in a low level of innovative activity. This section formalizes this intuitive idea and explores its implications.

There is one landlord and he has T types of tenants. Let $H = \{1, \ldots, T\}$ be the set of the types of tenants. For each i belonging to H, let n_i be the number of tenants of type i and q_i be the probability that a tenant of type i will quit. We follow the convention of labelling tenant-types such that

$$q_1 > q_2 > \cdots > q_T \tag{4}$$

Note that if $q_i = q_{i+1}$ then i and i+1 need not be distinguished. Hence not using weak inequalities in (1) imposes no restrictions.

Information is asymmetric in the sense of Akerlof (1970). Each tenant knows his q. The landlord does not know this, though he knows how many types of tenants he has and how many of each type. The assumption of asymmetric information has been contested in the literature (see Bardhan, 1984; Eswaran and Kotwal, 1985) on the ground that relations in such economies are personalised. I would however give asymmetric information a chance to explain certain features of rural economies.[9] It is true that relations here are personalised. But as long as we assume less than perfect information (which seems an eminently reasonable assumption) it seems reasonable to suppose that i´s information about j is worse than j´s information about j. Such informational asymmetry does not have to contradict the fact that overall interpersonal information is better in backward rural economies than in advanced industrialised systems. It may have been better to work with a model where the landlord has a 'fuzzy' idea of, or knows the intervals in which the tenants´ quit probabilities lie. The notion of better and worse information could then be captured by varying, for instance, the lengths of the intervals. In this paper, however, I stick to the more standard way of dealing with asymmetric information.

Let d be the fraction of the cost of innovation (i.e., C) which the landlord agrees to pay if a tenant adopts the innovation (X, C). Since to the landlord all tenants are identical, he does not discriminate between them and it is being assumed that he offers them all the same

cost-sharing arrangement, i.e., d. A tenant will adopt the new technology only if he expects to make a profit as a consequence. Hence, the expected profit of a tenant of type i, R_i, is given by[10]

$$R_i(d) = \max \{(1-q_i)X - (1-d)C, 0\} \tag{5}$$

Let A(d) be the set of tenant-types who adopt the new technology:

$$A(d) = \{i \epsilon H \mid (1-q_i)X - (1-d)C \geq 0\} \tag{6}$$

Implicit in (6) is the assumption that a tenant who is indifferent between accepting the innovation and not, accepts it. This is a harmless tie-breaking assumption.

The landlord's profit, R_L, is given by

$$R_L(d) = \sum_{i \epsilon A(d)} n_i [q_i X - dC] \tag{7}$$

The landlord's aim is to maximize $R_L(d)$ with respect to d. Hence the cost-sharing arrangement that will emerge in the equilibrium is given by d*, defined as follows:

$$R_L(d^*) \geq R_L(d), \text{ for all d in } [0,1].$$

What is interesting is that in this model, at equilibrium, there may be severe under-investment or widespread non-adoption of this new technology. The argument is essentially one of adverse selection. Consider first d = 1. As the landlord lowers d, the share of his cost falls, which seems to be good from his point of view (see (7)). But as d is lowered, A(d) becomes smaller, i.e., fewer tenants accept the innovation. And note that the tenants who drop out of A(d) are the ones with high quit probability. Hence the ones who remain and agree to adopt the technology are the ones with whom the landlord would least like to go into a cost-sharing venture. However, given that he cannot recognize tenant-types in advance and that the legal system is such that he is not

allowed to write contracts contingent on a tenant´s quitting decision, he has no method of averting the adverse selection problem. Hence as d becomes smaller, his profit may fall.

As a result of this, several interesting possibilities arise at the equilibrium of the above model. I shall follow the method of stating these possibilities as propositions and then establishing them:

1. There are situations such that for all i belonging to H, there exists $d(i) > 0$ such that both the landlord and the tenant of type i can earn positive profit if they have a cost-sharing arrangement where the landlord pays fraction $d(i)$ of the total cost; but nevertheless the landlord refuses to invest anything, i.e., $d^* = 0$. In this case the only tenants who will invest will be those whose tenure is so certain, i.e. q so small, that they find it profitable to "go it alone". It is easy to show that the adoption rate of the innovation may be suboptimal and, in fact, "very low".

