

# Evolution of Land Distribution in West Bengal 1967-2004: Role of Land Reform and Demographic Changes\*

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## Abstract

This paper examines the indirect effect of land reform and demographic changes on land inequality operating through induced household divisions and land market transactions. We develop an intra-household model of joint production where divisions, out-migration or land purchases arise to avoid inefficient free-riding arising from demographic growth. Land reform affects divisions and land transactions owing to induced effects on farm profitability and anticipation of future reforms. These predictions are successfully tested using household level data from West Bengal spanning 1967-2004, where we find that the quantitative effect of land reforms were dwarfed by demographic changes.

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# 1 Introduction

Land is the pre-eminent asset in rural sectors of developing countries, the primary determinant of livelihoods of the poor. Accordingly, there is a large literature on the role of land reform in altering the distribution of landownership, which affects productivity, inequality, poverty, local governance and social capital in rural areas of LDCs (e.g., Berry and Cline (1979), Binswanger, Deininger and Feder (1993), Besley and Burgess (2000), Banerjee *et al* (2001), Banerjee, Gertler and Ghatak (2002), Bardhan (2004), Besley and Ghatak (2010)). The bulk of existing literature on this topic has focused on effects of land reform on productivity resulting from changing size distribution of owner-cultivated farms, sharecropping tenancy distortions, access to credit, investment incentives or labor supply resulting from security of property rights.

However, the precise channels by which land reform may affect the distribution of landownership have not been closely examined. The usual presumption is that land redistribution programs result in a direct and mechanical replacement of large farms cultivated by large landowners using hired labor by small owner-cultivated farms relying on family labor. Tenancy regulations are presumed to result in increased empowerment of tenants, in the form of increased shares and security of tenure. Apart from imposing political and legal obstacles to this process, large landowners frequently attempt to circumvent land reforms by selling land, or subdividing properties amongst themselves. Land reforms may thereby give rise to pressures for household division and land market transactions, which could appreciably alter the distribution of landownership. These would tend to be missed by conventional measures of land reform focused on their direct effects.

For instance, announcement of a set of land reform legislations that are slowly implemented might result in relatively few instances of land actually redistributed by the program. Large landowners owning more lands than the legal ceiling could pre-empt the reforms by selling their land or splitting their households in order to sub-divide their properties. A tenancy reform could give rise to similar effects on the land distribution which would supplement its direct effect on tenanted plots. Additional effects on division or sale incentives would arise if the reforms affect the relative profitability of landholdings of various sizes, owing to induced effects on productivity or local wage rates.<sup>1</sup> Incorporating these indirect effects on household structure, land and labor markets is thus necessary to understand and measure the overall impact of land reforms.

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<sup>1</sup>For instance, productivity changes could arise owing to greater reliance on family labor in smaller owner-cultivated farms (Eswaran and Kotwal (1986)), changes in sharecropping distortions (Banerjee, Gertler and Ghatak (2002)), access to credit for land reform beneficiaries (de Soto (2000)) or effects on irrigation investments (Bardhan, Mookherjee and Neha Kumar (2012)). Wage rates could change as a result in changes in demand for hired labor from large landowners, and in the supply of wage labor by reform beneficiaries (Besley and Burgess (2000)) or increased flow of immigrants hoping to benefit from future reform implementations.

What makes this a challenging task is that the process of development simultaneously involves significant demographic and sociological changes that affect household structure. Traditional family structures in LDCs involving cohabitation and joint ownership of productive land by multiple nuclear units tend to give way to nuclear households as a result of desire for increasing economic independence and rising intra-household conflicts (Guirkingner and Platteau (2011, 2012)). This may be a response to increases in household size resulting from falling mortality rates. Economic growth and increased financial development reduce the need for members to stay in the same household in order to share risk or avail of household collective goods (Foster and Rosenzweig (2002)).

We develop a simple theory of household division and land transactions, based on a model of intra-household joint production among adult members. A sufficiently large growth in household size relative to land owned give rise to free-riding in the supply of effort on the household farm. This gives rise to incentives to subdivide the household, or for some members to out-migrate. Alternatively, it generates incentives for the household to buy land. The model characterizes stable distributions of household sizes and landownership, given the prevailing wage rate for hired workers, productivity of farms and transaction costs associated with land sales.

