Land Acquisition for Industrialization and Compensation of Displaced Farmers *

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Abstract: This paper addresses the question of how farmers displaced by acquisition of agricultural land for the purpose of industrialization ought to be compensated. Prior to acquisition, the farmers are leasing in land from a landlord, either a private owner or a local government. We identify three sets of incentive effects: the decision of the landlord to sell the land *ex post* to an industrial developer, and *ex ante* incentives of tenants and landlord to make specific investments in the agricultural quality of the land. Our main result is that under a broad class of circumstances, independent of equity considerations, efficiency considerations alone require farmers be over-compensated for their loss of agricultural income in the event of conversion.

1 Introduction

A major problem of contemporary development policy concerns compensation paid to those whose traditional livelihoods are uprooted by modern industrial projects. This involves both equity and efficiency considerations.

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In the absence of a welfare state those who are rendered unemployed by economic change are left at the mercy of market forces. The political and social fallout of this is a major cost of undertaking industrialization, a point that is often ignored in standard economic discussions about the costs and benefits of industrialization. Also, in the absence of a well defined compensation policy, those who fear displacement due to the process of industrial development, will tend to under-invest in the assets (e.g., land) which will affect the productivity of these assets in their existing use, as well as the willingness of the owners to convert them to alternative uses. In a world without frictions, complete contracts will take care of investment incentives, making sure that losers are compensated adequately by the gainers, and industrialization will occur only when the net social benefits exceed the net social costs. Our point of departure is to model explicitly frictions that typically characterize agricultural production, including problems of incentives and commitment, as well as departures from the assumption of transferable utility.

These problems have surfaced quite prominently all over the world in the past two decades, and in particular, in rapidly industrializing countries such as China and India. The transition to industrialization in these countries have been marked by conversion of agricultural land into land earmarked for industrial projects and urban real estate development. The process has been facilitated by local or regional governments anxious to raise the rate of growth in their jurisdictions, which generate large spillover effects and/or raise government revenues. At the same time, farmers cultivating these lands and workers employed by these farmers lose their livelihoods. The compensations paid to those displaced has been criticized as being inadequate. The process of determining and implementing these compensations have been described as arbitrary, *ad hoc* and lacking transparency. There have also been complaints of the lack of any rights or participation of those displaced in the process of transition.

These problems of compensation have created widespread social and political tensions. For instance, Cao, Feng and Tao (2008) report that in the first nine months of 2006, China reported a total of 17,900 cases of "massive rural incidents", in which a total of 385,000 farmers protested against the government. They go on to state that:

> "..there are currently over 40 million dispossessed farmers due to urban expansion and transportation networking and 70% of the complaints lodged from farmers in the past 5 years are related to rural land requisition in urbanization." (ibid, pp. 21-22)

Likewise in the eastern state of West Bengal in India, farmers were displaced by a motor car project started in 2007 for which land had been compulsorily acquired by the state government. A significant proportion of these protested that the compensation paid to them was inadequate. These protests were orchestrated by the principal opposition party to the party controlling the state government. The resulting tension and confrontations eventually led to the industrial group in question moving its factory to a different state in India in 2008, and eventually contributed to the incumbent government being voted out of power in 2011. Despite agreement between most parties that the land ought to be converted to industrial use, the problem of inadequacy of compensation caused the process of conversion to be reversed.

These events raise important questions regarding economic principles that should guide the design and implementation of compensation for agents displaced by industrial development projects. According to most legal frameworks, property owners do not require the permission of their current tenants or workers in order to sell the property. Nor are they required to compensate them in the event that the tenant gets evicted or the workers lose their jobs. Ownership rights include both freedom to decide how the property is to be used as well as over the sale of the property. Yet the preceding events in China and India raise the question whether tenants or workers employed by landowners should be legally entitled to some compensation if the owner were to sell the property. And if so, what principles should guide the design of such compensation.

The purpose of this paper is to initiate a theoretical analysis of compensation arrangements for incentives of concerned parties to invest in productivity-enhancing investments or actions. We examine contexts with limited scope for transferability of utility, owing to limited liability and wealth of agents undertaking productive investments, which is relevant to poor farmers in developing countries as well as most firm employees. Like most of the existing literature, we focus on implications for efficiency, as evaluated by a utilitarian social welfare function which neglects the issue of distributive equity. In particular, we examine whether there is an efficiency argument for restricting the rights of owners over the sale of assets in the sense of mandating compensation of displaced tenants. If so, inclusion of considerations of distributive justice would further strengthen the argument.

We consider a simple model with a set of plots of agricultural land owned by a landlord (or local government which is the *de facto* owner), which are leased to tenant farmers. The landlord and tenants make specific noncontractible investments in their respective plots. The law stipulates the share of the agricultural produce that must be given to tenants, as well as lump-sum compensations they are entitled to if they were to be evicted as a result of sale of the land. Opportunities for sale to an external industrialist arise stochastically, and the landlord makes this decision after specific investments have been made in agricultural improvement. Tenants are assumed to have limited liability and limited wealth, and there is uncertainty in agricultural harvests, and so, fixed rent contracts are not attractive to the landlord even though everyone is assumed to be risk neutral.[1] The question we analyze concerns the effects of varying the compensation paid to the tenant in the event of a sale. We consider three channels of potential impact: *ex ante* investments of the two parties respectively, and the decision concerning conversion.

In the absence of specific investments, the only allocative role of property rights concerns their implications for decisions for whether or not the property will be sold . If the decision rests with the landlord, standard economic analysis yields a straightforward answer to the question of compensation. Optimal resource allocation necessitates paying compensation to the tenant so that the landlord correctly internalizes the cost imposed on the latter as a result of the property sale. This will be traded off against the various benefits that will accrue to the landlord or the industrialist. If the rental market for property operates without distortion, the current rent captures the value to the tenant of leasing the asset. Since the landlord earns this rent which will be foregone upon selling the property, vesting the sole decision right over the sale to the landlord results in an efficient outcome. The argument is further strengthened if the landlord makes *ex ante* investments in the construction and upkeep of the property. Retaining full rights over sale will generate the correct (i.e., first-best) incentives to the landlord for making such investments.