2. There are situations such that for all $i \leq T-1$, there exists $d(i) > 0$ such that both the landlord and the tenant of type i earn a positive profit if they have a cost-sharing arrangement where the landlord pays $d(i)$ of the cost, but nevertheless for all $d > 0$, the landlord earns a negative profit.

Before stating the next proposition, I need to introduce some terminology. Consider two situations: one where $q = [q_1, \ldots, q_T]$ denotes the quit probabilities (of the T types of tenants) and another where $q' = [q'_1, \ldots, q'_T]$ denotes the quit probabilities. If for all i, $q'_i \geq q_i$ and there exists j such that $q'_j > q_j$, then we shall say that in the q-situation there is less mobility of tenants than in the q'-situation.

3. The relation between mobility of tenants and output is not monotonic. That is, with a decrease in the mobility of tenants, output may rise or fall.

These propisitions can be established by constructing suitable examples. I shall, however, follow the route of partially characterizing the equilibrium of our model and then use both examples and more general approaches to illustrate the above propositions. This method gives us a deeper insight of the "process" underlying the formal model.

Proofs. Let d_i be the smallest value of d which will induce group i to invest. Thus d_i is defined implicitly by

$$(1-q_i)X - (1-d_i)C = 0 \qquad (8)$$

It is easy to check that d* must be either O or one of d_1, ..., d_T. I prove this by contradiction. If d belongs to the open interval (d_i, d_{i+1}) then it is possible to lower d a little without altering the set A(d). Hence it follows from (7) that $R_L(d)$ will rise. Hence d could not have maximized $R_L(\cdot)$.

Given the observation in the above paragraph it is easy to see how to construct an example which validates proposition 1:

Let q_T be any number in the open interval (O, $1-\frac{C}{X}$). Note that (8) implies that as q_i becomes larger, d_i becomes larger as well. Suppose now that q_{T-1} is sufficiently large so that d_{T-1} is such that

$$q_T X - d_{T-1} C < O \qquad (9)$$

Observe now that if the landlord sets $d = d_j$, then all tenants of type i, where i < j will reject the new technology. Hence,

$$R_L(d_j) = n_j(q_j X - d_j C) + n_{j+1}(q_{j+1} X - d_j C) + \ldots + n_T(q_T X - d_j C) \qquad (10)$$

Given (4), (8) and (9) it follows that for all d_j belonging to {d_1, ..., d_{T-1}}, ($q_T X - d_j C$) is negative. Hence there exists a sufficiently large n_T, say $n_T(d_j)$, such that $R_L(d_j) < O$ if $n_T = n_T(d_j)$.
Suppose now that

$$n_T > \max \{n_T(d_1), \ldots, n_T(d_{T-1})\}$$

Then $R_L(d_j) < 0$, for all d_j in $\{d_1, \ldots, d_{T-1}\}$. Since $d_T < 0$ and $R_L(0) = 0$, it follows that $d^* = 0$. Hence the landlord will not invest anything towards the adoption of the new technology (X,C). Clearly only those groups, j, for whom $q_j \leq 1 - \frac{C}{X}$, will implement this new technology, thereby ensuring under-adoption.

Proposition 2 may be established in a similar manner but it may be more rewarding to use the alternative of constructing a numerical example.

Consider this example. There are only two types of tenants and these are characterized as:

$$q_1 = 1 \; ; \; n_1 = 10$$

$$q_2 = 0 \; ; \; n_2 = 1$$

In other words there are 10 sure quitters and one sure "stayer". The innovation available is given by

$$(X,C) = (12, 11).$$

It has been shown above that d^* in this case can be either 0 or 1. Now $R_L(1) = -1$ and $R_L(0) = 0$. Hence $d^* = 0$. It may be checked that for all d > 0, $R_L(d) < 0$. Since $X - C > 0$ (as is the assumption throughout this paper), every plot will benefit from the implementation of this new investment. But in this case, at equilibrium only one tenant out of the eleven makes the investment, thereby illustrating the under-adoption problem.

Proposition 3 may be established by extending this example. Suppose all other parameters remaining the same, the quit-probability of type 1 tenants becomes 0. Clearly then d^* will be 0 and all eleven tenants will

adopt the new technology. Hence a decrease in the mobility of tenants raises adoption and output.