The model is used to derive comparative static effects on household division and land transactions of exogenous shocks to household size, farm productivity and wage rates. We utilize it to predict the effects of land reforms undertaken in the eastern Indian state of West Bengal during the last three decades of the 20th century, incorporating the institutional details of this specific reform experience. West Bengal is an appropriate context for the study, as it witnessed large changes in land distribution, high rates of household division and a large land reform program during the 1970s and 1980s compared to other Indian states. There were two principal programs: distribution of land titles to the landless, and registration and regulation of tenancy contracts. Earlier research on the West Bengal land reforms have shown evidence of significant increases in productivity of farms of all sizes for the tenancy registration program, insignificant productivity effects of the land distribution program, and absence of significant effects on wage rates for hired workers for either program (Bardhan and Mookherjee (2011)). On the basis of these results, our model predicts that the tenancy registration program would lower rates of household division and out-migration uniformly across disparate land-size classes. Incorporating additional effects on anticipated future reforms by large landowners, and reduced profitability of leasing out lands, it predicts division rates would drop by less for large landowning households. There would also be increased incentives for large landowners to sell land to small landowners. Owing to these reasons, land inequality and landlessness should fall: the indirect effect of the tenancy regulation program in West Bengal would thus be expected to reduce land inequality, apart from its direct effect on productivity.

The indirect effects of the land distribution program on the other hand are expected to be somewhat different. Part of the reason is the absence of any significant effects of this program

on farm productivity (for reasons explored in earlier work, such as poor quality and small size of plots distributed). Since the plots were distributed to those owning no or little land, it would generate incentives among landowning households to sub-divide so that some of them would be entitled to enter the beneficiary queue. Such motives are more likely amongst small landowning households, thereby generating increased landlessness. Large landowning households may also be motivated to sub-divide or sell land if stepped-up implementation of the program signals greater redistributive resolve of the government in future. This would tend to reduce land inequality. Hence the expected indirect effect of the land distribution program would depend on which of the two contrasting effects dominates.

The model also predicts the effects of demographic changes. Growth in household size would enhance the likelihood of household division, controlling for landownership. This would cause land inequality to fall if larger landowning families were subject to greater demographic growth. The effect through the land market would move inequality in the opposite direction, as households growing faster in size would be more likely to buy land.

These predictions are tested on data concerning changes in landholding and household demographics for a panel of rural West Bengal households. To identify the effect of reform on land inequality, one needs to observe variation in the amount of reform that is plausibly uncorrelated with other determinants of household division and land transactions. In this paper, our main specification exploits differences in the timing and extent of reforms across villages. A difference-in-differences design can then filter out common underlying trends and examine how these variations were associated with changes in division and land market transactions across households located in different villages.

The assumption underlying this identification strategy is that variations in timing and extent of land reform were uncorrelated with other time-varying village-specific factors that may influence household division and land transactions. Banerjee, Gertler and Ghatak (2002) use this difference-in-differences approach to examine the effect of the tenancy reforms on farm productivity, and argue that the variations in implementation rates of the tenancy registration program arose primarily owing to idiosyncratic administrative compulsions of the state government. Moreover, Bardhan and Mookherjee (2010) show that a determinant of reform was the extent of political competition among the two rival parties at higher (district, state and national) levels, interacted with lagged incumbency at the village level. This reflects greater incentives for elected officials to implement land reforms owing to re-election pressures in more contested elections. This allows us to examine robustness of the estimates when we use political competition at higher levels as an instrument for tenancy reform, interacted with lagged local incumbency patterns. Bardhan and Mookherjee (2011) use a similar approach to study the productivity effects of tenancy reform.

Our main empirical findings are as follows. Consistent with the theoretical predictions, the indirect effects of the tenancy program appear to have reduced land inequality. After controlling for household fixed effects, lagged household size and lagged land owned, higher implementation rates of the tenancy reform in the past three years in the village significantly

reduced rates of division of small landowning households, and raised division rates among large landowning households. It raised the likelihood of land purchases by small landowning households. The estimated effects of the land distribution program on the other hand are not robust with respect to the regression specification.

The estimated effects of the land reforms, however, turned out to be overshadowed quantitatively by the effects of demographic growth. As predicted, increases in (lagged) household size significantly raised the likelihood of division, controlling for lagged landownership. The effect of expanding household size by 1.3 members (the average effect of population growth during this period) was between four and twenty five times the effect of either land reform program. A reduced form regression of changes in village land inequality or landlessness between 1978 and 1998 on the extent of tenancy reforms implemented shows an insignificant overall effect. The overall effect of the land distribution program on land inequality and landlessness was negative and significant, but considerably smaller than its direct impact. The large growth in landlessness and land inequality in West Bengal is thus attributable principally to demographic factors, a process which was mildly but not significantly arrested by the land reforms.