However, in the presence of distortions in the rental market, the tenant may be earning a surplus (due to limited liability or a legally stipulated minimum crop share). In this case, vesting sole decision rights with the landlord concerning sale of the asset will generate socially excessive incentives to sell to third parties when the opportunity arises. This is because the landlord will neglect the effect of the sale on the loss of surplus by the tenants. Moreover, we show that if tenants are under-compensated in the event of conversion, both the landlord and the tenants underinvest with respect to the efficient levels of investment. Raising the level of compensation for the tenants then allows for efficiency improvements on all three fronts simultane-

[1] As in Mookherjee (1997), and Banerjee, Gertler and Ghatak (2002).

ously. It curbs the landlord's socially excessive inclination to sell the land, thereby lessening the over-conversion distortion. It raises the probability that the land will remain in agricultural use, which will in turn increase the investments made by landlord and the tenants. Hence efficiency considerations via investment incentives as well as conversion decisions dictate that tenants be over-compensated. We show that this result holds under fairly general conditions of technology and preferences, provided the landlord can appropriate all the social surplus resulting from conversion of the property to industrial use (e.g., using competitive bidding among potential industrial users). The result need not hold as generally if this condition is not met, but it will hold as long as landlord's own role in investing in land improvement is negligible compared to the tenant's role.

This paper adds to the existing theoretical literature on property rights by incorporating an important dimension of these rights that has not been analyzed, namely, the right of an owner to sell his property at will. Most of the existing literature has focused almost exclusively on *use rights* rather than *exchange rights.* This includes the literature in development economics on property rights (Besley (1995), and Besley and Ghatak (2009)) as well as the incentive effects of sharecropping tenancy and its regulation in a context of complete contracts subject to moral hazard and limited liability (see, for example, Singh (1989), Mookherjee (1997), and Banerjee, Gertler and Ghatak (2002)). This also includes the literature in organizational economics, on incomplete contracts and the nature of the firm following Grossman and Hart (1986), Hart and Moore (1990), and Edlin and Reichelstein (1996).[2]

We extend the models used in the tenancy literature mentioned above to investigate issues concerning regulation of exchange-rights. In particular, we consider the case where both landlord and tenants invest in specific assets, and there is a problem of moral hazard in teams generating under-investment. Empirical evidence in the context of Indian agriculture for the importance of tenant's incentives has been provided by Shaban (1987), Banerjee, Gertler and Ghatak (2002), and Bardhan and Mookherjee (2011).[3]

[2]See Segal and Whinston (2010) for a review of this literature. While both these literatures do not focus very much on exchange rights, the organizational economics literature, in contrast to the development economics literature, also tends to assume away the problem of borrowing constraints, which may cause additional agency problems by preventing individuals from owning an asset even when it is efficient for them to do so (e.g., under tenancy).

[3]The latter two papers study the effect of a sharecropping regulation program in West Bengal which would be expected to lower the landlord's incentive and raise the tenant's incentives to raise agricultural productivity. They both find a net increase in agricul-

Section 2 introduces the model. Section 3 presents the main results, while Section 4 explores extensions of the basic model. Finally, Section 5 concludes.

2 Model

2.1 The Environment

There is a landlord L who owns n identical plots and leases each of them to a tenant. The yield or quality of any given plot equals $Ap(x, y)$ where A is positive and p depends on non-negative investments x and y made by the landlord and the tenant. All tenants have identical preferences and costs; we shall focus on symmetric outcomes where they behave identically, and the landlord invests the same amount in every plot. The function p is assumed to be strictly increasing, strictly concave, twice-differentiable, and exhibiting complementarity between x and y: $p_{xy} \geq 0$. It is normalized so as to lie between 0 and 1, and can be interpreted as a probability of a successful harvest of value A. We shall assume an interior probability of a successful harvest, irrespective of investments: $0 < p(x, y) < 1$ for all non-negative x, y. In particular, there is some likelihood of a successful harvest even if there is no investment: $p(0, 0) > 0$ and likewise, of a crop failure even if investments are chosen at the highest possible levels. This ensures that the level of the investments cannot be perfectly inferred by a third-party from any value of output, so that the agency problem has bite.

The tenant incurs cost $c_T(y)$ while the landlord's costs equal $c_L(nx)$, where c_T, c_L are both strictly increasing, strictly convex, and twice-differentiable functions. We shall focus on interior equilibria; all equilibria will be interior if costs and marginal costs are zero at zero investment, since p_x, p_y are strictly positive. However this assumption is not required for the results of the paper to be valid.

After investments have been made, the landlord observes the value of p or equivalently the underlying investments x, y which are assumed to be observable but non-verifiable.[4] Then there is a random outside option available to the landlord to sell all the n plots together and earn v per plot, where

tural productivity as a result of the reform, indicating that the enhancement of tenant's incentives outweighed the reduction in the landlord's incentive.

[4]In the existing literature on tenancy, the usual assumption is output is verifiable but effort or investments are not observable. We make this assumption because in our model the landlord decides on whether to sell the land after investments have been made but before output is realized. In the alternative case where the landlord cannot observe p before

$v \geq 0$ is drawn according to a density f and a CDF F. The density function is positive and continuously differentiable everywhere on its support.

The landlord does not have the option to sell some of the plots and not the others: either all or none must be sold, because the competing use of the land entails an indivisibility (i.e., a factory is to be built which requires a minimum area). For most part we shall assume that the distribution of v is exogenously given. As we explain in Section 4, this requires the assumption that the landlord can capture all of the surplus from the alternative use of the land. We explain there how the results get modified if this assumption does not hold.