Now suppose that in the original example, all other parameters remaining the same, the quit-probability of type 1 tenants becomes 1. Then $d^* = 1$, and the new technology is adopted everywhere. Hence an increase in the mobility of tenants, raises adoption and output.

Hence in the absence of an arbitrary prior assumption that either landlords or tenants cannot innovate (an assumption which underlies a lot of conventional writing), one cannot monotonically relate adoption of technology to the likelihood of tenants quitting.

Finally, and this is related to proposition 3, it is worth observing that the level of quit-probabilities is not important for the under-adoption of technology. What matters are the differentials. This is true in many different senses. I formalise one here as illustration. This is stated as a proposition:

4. Suppose in society 1 the quit probabilities are given by $(q_1, ..., q_T)$. Society 2 is identical to society 1 in every way excepting that its quit probabilities, $(q_1', ..., q_T')$, are such that for all i, $q_i' = q_i - e$, where e is any number (satisfying the condition that $q_i' \in [0, 1]$ for all i). In this case the level of under-adoption of technology (or the number of people who adopt the technology) is identical in societies 1 and 2.

This proposition implies that the mere fact that one society's tenants have a lower level of mobility does not destroy the argument constructed in this section.

Proof. From the proof of propositions 1-3, we know that the landlord will choose d from the set $\{0, d_1, ..., d_T\}$. Defining $0 = d_0$, we could then clearly think of the landlord choosing a $j \in \{0, ..., T\}$, where a choice of $j = k$ implies d is set equal to d_k. Hence we shall write the

landlord´s profit in (10) as a function of j, i.e. $R_L = R_L(j)$.

(8) implies that

$$d_j = 1 - (1 - q_j)\frac{X}{C}.$$

Substituting this in (10) and rearranging, we have

$$R_L(j) = \sum_{k=j}^{T} n_k(q_k - q_j)X + (X - C) \sum_{k=j}^{T} n_k \qquad (11)$$

Let $j^* = \text{argmax } R_L(j)$.

If now the quit-probabilities change as in the hypothesis of the proposition, then $q_k' - q_j' = (q_k - e) - (q_j - e) = q_k - q_j$. Thus (11) is unchanged. Thus the profit-maximising choice of j remains unchanged. So the number of tenants rejecting the technology remains unchaged.

VI CONTRACT FEASIBILITY

The formal argument of this paper was based on axiom A. This axiom was, in turn, motivated by (but not formally deduced from) axioms L(1) and L(2), which are a stylized description of the legal insitutions of some agrarian economies. A critique of the relevance of my model as a theory of under-adoption of new technology could hinge on the extent to which axiom A is an implication of L(1) and L(2). If, for instance, in an economy individuals are free to enter into any contract and the law is such as to uphold this, then suboptimality of the kind described in this paper cannot arise. The tenant and the landlord have to simply write out a contract where the benefits earned by the two agents are contingent on the tenant´s decision to stay or to quit. Since the act of quitting is an observable one, it is, in principle, possible to enforce such a contract. Hence, the question of the relevance of my model is predicated upon our belief as to whether all contracts are enforceable or not. There seem to be good empirical grounds for believing that they are not. This seems to be especially true in economically less developed

areas. One can find examples galore in anthropological works. A particularly relevant reference is Epstein (1967) which gives examples from agrarian India and clearly outlines the contraints on free contracting imposed by customs.

Even if one agrees – as is easy to do – that customs and the law impose severe restrictions on the set of feasible contracts, it seems possible to argue that there are simple schemes which allow us to circumvent axiom A. For example, if the landlord offers to incur the entire cost of innovation, C, and the tenant agrees to raise the rent by some amount between X and C, then this is agreeable to both and the contract seems simple enough to be feasible.[11]