Section 2 introduces the theoretical model. Section 3 explains the West Bengal land reforms and the household surveys used to construct the data. Section 4 provides some descriptive statistics concerning the major changes observed during this period. Section 5 presents the main empirical results. Section 6 describes relation to existing literature, while Section 7 concludes the paper.

## 2 Theory

In this section we develop a theory of household division and land market transactions, focusing on problems of free-riding within the household as different members work together on their jointly owned family farm. We abstract from potential conflicts of interest arising with regard to collective consumption goods. Our focus is also on purely economic incentives for division and market transactions. In subsequent sections we shall explain the impacts of anticipated redistributive policies of local governments.

A household is represented by a vector  $(n, L)$ , where  $n$  denotes the number of adults and  $L$  the amount of land owned jointly by these adults. Household members work together as a team on their collective farm. They have identical abilities and preferences. Individual effort cannot be monitored, resulting in a classic moral-hazard-in-teams problem. Collective income is shared equally among household members. If the household engages in cultivation, their collective income from the family farm is given by

$$Y = aL^{1-\alpha} \left( \sum_{i=1}^n l_i + h \right)^\alpha - w(1+s)h - F \quad (1)$$

where  $\alpha \in (0, 1)$  and  $a$  is a parameter representing crop price and agricultural productivity.  $l_i$  denotes the labor effort of member  $i$  of the household, while  $h$  is the extent of labor hired from the labor market at a wage rate of  $w$ . As in Eswaran and Kotwal (1986), hired workers have to be supervised, which raises the cost of hired workers by a fixed proportion  $s > 0$ .  $F > 0$  is a fixed cost of running a farm, representing costs of acquiring information about technology and prices, keeping accounts, obtaining water or electricity connections and engaging in market transactions.

Each household member has a unit endowment of time, and decides to allocate it between working on the household farm ( $l_i$ ) and working on a labor market at a fixed wage  $w$ . An individual member earns income  $\frac{Y}{n} + w(1 - l_i)$ . Household members may exhibit mutual altruism, assigning a weight of  $\lambda \in [0, 1]$  to the income of every other member in the household. Hence member  $i$ 's objective is to maximize

$$\frac{Y}{n} + w(1 - l_i) + \lambda \sum_{j \neq i} \left[ \frac{Y}{n} + w(1 - l_j) \right] \equiv [1 + (n - 1)\lambda] \frac{Y}{n} + w(1 - l_i) + \lambda \sum_{j \neq i} w(1 - l_j). \quad (2)$$

We assume that the extent of altruism is imperfect so that each member places a lower weight on the welfare of other members relative to his own:  $\lambda < 1$ . This is the source of free-riding among household members.

The sequence of decision making is as follows. At the first stage, all members will make a collective decision concerning whether to engage in cultivation, and the amount of labor  $h$  to be hired on the family farm. At the second stage, each member  $i$  will select his own effort  $l_i$  on the family farm noncooperatively. This reflects either lack of perfect mutual observability of effort, or inability to enter into enforceable binding agreements concerning their respective efforts. We shall focus on symmetric subgame perfect Nash equilibria of this game, wherein all household members will have the same preferences over  $h$  at the first stage.

Let  $\gamma \equiv [\frac{1}{n} + (1 - \frac{1}{n})\lambda] \in [\frac{1}{n}, 1)$ . At the second stage after  $h$  has been decided, a symmetric equilibrium will involve individual effort  $l^*(h)$  which maximizes

$$\gamma L^{1-\alpha} [h + (n - 1)l^*(h) + l]^\alpha + w(1 - l) \quad (3)$$

subject to  $l \in [0, 1]$ . There is a unique symmetric equilibrium

$$l^*(h) = \min \left\{ \frac{L}{n} \left[ \frac{\gamma \alpha a}{w} \right]^{\frac{1}{1-\alpha}} - \frac{h}{n}, 1 \right\} \quad (4)$$

generating payoff per member

$$\Pi(h) = [1 + (n - 1)\lambda] \pi(h) \quad (5)$$

where  $\pi(h)$  denotes per member income  $[\frac{1}{n} \{ a L^{1-\alpha} [h + n l^*(h)]^\alpha - w(1+s)h - F \} + w(1 - l^*(h))]$ . Anticipating this, members will agree at the first stage to choose  $h$  to maximize  $\pi(h)$ , and will decide to engage in cultivation if the resulting per member income is at least  $w$ .