If the landlord does not sell, the farm yields are shared between landlord and tenant in fixed proportions $1 - s$ and s stipulated by rental regulations. And if the landlord does sell, he is required by law to compensate each farmer by a lumpsum amount c. In particular, it is not a function of the quality of the plot (because this is not verifiable by third parties). A law which required the compensation to be some fraction of the price at which the land is sold would also have difficulty in getting enforced, as it would invite collusion between the landlord and the third party by understating the price, accompanied by hidden side payments. What is publicly verifiable instead is that ownership of the land has been transferred to a third party, whence the law mandates a lump-sum compensation to each displaced tenant.

Apart from c, the tenant's share s is also stipulated by the law (e.g., as is the case in West Bengal under Operation Barga), or in the form of property taxes that tenants are stipulated to pay to local governments in the Chinese context. This nevertheless leaves open the question whether the landlords would voluntarily offer the tenants a larger share than is mandated by the law. Given the lack of contractibility of the tenant's investment, this may help induce the tenant to invest more which raises the value of the land. Might this be in the interest of the landlord?

One context where the question is not pertinent is when the landlord cannot commit to honor promises to give tenants a large share than legally mandated: *ex post* the landlord would have an incentive to renege on this promise. Even if they could commit, we provide conditions in a later section under which the landlord would not want to offer more than the legally mandated share.[5]

deciding to sell, the same results will obtain. The arguments would be even simpler, since tenants will not have any incentive to manipulate the landlord's sale decision through their investment, and assumption 1 below on the number of tenants will no longer be needed.

[5]The question of what values of s and c might voluntarily choose, and the welfare effects of regulating these, is considered in a companion paper (Ghatak and Mookherjee

An additional assumption in this model is that there are no other financial transfers between landlords and tenants, who are both risk-neutral. In other words, this is a standard model of moral hazard with limited liability. There is no scope for a fixed rent, which is paid irrespective of the harvest from the land. One interpretation is that if retained in agriculture, the plots will either return A (a 'success') or nothing (a 'failure'), the tenants have no assets, are subject to limited liability, have zero outside options and no bargaining power vis-a-vis the landlord. Then it is not possible for transfers to tenants to be negative, and the landlord will have no incentive to pay positive transfers to any tenant in the event of a failure. The landlord-share $1-s$ can then be interpreted as the ratio of the transfer paid in the successful state to the value of the harvest realized.

Finally we impose an assumption concerning n, the number of tenants involved. We are interested in contexts where n is 'large' enough that any single tenant's investment decision has a negligible effect on the landlord's conversion decision. Specifically:

$$n > \frac{1-s}{s}[1 + \{sp(0,0)A - \bar{c}\}M] \tag{1}$$

where

$$M \equiv \sup_{v \in [(1-s)p(0,0)A, \bar{c}+(1-s)A]} \{\frac{-f'(v)}{f(v)}\}$$

and $\bar{c}$ denotes an upper bound to the compensation to be paid to the tenant. Our main focus will be on situations where the tenant is under-compensated, i.e., $c < spA < sA$, in which case $\bar{c}$ equals sA. Otherwise a natural upper bound to compensation would be A, the maximum value of the land in agriculture. Condition (1) imposes a lower bound to n which involves the rate of change of the density over the outside opportunities v over the relevant ranges of compensation.

A special case of this model is when p is linear:

$$p = \alpha x + \beta y + \gamma$$

with α, β, γ all positive; the investment costs are quadratic:

$$c_T(y) = \frac{y^2}{2}, c_L(X) = \frac{X^2}{2}$$

where X denotes nx, and investments x, y are constrained to be less than one. Moreover, the outside option v has a uniform distribution over the

(2011)).

range $[0, \frac{1}{f}]$ with a constant density f. In this case the following restrictions are imposed:

$$\alpha + \beta + \gamma < 1, A(\alpha + \beta) < 1$$

to ensure interior solutions, and

$$A < \frac{1}{2f}$$

which ensures that the expected productivity of the land in industry exceeds that in agriculture. We will refer to this case as the linear-quadratic-uniform (LQU) case.

3 Analysis and Results

We now return to the general model, and will occasionally refer to the LQU case.

3.1 The First Best

As a benchmark we characterize the first-best. Here a hypothetical planner selects investments x, y and makes the conversion decision in order to maximize the sum of expected payoffs of landlord and tenants. In this setting the land will be converted if and only if its value in industry exceeds its value in agriculture, i.e., if $v > pA$. Let $P^* \equiv \int_{pA}^{\infty} f(v)dv$ denote the probability of the land being converted under the first-best. In this case, expected social surplus per plot equals:

$$W(x, y) = pA[1 - P^*] + \int_{pA}^{\infty} vf(v)dv - \frac{1}{n}c_L(nx) - c_T(y).$$

In general, there are two effects of increasing x or y: the effect on agricultural productivity conditional on land not being converted and the effect on the probability of land being converted, with higher investments lowering this probability.

The first-order conditions are

$$\frac{\partial W(x,y)}{\partial x} = p_x A[1 - P^*] - (pA - pA)\frac{\partial P^*}{\partial x} - \frac{1}{n}c_L'(nx) = 0 \quad (2)$$

$$\frac{\partial W(x,y)}{\partial y} = p_y A[1 - P^*] - (pA - pA)\frac{\partial P^*}{\partial y} - c_T'(y) = 0. \quad (3)$$

As we can see, the second term drops out for both expressions. That is, in the choice of x and y the marginal effect on the probability of conversion is ignored since the conversion decision is taken optimally (i.e., the decision-maker is indifferent between converting and not converting at the margin).

$$\frac{\partial W(x,y)}{\partial x} = p_x A[1-P^*] - \frac{1}{n}c'_L(nx) = 0 \tag{4}$$

$$\frac{\partial W(x,y)}{\partial y} = p_y A[1-P^*] - c'_T(y) = 0. \tag{5}$$

These conditions are intuitive: the optimal level of investments sets the expected marginal return, which is the probability of land staying in agriculture times the marginal increase in expected agricultural productivity, to marginal cost.