Apart from the fact that in reality even such a simple contract may not be feasible (mainly because of the landlord´s legitimate fear that the tenant may refuse to pay a higher rent when the time comes, by taking refuge behind the law), there is a good reason why this criticism is not compelling: Note that in reality innovations take the form of entailing an initial installation cost followed by a stream of benefits over some periods, say S, given by $X(1)$, ... $X(S)$. This stream will typically not be uniform, i.e., $X(j)$ need not equal $X(k)$. Hence, the rent will also have to be non-uniform over the years, high in one, low in another, etc., in order to get around axiom A. It seems reasonable that such a complex contract, which is also not enforceable by the law, would be infeasible. Though in the formal model S is set equal to 1 for simplicity, axiom A reflects the above argument and seems to be reasonable in an insitutional set-up described by axioms $L(1)$ and $L(2)$. More generally, it is possible to claim that the set of contracts that is feasible varies across societies; and depending on the structure of these feasibility sets different societies are more or less prone to accepting change and innovation.[12]

This of course raises the prior question as to how an economy´s customs and institutions arise. This is a large and controversial

subject and its detailed analysis is quite beyond the scope of this paper. But since some writers have maintained that institutions which exist do so because they are socially optimal, a brief digression to this question could be of interest here.

VII THE OPTIMALITY OF INSTITUTIONS: A DIGRESSION

Since the sub-optimal outcome described in this paper arises as a consequence of existing legal institutions, this approach seems to contrast with the one where legal institutions are hypothesized to be socially optimal (e.g., Anderson and Hill 1975; Posner 1981):[13] According to Anderson and Hill, a law gets established if its marginal benefit outweighs its marginal cost. Posner's position is more tempered but similar.

The logic of such an hypothesis seems questionable. It appears to stem from an erroneous translation of the axiom of individual rationality to social domains. Individuals choose in the marketplace, they choose at the dining table, and in Chinese restaurants; but they do not generally choose institutions and customs. These latter usually evolve and are the outcome of a multitude of individual choices scattered over large tracts of time. Hence, unless one is committed to a "conspiracy theory" of institutions and customs, or a tautological view of what constitutes optimality, there is no obvious reason why one should treat the institutions that exist as the optimal ones.[14]

Despite this rejection of such an extreme functionalist view of legal and social insitutions, it seems possible to argue in favour of what may be labelled a minimal functionalist position. This emerges from viewing institutions as outcomes of evolutionary processes: Let us assume that each social unit or community has a set of customs and these get transmitted from one generation to another. Now if a set of customs is so detrimental to economic efficiency as to cause increasing impoverishment of the community, then it is obvious that such customs will not be observed in societies which have survived over

long periods of time. In other words, the sheer fact of a society's stagnancy ensures that its customs are functional above a certain cut-off point.

This approach can give us some limited mileage in understanding the non-existence of certain social or legal institutions. For instance, Posner (1981, p. 182) has noted that there are some interesting exceptions to the fact that in most primitive societies the right to a particular good belongs to the person who first gets possession of it: "Where investment is feasible in primitive society — the setting of traps is an example — it is often protected by the grant of a non-possessory property right. The man who sets a trap is entitled to the trapped animal even if someone else finds it in the trap and thus 'possesses' it first". The position being taken here is that instead of explaining such a right (i.e., the trap-setter's right) in terms of some social cost-benefit criterion (which is anyway likely to end up being a tautological exercise), it is more convincing to provide an evolutionary explanation. Without exact empirical parameters it is impossible to provide a full answer but the following reasoning has at least some a priori appeal. Consider a hunter-gatherer economy where the trap-setter does not have a right to the trapped animal. In such an economy people would soon cease to set traps. Their productivity would be low and it is very possible that such a society would not survive too many generations. Hence the societies we observe do grant the trap-setter the right to the trapped animal; but this is not the consequence of some social effort at welfare-maximization. This minimal-functionalist view maintains that the customs which characterize a society and its legal and other institutions cannot be too detrimental to economic functioning, but it does not go to the extreme of implying optimality.