In what follows we shall focus on situations where there is enough altruism within households, so that

$$\lambda > \frac{1}{1+s} \quad (6)$$

This assumption is relatively inessential as qualitatively similar results also obtain when it does not hold, though the detailed results differ in that case.<sup>2</sup> When (6) holds,  $(1+s)\gamma > 1$  irrespective of the value of  $n$ . We can then classify households into three types on the basis of their endowment of land relative to household members:

(a) *land-poor* where

$$\frac{L}{n} < \left[ \frac{w}{\gamma\alpha a} \right]^{\frac{1}{1-\alpha}} \quad (7)$$

(b) *medium-land* where

$$\left[ \frac{w}{\gamma\alpha a} \right]^{\frac{1}{1-\alpha}} \leq \frac{L}{n} \leq \left[ \frac{w(1+s)}{\alpha a} \right]^{\frac{1}{1-\alpha}} \quad (8)$$

(c) *land-rich* where

$$\frac{L}{n} > \left[ \frac{w(1+s)}{\alpha a} \right]^{\frac{1}{1-\alpha}} \quad (9)$$

The following Proposition describes the nature of the unique symmetric equilibrium.

**PROPOSITION 1.** *Assume that (6) holds.*

(i) *Conditional on deciding to cultivate, a symmetric equilibrium results in the following:*

(a) *For land-poor households:  $l^* = \frac{L}{n} \left[ \frac{\gamma\alpha a}{w} \right]^{\frac{1}{1-\alpha}} < 1$ ,  $h^* = 0$  and per member income of*

$$\pi_p \equiv \frac{1}{n} [La^{\frac{1}{1-\alpha}} w^{\frac{-\alpha}{1-\alpha}} \{(\gamma\alpha)^{\frac{\alpha}{1-\alpha}} - (\gamma\alpha)^{\frac{1}{1-\alpha}}\} - F] + w \quad (10)$$

(b) *For medium-land households:  $l^* = 1$ ,  $h^* = 0$  and each member earns*

$$\pi_m \equiv \frac{1}{n} [aL^{1-\alpha} n^\alpha - F] \quad (11)$$

(c) *For land-rich households:  $l^* = 1$ ,  $h^* = L \left[ \frac{a\alpha}{w(1+s)} \right]^{\frac{1}{1-\alpha}} - n$  and each member earns*

$$\pi_r \equiv \frac{1}{n} [La^{\frac{1}{1-\alpha}} \{w(1+s)\}^{\frac{-\alpha}{1-\alpha}} \{\alpha^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}}\} - F] + w(1+s) \quad (12)$$

(ii) *The household decides not to cultivate if the resulting income per member falls below  $w$ , i.e. for land-poor households if:*

$$L < L_p^* \equiv Fa^{\frac{-1}{1-\alpha}} w^{\frac{\alpha}{1-\alpha}} [(\gamma\alpha)^{\frac{\alpha}{1-\alpha}} - (\gamma\alpha)^{\frac{1}{1-\alpha}}]^{-1} \quad (13)$$

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<sup>2</sup>The main difference when (6) does not hold is that there may be two types of cultivating households rather than three: the medium-land type of household may not arise.

for medium-land households if:

$$L < L_m^* \equiv [(F + nw)a^{-1}n^{-\alpha}]^{\frac{1}{1-\alpha}}. \quad (14)$$

and land-rich households if:

$$L < L_r^* \equiv [F - nws]a^{\frac{-1}{1-\alpha}}[w(1+s)]^{\frac{\alpha}{1-\alpha}}[\alpha^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}}]^{-1} \quad (15)$$

(iii) There is free-riding (i.e., member incomes are not maximized) only in land-poor households.

**Proof of Proposition 1:** Given  $h$ , a symmetric equilibrium effort  $l^*(h)$  at the second stage must maximize  $\gamma a L^{1-\alpha}((n-1)l^* + l + h)^\alpha + w(1-l)$  with respect to choice of  $l \in [0, 1]$ . Hence  $l^*(h) = \min\{\frac{L}{n}\{\frac{\gamma\alpha a}{w}\}^{\frac{1}{1-\alpha}} - \frac{h}{n}, 1\}$ . This implies aggregate labor hours in the household farm  $l(h) \equiv nl^*(h) + h = \min\{L(\frac{\gamma\alpha a}{w})^{\frac{1}{1-\alpha}}, n + h\}$ .