3.2 Tenant Incentives

We now turn to the second-best situation, where tenants and landlord behave to maximize their respective payoffs and select their investments independently, with the landlord subsequently deciding whether to sell the plots after observing the realization of v. At this stage, the landlord observes the quality $p_i = p(x_i, y_i)$ of each plot $i = 1, \ldots, n$, and will decide to sell if

$$v > c + (1-s)A\frac{1}{n}\sum_{i=1}^{n} p_i.$$

We shall be focusing on symmetric equilibria, where x_i and y_i are independent of i. Nevertheless to check whether it is an equilibrium, we need to check that unilateral deviations are unprofitable.

Let $\hat{P}(y_i; x, y)$ denote $1 - F(c + (1-s)A\{\frac{1}{n}p(x, y_i) + (1-\frac{1}{n})p(x, y)\})$, the probability that the land will be converted when a tenant selects an investment y_i and expects all other tenants to select y and the landlord to select x. His expected payoff is then

$$U_T(y_i; x, y) = sAp(x, y_i)[1 - \hat{P}(y_i; x, y)] + c\hat{P}(y_i; x, y) - c_T(y_i). \tag{6}$$

The first-order condition for the tenant to optimally choose $y_i = y$ is then (with $P(x, y)$ denoting $\hat{P}(y; x, y)$):

$$[sA(1-P) + (spA - c)\frac{1}{n}Af(1-s)]p_y = c'_T(y) \tag{7}$$

where P and p are evaluated at x, y and f at $c+(1-s)pA$. The second-order condition is

$$c''_T(y) \geq \Delta_y \tag{8}$$

where $\Delta_y \equiv \left(1+\frac{1}{n}\right) s{p_y}^2 A^2(1-s)f + (spA-c)\frac{A^2(1-s)^2}{n} f' p_y^2 + [sA(1-P) + (spA-c)\frac{1}{n}(1-s)Af]p_{yy}$. We shall focus attention on the generic case where this second-order condition holds strictly, in order to carry out local comparative statics: in the LQU case this can be verified to always hold strictly.[6]

Differentiating the first-order condition (7) with respect to x, we obtain the slope of the tenant's reaction function:

$$y'(x) = \frac{\begin{array}{c}\left(1+\frac{1}{n}\right) sp_x p_y (1-s)A^2 f + (spA-c)\frac{A^2(1-s)^2}{n} f' p_x p_y \\ +\{sA(1-P) + (spA-c)\frac{1}{n}(1-s)Af\}p_{yx}\end{array}}{c_T'' - \Delta_y}. \qquad (9)$$

Increasing investment by the landlord affects investment incentives in the following ways. The first and third terms in the numerator of the right-hand-side of (9) represent the effect of a rise in x on the marginal return from agriculture to the tenant's investment. Under the assumption of technical complementarity between the tenant's and landlord's investments, and that the tenant is under-compensated ($spA - c > 0$), both these terms are positive. A higher investment by the landlord reduces the likelihood of the land being converted, raising the tenant's incentive to invest. This strategic complementarity is augmented by the technical complementarity between their respective investments.

The middle term of the numerator of the right-hand-side of (9) represents the change in the tenant's incentive to manipulate the probability of conversion of the land, as a result of higher investment by the landlord. The sign of this depends on the slope of the density at the initial point, which can be either positive or negative. However, with n large enough (as represented by our assumption (1)) this term will be dominated by the sum of the first and the third terms. Hence we obtain

Lemma 1 *If tenants are under-compensated ($spA - c > 0$), each tenant's reaction function is upward sloping.*

3.3 Landlord Incentives

The landlord's expected payoff per plot is

$$U_L(x,y) = (1-s)pA[1-P] + \int_{c+(1-s)pA}^{\infty} (v-c)dF(v) - \frac{1}{n}c_L(nx) \qquad (10)$$

[6] It reduces to the condition $\frac{2}{n}s\beta^2 A^2(1-s)f < 1$, which holds since $2s(1-s) \leq \frac{1}{2}, Af < 1, A\beta^2 < A\beta < 1$.

when choosing an investment of x in each plot and expecting each tenant to invest y. The first order condition for an equilibrium is

$$(1-s)p_x A(1-P) = \frac{1}{n}c_L'(nx) \tag{11}$$

and the second-order condition is

$$nc_L''(nx) \geq \Delta_x \tag{12}$$

where $\Delta_x \equiv (1-s)Ap_{xx}(1-P) + p_x^2(1-s)Af$. We assume this to hold strictly, as it does in the LQU case.[7]

The slope of the landlord's reaction function is

$$x'(y) = \frac{(1-s)^2 p_x p_y A^2 f + (1-s)p_{xy}A(1-P)}{nc_L'' - \Delta_x} \tag{13}$$

which is always seen to be positive. Since the landlord himself makes conversion decisions, there is no strategic investment motive akin to the tenant's which incorporates the indirect effect on the likelihood of sale. The other two motives are akin to the tenant's: apart from direct complementarity, higher investments by the tenants makes it less attractive for the landlord to sell the land, which in turn motivates the landlord to invest more.

Lemma 2 *The landlord's reaction function is upward sloping.*

3.4 Equilibrium

In general, existence of a pure strategy Nash equilibrium is difficult to ensure, as the possibility of sale of the land may induce the payoff functions to be non-concave. For instance, the marginal benefit of investing for the landlord is $(1-s)p_x AF(c+(1-s)Ap)$, which may be non-monotone as p_x is decreasing in x while p is increasing in x. Increasing investment is subject to diminishing returns, conditional on not selling the land. But it also raises the probability of the latter event.