VIII CONCLUSIONS

The structure of property rights has always played a major role in impeding or stimulating innovation and the adoption of new technology. But it is easy to misunderstand its exact role. It does not thwart

innovation because it gives no security of tenure to tenants or because it gives too much security – the two most popular explanations. Innovation is impeded because the law or custom circumscribes the rights of both tenants and landlords in a particular way. As argued in the previous section, there is no reason why legal institutions will automatically be the ones most congenial to economic efficiency. In this case, the legal institutions rule out free contracting between the landlord and his tenant. This leads to externalities which make it possible that no agent (neither landlord nor tenant) will want to adopt innovations. Further, if there are many tenants of different types and the landlord cannot distinguish between them, then an adverse-selection argument ensures that innovations may not be acceptable even on a cost-sharing basis; and there may be under-adoption of new technology. This result, it was shown, does not depend on the absolute levels of quit-probabilities of tenants. A society which is relatively immobile, that is, the quit-probabilities are small could have the same under-adoption of technology as long as the differentials in quit-probabilities are the same.

NOTES

1. This problem has received a large amount of attention from the time
    of Adam Smith to recent times. Recent writings include Epstein
    (1967), Bhaduri (1973, 1983), Griffin (1974), Newbery (1975), Ghose
    and Saith (1976), Bardhan (1984, especially Chapter 8), and
    Braverman and Stiglitz (1986).

2. Bardhan in his recent book has an interesting section (Chapter 8) on
    tenurial insecurity and investment, but his approach is very
    different from mine. He develops the idea that an increased threat
    of eviction could make the sharecropper more efficient in the
    immediate context but less willing to invest in long-run
    improvements of land. His is a principal-agent model which presumes
    that it is only the tenant who may invest in land improvement, which
    is precisely the assumption that this paper tries to do without.

3. See Kumar (1983) for a discussion of the concept of land ownership
    in the context of a less-developed economy.

4. An exception to this is Section 21 of the Delhi Rent Control Act of
    1958 (DRCA, 1958) which, under special circumstances, recognizes
    short-term leases agreed upon by a landlord and his tenant and makes
    it possible for a landlord to appeal to the government if a tenant
    tries to continue occupancy after the lease has run out. This is,
    however, very much an exception. There is much less scope for such
    short-term leases elsewhere in the country and also in the case of
    Delhi, barring this minor exception, the sections of DRCA (1958)
    read very much like the axioms of a theory of non-maintenance of
    houses (which is the urban analogue of non-innovation on rural
    land).

5. For an interesting attempt at explaining stagnation via customs, see
    Epstein (1967).

6. As Johnson (1972, 265) noted, "If within the land tenure system the cost-reward structure internalizes the benefits and costs, each user of land is motivated to use land in space and time so as to yield the maximum wealth from the land". In this paper we try to illustrate the case of certain legal institutions which thwart such an internalization of benefits.

7. Breman (1985), in an absorbing study of migration in western India shows the great importance of short-distance migration among the rural poor. Though Breman is critical of the economist's approach to migration, I believe the conflict appears larger because of linguistic impediments to communication between anthropologists and economists.

8. It may be possible to think of alternative contractual arrangements which would internalize the externalities and thereby make the innovation feasible. But what I am arguing is precisely that alternative contractual arrangements may not be acceptable to both parties in the absence of a law that recognises such contracts. This problem is discussed in Section VI.

9. In Basu (1987) I try to show that it plays an important role in understanding credit markets and interlinkage in rural economies.

10. In keeping with the model in Section IV, we may assume that if a tenant quits it is to take up a better job. The amount he earns in such an eventuality need not however enter our calculation since (3) implies this will be the same whether the innovation is undertaken or not.

11. At first sight it may appear that a simple credit arrangement (a loan from the landlord to the tenant) could also work. Apart from the fact that with default risks and other imperfections (I have discussed these elsewhere: Basu 1984) the rural credit market in less developed countries happens to be very ill-formed, it is also

true that once uncertainty is introduced, a credit arrangement cannot always achieve what an optimal contract can. Thus, the assuming away of credit markets from this model simply amounts to ruling out unnecessary complications.

12. See Dalton (1962). Having raised the questions (pp. 360-61): "What accounts for the marked difference in receptivity to economic and technological change among primitive societies? Why do some adopt Western institutions and techniques with ease and alacrity while others resist the changes necessary to generate growth?", Dalton goes on to search for the answer in "social organizations" and other institutions.

13. See Field (1981) and Basu (1986) for critiques different from the one that follows.

14. A similar position is taken by Weitzman (1984, p. 45-6) and Sen (1985). See, also, Basu, Jones and Schlicht, 1987.

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