The first-stage choice of  $h$  will then maximize  $aL^{1-\alpha}l(h)^\alpha - w(1+s)h$  subject to  $h \geq 0$ . Given the expression for  $l(h)$  above, it is evident that the optimal choice  $h^* > 0$  only if  $L(\frac{\gamma\alpha a}{w})^{\frac{1}{1-\alpha}} \geq n + h$ , which implies  $l^*(h) = 1$  and  $l(h) = n + h$ . Then  $h^* > 0$  if and only if condition (12) holds, i.e., the household is land-rich. In that case we also have  $l^* = 1$ .

If condition (12) does not hold, either (10) or (11) holds. We have  $h^* = 0$  for these households. Evidently the equilibrium member effort  $l^* = l^*(0) < 1$  if (10) holds, while  $l^* = l^*(0) = 1$  if (11) holds. The rest of Proposition 1 follows from routine computations. ■

Land-poor households have ‘surplus labor’: they divide time between working on the family farm and on the outside market. No workers are hired from the market. Owing to imperfect altruism, members spend too little time on the family farm. Income per member would be maximized if each member were to supply labor of  $\frac{L}{n}[\frac{\alpha a}{w}]^{\frac{1}{1-\alpha}}$  on their own farm, which is larger than what they actually supply (since  $\gamma < 1$ ). In households that are not land-poor, members work fulltime on the family farm and there is no free-riding: the equilibrium maximizes income per member. Medium-land households rely entirely on the labor of its members. Land-rich households encounter enough labor scarcity that it is worthwhile for them to hire workers from the market. These land-rich households constitute the employers on the labor market.

For households of any given type, they decide to operate a family farm only if they own a minimum amount of land, given by expressions  $L_p^*$ ,  $L_m^*$  and  $L_r^*$  for the three types respectively. A minimum landholding is necessary to ensure that the household earns enough from the farm to cover its fixed costs. Those owning less land would not operate a farm and rely entirely on supplying labor to other farms. The supply side of the labor market is constituted of such land-poor households.

The model could be closed with wage rates determined by the condition that the labor market clears. In what follows we shall abstract from the possibility of equilibrium wages that respond to village level shocks. We assume there is a sufficiently large mass of landless households in the village, that pin wages down to an exogenously fixed reservation wage for the landless. The justification for this is empirical: we do not see significant responses of wage rates to land reforms in West Bengal (Bardhan and Mookherjee (2011, Table 14)). And as we shall see below, there is a large and growing mass of landless households in these villages, supplemented by inflows of immigrants.

## 2.1 Household Division

We now discuss how the equilibrium described in Proposition 1 would be modified if households could sub-divide. To start with we abstract from the possibility of a land market; the next section will describe the consequences of introducing such a market.

A household is described by its size and landholding  $(n, L)$  which enables its members to earn an income of  $\Pi(n, L)$  from a household collective farm. This can be viewed as the short-run outcome. Over time, the household can experience change in a variety of ways. Some members may exit, or the household may divide into two smaller households.

Some members could quit while others remain in cultivation: call this *exit* or out-migration. An extreme case of this is when every member of the household decides to quit and go work full time on the labor market. This is essentially the counterpart of deciding to not cultivate a family farm at all. Call this a *shutdown*. Finally, the household could divide into two cultivating households, which we shall refer to as *division*.

More complicated changes may involve a combination of exit and division, or a division of the household into more than two households. We shall ignore this for the time being, as it can be shown it suffices to consider these three kinds of changes to describe stable household structures.

An important assumption we make is that two households cannot merge into a single large household. The incentive for a merger could arise from avoiding the duplication of the fixed costs of farming. This phenomenon is empirically very rare, possibly for the reason that households are formed around close kinship and familial ties. If the village is partitioned into ‘familial’ subsets of individuals with high altruism within subsets and low altruism across subsets, coalitions comprising individuals from disparate ‘families’ would encounter too much free-riding and would thereby not be stable. In that case households can only be subsets of families. We have in mind an initial situation where households are of maximal size within each family, and are subject to division pressures owing to growth in household size owing to demographic reasons. We abstract from this complication by simply excluding the possibility of mergers.

We make additional simplifying assumptions of transferable utility and symmetric information within each household. So exits and divisions can be accompanied by side-transfers

among members — e.g., exiting members can be given a side-transfer by remaining members. Under this assumption, exits and divisions will take place if and only if the total income of members of the original household increases as a result. This motivates the following definition.