In the LQU case, however, there is a unique Nash equilibrium which is locally stable and varies smoothly with the policy parameters c, s. This is because the slopes of the two reaction functions can be checked to be constant:

$$x'(y) = \frac{(1-s)^2\alpha\beta A^2 f}{n - \alpha^2 A^2(1-s)^2 f} \tag{14}$$

[7] It reduces to the condition $(1-s)^2\alpha^2A^2f < 1$, which holds since $Af < 1, A\alpha^2 < A\alpha < 1$.

which is smaller than 1 because $n \geq 1 > (1-s)^2\alpha AAf(\beta+\alpha)$. Moreover,

$$y'(x) = \frac{(1+\frac{1}{n})s\alpha\beta(1-s)A^2 f}{1-(1+\frac{1}{n})s\beta^2 A^2(1-s)f} \tag{15}$$

is smaller than one as $(1+\frac{1}{n})s(1-s)\beta Af(\alpha+\beta) \leq 2ss(1-s)\beta Af(\alpha+\beta) < 1$. Owing to the assumption of linearity of p in x and y, there is no technical complementarity between the agent and landlord's investments. Hence the slope of the tenant's reaction function does not depend on whether he is under or over-compensated: the complication in connection with Lemma 1 does not arise.

The best response to a zero investment by the other side is a positive investment by either side. So there is a unique Nash equilibrium in the LQU case. It can be explicitly solved:

$$x = \frac{m_0 + m_1 n_0 + (m_2 + m_1 n_2)c}{1 - m_1 n_1}, y = \frac{n_0 + n_1 m_0 + (n_2 + n_1 m_2)c}{1 - m_1 n_1} \tag{16}$$

where:

$$m_0 = \frac{(1-s)^2\alpha\gamma A^2 f}{1-(1-s)^2\alpha^2 A^2 f}, m_1 = \frac{(1-s)^2\alpha\beta A^2 f}{1-(1-s)^2\alpha^2 A^2 f}, m_2 = \frac{(1-s)\alpha Af}{1-(1-s)^2\alpha^2 A^2 f}$$

and

$$n_0 = (1+\frac{1}{n})s(1-s)\beta\gamma A^2 f - (1+\frac{1}{n})s(1-s)\beta^2 A^2 f,$$

$$n_1 = \frac{(1+\frac{1}{n})s(1-s)\alpha\beta A^2 f}{1-(1+\frac{1}{n})s(1-s)\beta^2 A^2 f}, n_2 = \frac{\beta Af\{s(1+\frac{1}{n}) - \frac{1}{n}\}}{1-(1+\frac{1}{n})s(1-s)\beta^2 A^2 f}.$$

In what follows for the general case, we shall focus on the properties of any locally stable Nash equilibrium satisfying the condition that $y'(x)x'(y) < 1$, where the slopes of the reaction functions are given by (9) and (13).

3.5 Effects of Varying Compensation c

Differentiating the landlord's first order condition (11) with respect to c:

$$x_c = \frac{(1-s)p_x Af}{nc_L'' - \Delta_x} + x'(y)y_c. \tag{17}$$

The first term on the right-hand-side is the direct effect of higher compensation on the landlord's incentive to invest, while the second term is the reaction to the tenant's change in investment. Using the second-order condition, the direct effect is positive. In other words, the landlord's reaction function shifts 'outwards'.

To examine the effect on the tenants incentives, differentiate the first order condition (7) to obtain:

$$y_c = \frac{\{s - \frac{1}{n}[(1-s) - (spA - c)(1-s)\frac{f'}{f}]\}Afp_y}{c''_T - \Delta_y} + y'(x)x_c. \tag{18}$$

Condition (1) ensures that n is large enough that we can ignore the possibility of any single tenant's investment incentive being dominated by strategic manipulation of the probability of conversion. Hence the direct impact dominates, i.e., a rise in compensation lowers the probability of a sale, raising the tenant's incentive to invest. For a given investment by the landlord, then, the tenant's investment rises — the latter's reaction function also moves outwards.

The second term in the right-hand-side of (18) reflects the additional effect of the rise in c induced by the change in the landlord's investment. Using (17), we obtain the net effect:

$$y_c = [1-y'(x)x'(y)]^{-1}[y'(x)\frac{(1-s)p_xAf}{nc''_L - \Delta_x} + \frac{s - \frac{1}{n}[(1-s) - (spA - c)(1-s)\frac{f'}{f}]Afp_y}{c''_T - \Delta_y}].$$

Local stability implies $y'(x)x'(y) < 1$. By Lemma 1, $y'(x) > 0$ in an under-compensated equilibrium. Hence (1) implies $y_c > 0$. Since $x'(y) > 0$ by Lemma 2, it also follows that $x_c > 0$. We thus arrive at the following result.

Proposition 1 *Suppose tenants are under-compensated in a locally stable Nash equilibrium. Then an increase in c induces both tenants' and landlord's investments to rise.*

3.6 Welfare Implications

Consider the associated welfare implications of changing mandated compensation. To obtain some intuition here, it is helpful to distinguish between three effects we need to incorporate: on the tenant's investment, on the landlord's investment, and on the conversion decision. We have seen that the former two effects are positive, if we are in an equilibrium where the tenant is undercompensated. The resulting welfare effects will be positive, provided both tenant and landlord are under-investing to start with. This is indeed the case, as we now show.

Excluding investment costs, (gross) social welfare GW can be expressed as a function of p, the probability of conversion:

$$GW = ApF(c + (1 - s)pA) + \int_{c+(1-s)pA}^{\infty} vdF(v) \tag{19}$$

whereupon it follows that

$$\frac{\partial GW}{\partial p} = A[F + (1 - s)pAf] - f(1 - s)A[c + (1 - s)pA]. \tag{20}$$

The corresponding expression for the expected (gross) payoff of the tenant excluding investment costs is

$$GU_T = sApF(c + (1 - s)pA) + c[1 - F(c + (1 - s)pA)] \tag{21}$$

implying

$$\frac{\partial GU_T}{\partial p} = sA[F + (1 - s)pAf] - f(1 - s)Ac \tag{22}$$

which is seen to be below (20). The corresponding expected (gross) payoff of the landlord excluding investment costs

$$GU_L = (1 - s)ApF(c + (1 - s)pA) + \int_{c+(1-s)pA}^{\infty} vdF(v) \tag{23}$$

so that

$$\frac{\partial GU_L}{\partial p} = (1 - s)A[F + (1 - s)pAf] - f(1 - s)A[c + (1 - s)pA] \tag{24}$$

which is also below (20). Therefore:

Lemma 3 *Both landlord and tenants under-invest.*

This implies that if tenants and landlord invest more, utilitarian welfare will rise. What about the third effect, on the probability of conversion? Increasing c lowers the probability of conversion. If the tenants are under-compensated the landlord has a socially excessive incentive to convert, as he ignores the adverse consequence of conversion on the tenants' payoffs. Hence *all three distortions are ameliorated* upon raising the mandated compensation, if the tenants are under-compensated to start with. This is the main result of this paper:

Proposition 2 *Suppose tenants are under or fully-compensated in a locally stable Nash equilibrium. Then a small increase in the compensation will* *raise welfare, as well as the expected utility of each tenant. Hence at a welfare optimum tenants must be over-compensated.*

It may be helpful to verify the argument for this directly, instead of relying on the intuition provided above. Differentiating the tenant's payoff with respect to c, and using the first-order condition (7):

$$\frac{\partial U_T}{\partial c} = (spA - c)[1 + (1-s)A\{p_x x_c + (1 - \frac{1}{n})p_y y_c\}] + sA(1-P)p_x x_c + P. \quad (25)$$

The first term is the effect of raising c, both directly and through induced effects on investments by others (the landlord and other tenants), on the under-compensation effect. The former lower the probability of a sale, if Proposition 1 applies, which raises each tenant's utility if they are being under-compensated in the event of a sale. The second effect is the direct effect of changes in investments of the landlord on the expected return to the tenant from agriculture. The third term is the direct effect on expected compensation, which is proportional to the probability of sale. The induced effect on own investments can be ignored owing to the Envelope Theorem.

The corresponding effect on the landlord's per plot payoff is

$$\frac{\partial U_L}{\partial c} = (1-s)p_y y_c A(1-P) - P \quad (26)$$

as the Envelope Theorem implies that effects operating through own investments and the sale decision can be ignored, leaving only the effect of changes in tenants investments on the landlord's expected crop share and the marginal financial cost of the compensation, equal to the probability of sale.

Combining (25) and (26), the welfare (per plot) impact equals

$$\frac{\partial (U_L + U_T)}{\partial c} = (spA - c)[1 + (1-s)A\{p_x x_c + (1 - \frac{1}{n})p_y y_c\}] + [sp_x x_c + (1-s)p_y y_c]A(1-P) \quad (27)$$

i.e., the sum of the effect on expected under-compensation of the tenant, and the external effect of investments of each party on the other. Combining the effects of all of the previous results, Proposition 2 now obtains.

A key factor driving all of the above results is the fact that the tenant's participation constraint is not binding, i.e., he is getting a surplus that the landlord cannot extract. Otherwise, even if a legal share is stipulated at $\underline{s}$, to the extent the landlord can charge a fixed fee that reduces the tenant's payoff down the to reservation level, say, $\overline{u}$. If the landlord can commit *ex ante* to a compensation payable to the tenant in the event of conversion, then we will not get the over-conversion result. To see this, suppose the landlord can charge a fee t ex ante from the tenant although the incentive problems are as above. In that case, the landlord can set

$$t = U_T - \overline{u}$$

where U_T is the gross expected payoff of the tenant as defined above. Given this, the landlord's net expected payoff is

$$U_L + t = U_L + U_T - \overline{u}$$

where U_L is the gross expected payoff of the landlord as defined above. Since $U_L + U_T$ is expected social surplus, despite the incentive problems or the fact that $\underline{s}$ is legally stipulated, the landlord's choice of c will be the same as the second-best surplus maximizing one.

Note that whether or not the tenants are under-compensated is not a condition on the primitives of the model. It entails a comparison between the compensation and loss experienced by tenants in the event of a sale, and the latter depends on the expected yield from the land, which depends in turn on investments. What is the connection between the compensation level c fixed by policy, and the extent of undercompensation $spA - c$? Does raising compensation necessarily lower the the extent of undercompensation? This may not be the case if raising compensations raise the investment levels by a lot, so that the expected loss of tenants increases by more than the compensation amount.

We have been able to answer this question in the LQU case.

Proposition 3 *Consider the LQU case. Then there exists a level of compensation $c^* > 0$ such that the tenant is under, exactly and over-compensated whenever c is respectively smaller than, equal to, or bigger than c^*. Increasing c lowers the extent of under-compensation in this case.*

The proof of this involves detailed but straightforward calculations of the Nash equilibrium in the LQU case, which we omit.

We have not been able to obtain any definite result concerning the effect of c on the landlord's utility. This bears on the question whether the landlord would voluntarily offer some compensation to the tenant, and the need for regulating compensation. The landlord gains owing to increased investment of the tenant, but loses on account of the higher compensation in the event of a sale. From (26) the landlord is worse off as long as

$$(1 - s)p_y y_c A < \frac{P}{1 - P}. \tag{28}$$

In the LQU case, this condition is satisfied if f is sufficiently close to 0, as P tends to 1 while the left-hand-side of (28) tends to 0 (as y_c tends to 0). This is to be expected: the land will then be sold with probability approaching one, so the benefits of enhanced agricultural productivity are negligible while the financial cost of compensation is sizeable. We need to examine whether the opposite is true when f is large. Given the parameter restrictions in the LQU case where $A < \frac{1}{2f}$, we have an upper bound $\frac{1}{2A}$ to the value of f. What happens as f approaches this bound? The land will be sold with a probability of at least one half, implying a lower bound of 1 to the right-hand-side of (28). If the left-hand-side (which is a constant in the LQU case) is less than one, the landlord will always be worse off as c rises.