**DEFINITION 1.** *A cultivating household  $(n, L)$  is **stable** if its members do not collectively benefit from a shutdown, exit or division:*

$$\Pi(n, L) \geq w \quad (NS)$$

$$n\Pi(n, L) \geq mw + (n - m)\Pi(n - m, L) \quad \text{for any } m \in \{1, \dots, n - 1\} \quad (NE)$$

$$n\Pi(n, L) \geq n_1\Pi(n_1, L_1) + (n - n_1)\Pi(n - n_1, L - L_1) \quad \text{for any } L_1 < L, \text{ and any } n_1 \in \{1, \dots, n - 1\} \quad (ND)$$

*Conversely it is **unstable** if one or more of these inequalities are violated.*

It may be argued that condition (NE) is incorrect if the household that remains after the exit of  $m$  members is induced to shut down (which will happen if  $\Pi(n - m, L) < w$ ), since the payoff of the remaining members would then equal  $w$  rather than  $\Pi(n - m, L)$ . But in this case the consequences of exit would be the same as shutdown, so this case is covered by (NS). Similarly, in the case of division where  $\Pi(n_1, L_1) < w$ , but it pays the remaining household to continue to cultivate, the correct condition should be  $n\Pi(n, L) \geq n_1w + (n - n_1)\Pi(n - n_1, L - L_1)$ . Since  $\Pi$  is increasing in  $L$ , this condition is ensured by (NE).<sup>3</sup>

In the absence of a land market and given the assumption of exogenous wages, the stability of a household is independent of the characteristics of other households in the village. Hence we can define a stable household distribution as follows. We shall refer to any household  $(n, L)$  as a *cultivating household* if  $\Pi(n, L) \geq w$ , and a non-cultivating household otherwise. A non-cultivating household does not utilize its land: such a household might gift its land to other cultivating households, or sell it if there is a land market. So without any loss of generality we can identify non-cultivating households as landless.

**DEFINITION 2.** *A distribution over households (i.e. vectors  $(n, L)$ ) is **stable** if there is no positive fraction of cultivating households that are unstable. Otherwise it is said to be an *unstable distribution*.*

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<sup>3</sup>Nevertheless, there may still be the concern that the notion of stability could fail a consistency condition: e.g., one of the fragmented households may itself be unstable and prone to further exits or divisions, which members of the original household ought to anticipate. However, this will not be a problem since further exits or divisions of one of the fragments would only serve to increase further the collective payoff of the members of that fragment. So conditions (NS), (NE) and (ND) are necessary for stability. Are they sufficient? In other words, what about the possibility of division into three or more households, or combinations of exits and division? This is not a problem for the following reason. Owing to the assumption concerning presence of fixed costs and CRS technology, a household dividing into two or more fragments will not be able to attain a higher collective profit. Hence the three conditions are collectively sufficient.

Our main result below provides a near-complete characterization of the set of stable cultivating households.

**PROPOSITION 2.** *A cultivating household  $(n, L)$  is stable if there is no free-riding and each member earns at least  $w$ , i.e., the following conditions hold:*

$$L \geq L_I(n) \equiv n\left[\lambda + \frac{1}{n}(1 - \lambda)\right]^{\frac{-1}{1-\alpha}} \left(\frac{w}{a\alpha}\right)^{\frac{1}{1-\alpha}} \quad (IC)$$

$$L \geq L_R(n) \quad (IR)$$

where  $L_R(n)$  equals  $L_p^*, L_m^*, L_r^*$  for land-poor, medium-land and land-rich households respectively (as defined in Proposition 1).

Conversely, the household is unstable if it violates either (IR) or

$$n > \lfloor n_I(L) \rfloor \quad (IC')$$

where  $n_I(L)$  denotes the inverse of  $L_I(n)$  and  $\lfloor x \rfloor$  denotes the smallest integer exceeding  $x$ .

**Proof of Proposition 2:** We start with sufficiency. Suppose there is no free-riding and each member earns at least  $w$ . The latter implies (NS) is satisfied. To show (NE) holds, note that  $L_I(n)$  is an increasing function. So for any positive integer  $m$ , the equilibrium outcome for a household with  $n - m$  members and  $L$  land will involve no free-riding, with each member selecting  $l = 1$ . This implies the marginal contribution of any member in any such household exceeds  $w$ , and so the marginal contribution of  $m$  members will exceed  $mw$ , which implies (NE). (ND) follows from noting that the production function defined by ‘output’ equal to collective income of a household plus the fixed cost, and inputs consisting of land  $L$  and household size  $n$  (i.e.,  $y(L, n)$  which equals  $n\pi_m + F$  for a medium-land household and  $n\pi_r + F$  for a land-rich household) defines a production set which is a convex cone. Hence the collective income of the household net of the fixed cost is superadditive.