4 Extensions

Now we check the robustness of the main result to departures from various assumptions made so far.

4.1 Landlord's Choice of s

So far we took s as exogenous, determined by a legal mandate. Might the landlord prefer to offer a higher share to the tenants, in the interest of motivating them to invest more? One presumes that if the legal floor on s is high enough the landlord would not want to offer the tenants a higher share, owing to the fact that it lowers the share accruing to the landlord the effect of which would outweigh any benefit resulting from higher investments made by tenants. Moreover, in this setting with endogenous conversion of land, there is a reason why increasing the share of the tenants may reduce their investment incentive. For a higher share accruing to tenants would make the landlord more inclined to sell the land, which would reduce the security of the tenants. If the tenant's investment incentive actually declined as a result, the landlord would never benefit from offering a higher share.

We verify this latter reason alone will make the landlord unwilling to offer a higher share to tenants beyond some legally mandated value of s. It can be checked that a sufficient condition for the tenant's investment to decline with higher s as a result of the effect on the landlord's conversion incentive is that[8]

$$\frac{F}{f} < pA[s - \frac{1}{n}(1-s) + (spA - c)(1-s)\frac{1}{n}\frac{f'}{f}] + (spA - c)\frac{1}{n}. \qquad (29)$$

Specializing to the case of a uniform distribution where the density f is a constant and the support of the distribution is $[0, \frac{1}{f}]$, condition (29) reduces to

$$s > \frac{1}{2}[1 + \frac{c}{pA}] \qquad (30)$$

implying that the tenant invests less when s rises as long as

$$s > \frac{1}{2}[1 + \frac{c}{p(0,0)A}]. \qquad (31)$$

Hence if the legally mandated floor to s lies above the right-hand-side of (31), the landlord will not want to offer the tenants a higher share than mandated. This bound depends on c. If $c = 0$, note that this bound equals $\frac{1}{2}$. If the legally mandated compensation c is set at some constant fraction β of the loss spA suffered by the tenant, another bound on s is

$$s > \frac{1}{2-\beta}. \qquad (32)$$

4.2 Where Landlord Shares the Surplus from Conversion with the Industrialist

Now consider what happens when the landlord shares the surplus resulting from conversion with the industrialist, as a result of Nash bargaining. Then the condition for conversion to take place is unaffected, as the joint benefit to the landlord and the industrialist has to exceed the compensation c that has to be paid to the tenants, and the former is still $v - (1-s)pA$. This implies that the expressions for the tenants' payoff and incentives are unaffected. However, the landlord's benefit from conversion is now $\frac{v-c-(1-s)pA}{2}$, and his actual payoff conditional on conversion is $\frac{v-c+(1-s)pA}{2}$ instead of v. The main difference is that the landlord's payoff from conversion is itself a function of the compensation c as well as the landlord's payoff $(1-s)pA$ from the land in agriculture which matters as it forms the status quo for the bargaining with the industrialist. A higher value of the land in its agricultural use therefore

[8] This condition ensures that the tenants' reaction function shifts 'inwards'. Since the rise in s causes the landlord's reaction function to also shift inwards, the result follows from the complementarity between their investments.

provides a strategic advantage to the landlord by affecting his outside option in bargaining with prospective buyers. As we shall see below, this will increase the landlord's investment incentive considerably, which may induce over-investment by the landlord. This may in turn cause the welfare effects of increasing compensation to be reversed.

The landlord's expected payoff is now (where we normalize by setting $A = 1$):

$$U_L = (1-s)pF(c+(1-s)p) + \int_{c+(1-s)p}^{\infty} \frac{v - c + (1-s)p}{2} dF(v) - c_L(nx) \quad (33)$$

implying that

$$\frac{\partial GU_L}{\partial p} = (1-s)[F + (1-s)fp] + \frac{(1-F)(1-s)}{2} \quad (34)$$

where $GU_L \equiv U_L + c_L(nx)$ denotes the landlord's payoff gross of investment costs. Hence the landlord over-invests if (34) exceeds expression (20) for $\frac{\partial W}{\partial p}$, i.e.,

$$s[F + (1-s)fp] < f(1-s)[c + (1-s)p] + \frac{(1-F))(1-s)}{2}. \quad (35)$$

Now if we consider a sequence of distributions $F_m, m = 1, 2, 3..$ with the property that $F_m(c+(1-s)) \longrightarrow 0$, condition (35) will be satisfied for large enough m. Here the distribution over the industrial value v is such that the land is very unlikely to be retained in agriculture. Then the landlord will definitely over-invest. With the land almost sure to be converted to industrial use, investment in the land for agricultural purposes has almost no social value. Yet the landlord will continue to invest in order to boost his bargaining power *vis-a-vis* the industrialist. Indeed, for large n, the tenant's investment incentive will nearly vanish, as is evident from inspecting the first-order condition (7) for the tenant's investment.[9] And the social value of investment of either tenants or landlord will converge to 0. On the other hand, the limiting value of the landlord's investment is given by $\underline{x}$ which solves

$$\frac{(1-s)}{2} p_x(\underline{x}, 0) = \frac{1}{n} c_L'(n\underline{x}). \quad (36)$$

So for large enough m, the landlord over-invests, while the tenant's under-investment converges to 0. Moreover, the probability of conversion converges

[9]Note that $F_m(c + (1-s)) \longrightarrow 0$ also implies $f_m(v) \longrightarrow 0$ for all $v \in [0, c + (1-s)]$.

to 0. So from a welfare standpoint the dominant consideration is the over-investment of the landlord.