The necessity of (IR) for stability is obvious. To show necessity of (IC’), suppose this condition is violated and we have  $n > \lfloor n_I(L) \rfloor$ . This implies there is free riding at both  $n$  and  $n - 1$ , and per member incomes are defined by (10). Hence  $n\pi_p(n, L) = nw - F + H(n)$  and  $(n - 1)\pi_p(n - 1, L) = (n - 1)w - F + H(n - 1)$  where  $H(m) \equiv La^{\frac{1}{1-\alpha}} w^{\frac{-\alpha}{1-\alpha}} \{(\gamma(m)\alpha)^{\frac{-\alpha}{1-\alpha}} - (\gamma(m)\alpha)^{\frac{1}{1-\alpha}}\}$  and  $\gamma(m) \equiv \lambda + (1 - \lambda)\frac{1}{m}$ . Clearly  $\gamma(m)$  is strictly decreasing in  $m$ . Hence  $n\pi_p(n, L) - (n - 1)\pi_p(n - 1, L) = w + H(n) - H(n - 1) < w$ , and (NE) is violated. ■

Proposition 2 is illustrated in Figure 1. (IC) is an incentive compatibility condition, stating that given the land owned by the household, the number of members is small enough to ensure absence of free-riding: every member supplies maximal effort on the farm. It is a restatement of the condition that the household be either medium-land or land-rich. The

corresponding necessary condition (IC') is slightly weaker, owing to the fact that the number of household members is integer-valued. The necessity of this condition flows from the fact that land-poor households are characterized by free-riding, and collective household income is strictly decreasing in the number of members. It then pays one member to exit with a suitable compensation paid by the remaining household members. Condition (IC) reduces to a minimum landholding requirement  $L_I(n)$  which is strictly increasing and strictly convex in household size  $n$ , provided the extent of altruism is imperfect (i.e.,  $\lambda < 1$ ). Conversely it amounts to a maximum household size  $n_I(L)$  corresponding to any given ownership of land.<sup>4</sup>

Condition (IR) is an individual rationality constraint that corresponds to condition (NS) wherein every member should earn at least as what they would earn on their own working full time on the labor market. It translates into a minimum landholding requirement  $L_R(n)$  given household size. It is evident that for land-rich households this lower bound  $L_r(n)$  is linear and decreasing in  $n$ . For medium-land households, the bound  $L_m(n)$  is U-shaped in  $n$ , achieving a minimum at  $n^* = \frac{\alpha}{1-\alpha} \frac{F}{w}$ . Since stability also requires 'near-absence' of free-riding within the household as expressed by condition (IC'),  $L_m(n^*)$  forms an approximate lower bound to the landholding of any stable household, irrespective of how many members it has. Hence a stable land distribution must exhibit a 'hole' in-between 0 and  $L_m(n^*)$  quantities of land. Note also that the minimum landholding size needed to satisfy (IR) depends on both  $F$  and  $w$ . Even if  $F$  were zero, a minimum land size would be needed to ensure that per capita earnings are above the wage rate.

The sufficiency of the two conditions arises from the fact that a non-land-poor household realizes maximal agricultural income from its endowment of labor and land, which is increasing in  $n$  and  $L$ . The absence of free-riding in such households implies that the marginal contribution of each member to household income exceeds the outside wage  $w$ . Hence there are no incentives for exit. There are no incentives for division either — at best the fragments would be better off cultivating rather than not cultivating (which would happen if they both continued to satisfy (IR)). And the best-case scenario for division is when neither fragment is characterized by any free-riding. In that case owing to the constant returns feature of the production function (ignoring the fixed cost), collective production would remain the same, and collective income would decline on account of the duplication of fixed cost  $F$ .<sup>5</sup> Finally, the (IR) constraint implies that there are no benefits from shutdown.

It is easy to check that the IC and IR curves cross in  $n - L$  space at a single point  $n^{**}$ . To the right (left) of this, the IC curve lies above (resp. below) the IR curve. In case A of Figure 1 where  $\frac{F}{w}$  is high enough (relative to  $\alpha$ ), they intersect to the right of the bottom

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<sup>4</sup>If  $\lambda = 1$ , there would be no free-riding within the household, and collective income of the household would be independent of household size within region (a). In that case there would be no limit to household size.