From (34) it is evident that an increase in c increases the landlord's investment incentive if

$$\frac{1}{2} > (1-s)\frac{-f'}{f} \tag{37}$$

which is satisfied in the case of a uniform distribution, or more generally if the density function f does not fall too fast. In such cases, increasing the tenant's compensation will encourage greater investment by the landlord, which will lower welfare if the landlord over-invests. Hence our previous result concerning socially desired levels of compensation is reversed.

Proposition 4 *Suppose the landlord and the industrialist share the surplus from conversion of land via Nash bargaining, there is a sequence of distributions $F_m, m = 1, 2, ..$ such that $F_m(c + (1-s)) \longrightarrow 0$ as $m \longrightarrow 0$, which satisfies condition (37) for all m. Then for m sufficiently large, increasing the mandated compensation c lowers welfare, and it is socially optimal to set the required compensation at* 0.

Note that it continues to be the case that the tenant under-invests, and increasing c raises the tenant's incentive to invest. So increasing c improves welfare from the standpoint of the tenant's incentives. But in the above result, the extent of underinvestment of the tenant goes to zero as m becomes large, so this becomes a second-order issue that is dominated by the first-order effect of raising c on the landlord's overinvestment.

One case, however, where our earlier result continues to apply is when the technology is such that the landlord has no role to play in investing in agricultural improvement, so only the tenant's investment incentives matter. So if we consider a technology where p is independent of x, our earlier result continues to apply as both the tenant's investment and the conversion effects continue to apply as before.

Proposition 5 *Suppose the landlord and the industrialist share the surplus from conversion of land via Nash bargaining, and there is no scope for the landlord to make any investments (p is independent of x, but strictly increasing and concave in y). Then if the tenant is under-compensated, welfare and the tenant's investment rise in c; hence at a welfare optimum the tenant must be over-compensated.*

We expect from this that our result would therefore continue to hold as long as the landlord's investment is of negligible importance compared to the tenant's.

5 Concluding Comments

In this paper we have provided an analysis of compensation policy for farmers displaced by the process of industrialization. The need for such a policy arises from contracting frictions which take the form of a two-sided moral hazard problem with limited liability for tenants. There are distortions associated with specific investments made by tenants and landlords that are made to improve agricultural productivity, with a general tendency towards under-investment. Moreover, the limited liability of tenants implies that they earn a surplus that is not extracted by the landlord in the form of a fixed rent. This in turn implies that the landlord has a socially excessive tendency to convert the land to industrial purposes, as his private profit calculus ignores the loss of rents suffered by tenants in the process. Mandating compensation to the tenant in the event of conversion affects three distortions: the landlord's incentive to convert the land, and the specific investments of the landlord and tenant. We provided conditions under which economic efficiency dictates the tenants be over-compensated, in the sense that the tenants would be better off in the event of conversion. Otherwise if the tenants were under-compensated, a small increase in the compensation policy would reduce the size of each of the three distortions: it would reduce the incentive of the landlord to convert, thus raising the probability of retaining the land for agricultural use, which would boost investment incentives of both landlords and tenants. To these arguments would be added considerations of equity and political stability, which would further increase the case for adequate compensation of displaced tenants.

Our analysis was based on a model which abstracted from a number of significant real-world issues. One is the possibility that industrialists are privately informed about the value of the land in industrial use.[10] However, the landlord would have an incentive to extract this information through competitive bidding. If full extraction is not possible, the landlord would have to share the surplus with the industrialists that purchase the land. In that case we expect the analysis of the previous section would continue to apply, and our main result would continue to be valid provided the landlord's own investment role is negligible. If this is not the case, the landlord may have a socially excessive incentive to invest in agricultural quality of the land in order to raise his reservation utility in bargaining with investors. Raising the compensation level would then improve the distortions associated with the decision to convert, and raise the tenant's investment incentive, at the

[10]See Ghatak and Ghosh (2011) for one approach to this problem.

cost of aggravating the distortion involved in the over-investment of the landlord. These distortions would have to be traded off against each other.

A major assumption is that the supply of land is fixed *ex ante*. In the context of agricultural land this assumption may be quite reasonable. It is less reasonable in the context of real estate or industrial property. In the latter contexts mandating compensation to tenants will be likely to reduce the *ex ante* profitability for landlords to invest in real estate or property in the first place, generating an additional distortion of the sort emphasized in the traditional literature on effects of rent control or minimum wage laws. In the context of land, this distortion is unlikely to be important.

Another issue we abstracted from is heterogeneity across farmers and plots. It is unlikely that judicial authorities will be able to measure the quality of each individual plot leased and calibrate compensations based on such valuations. It is more likely that some kind of average valuation of land in the area will be used to set a standard rate of compensation, whereupon some tenants will end up being under-compensated. We conjecture that our results will continue to extend with regard to the average rate of compensation, i.e., on average, displaced farmers ought to be over-compensated. Nevertheless, the exact details of such an extension need to be worked out. The model also abstracted from considerations of risk-aversion. We conjecture, however, that risk aversion of tenants will further strengthen the case for fully compensating them.

We assumed for most part that the share of the tenants and the compensations paid in the event of conversion were determined by policy mandates. This can be rationalized if landlords cannot commit to paying tenants *ex post* more than the legal mandate. However, reputational considerations may allow landlords to offer more than is legally mandated. We provided a condition (on the mandated share) which guarantees that the landlord would not wish to offer a larger share *ex ante* even if he could commit to it. Nevertheless a fuller analysis of this issue is needed; this issue is analyzed in detail in a companion paper (Ghatak and Mookherjee (2011)) for a special case of a two-point distribution for v.

Finally, it would be interesting to obtain empirical estimates of the extent of agricultural income loss experienced by displaced farmers in recent Chinese and Indian experiences, and assess the adequacy of the compensation that has been provided. We are currently engaged in such an exercise in the West Bengal context. This will help assess the extent of under-compensation that has taken place in practice, and therefore the extent to which further improvements in land acquisition policy are needed.

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