<sup>5</sup>For the same reason, division into three or more fragments would not be valuable, when it is not worthwhile to fragment into two fragments.

of the IR curve (i.e.,  $n^{**} > n^*$ ). In the other Case B when  $\frac{F}{w}$  is low, they intersect to the left of the bottom ( $n^{**} > n^*$ ). The implications of demographic growth of the number of household members can differ between the two cases, as we discuss next.

## 2.2 Effects of Changes in Demographics and Profitability on the Land Distribution

Suppose we start with a stable distribution, with support of cultivating households contained in the region bounded below by the intersection of the IR and IC curves, with all remaining households landless. Now take any cultivating household which is initially in the stable region, and suppose that the number of household members increases (owing to either fertility increases or decreases in mortality) while its landholding remains the same.

Consider case B of Figure 1, with relatively low fixed costs. Or suppose we are in case A instead, but  $n$  exceeds  $n^*$ . If the number of members increases sufficiently, the IC constraint will be violated and the household will cease to be stable. As the endowment point moves across the IC curve, the IR constraint continues to be satisfied. Hence either exit or division of the household will be induced, rather than a shutdown. The problem is that the household has too many members relative to its land, inducing some free-riding.

It is also possible that the IR constraint is the first to be violated as the household size grows relative to its landholding. This would happen for instance in Case A where the landholding is close to the lower bound  $L_m(n^*)$ .

Can we predict whether the outcome of demographic growth will be exit (in which case  $n$  will fall while  $L$  of the surviving household will remain unchanged) or division (whence landholdings of the surviving fragments will be smaller than of the original household)? Which of these two outcomes will happen will depend on which is associated with a higher collective income of the members of the original household.<sup>6</sup> Note that exit is always feasible, since the extra number of household members that caused IC to fail can exit so as to leave a cultivating household with exactly the same number of members as in the original household. But division may not be feasible, if there was little slack in the IR constraint to start with. For instance, division is infeasible if the original household owned less than twice  $L_m(n^*)$ , since each of the fragments will have to have at least this amount of land in order to be viable. At the lower end of the land distribution, thus, demographic growth will result in exits, resulting in growing landlessness.

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<sup>6</sup>Suppose the IC constraint is the first one that is violated, with  $n$  close enough to  $n_I(L)$  after the demographic expansion, and fixed costs  $F$  smaller than  $w$ . Then had the original household remained intact the marginal contribution of any member to collective income will be at least  $w$ . Hence exit of any member would result in a reduction in total income by at least  $w$ . On the other hand, it is feasible to divide the household into two cultivating households which are stable, in which case their collective income will decline by  $F$ , which is smaller than  $w$ . In this case division is going to happen rather than exit. On the other hand, if  $F$  is large enough then exit will happen rather than division.

Next suppose agricultural profitability (represented by  $\frac{a}{w}$ ) increases. This causes the IC curve to shift outwards, and the IR curve moves downwards — both constraints are relaxed. This will tend to slow down exits and divisions occurring due to demographic growth.

### 2.3 Land Market Transactions

Now suppose land can be bought and sold, subject to a unit transaction cost of  $t$ . Other problems that may restrict land market transactions include credit constraints that restrict purchases, while status effects or insurance value of land that make households reluctant to sell. Asymmetric information concerning land quality may also create a ‘market for lemons’ problem. We abstract from these here, and focus on the role of costs of registering land transactions.

Continuing with the assumption of transferable utility and lack of credit constraints or asymmetric information, two cultivating households  $(n_i, L_i), i = 1, 2$  will have an incentive to engage in a land transaction of  $l$  units if and only if

$$n_1\Pi(n_1, L_1 - l) + n_2\Pi(n_2, L_2 + l) - tl > n_1\Pi(n_1, L_1) + n_2\Pi(n_2, L_2)$$

Since the marginal contribution of land to collective income of any medium-land household  $(n, L)$  equals  $(1 - \alpha)a(\frac{n}{L})^\alpha$ , it follows that there is an incentive for two medium-land households to enter into a land transaction if and only if their relative endowments differ sufficiently, relative to transaction costs and profitability parameter  $a$ :

$$|(\frac{n_1}{L_1})^\alpha - (\frac{n_2}{L_2})^\alpha| > \frac{t}{a(1 - \alpha)} \tag{16}$$

The results in the preceding section imply that in order to identify stable land distributions, we can focus on households that are either land-rich or medium land types. All land-rich households have the same marginal value of land, equal to the value of land for a medium-land household located at the boundary between the medium-land and land-rich regions, i.e., with  $\frac{n}{L} = b \equiv \{\frac{\alpha a}{w(1+s)}\}^{\frac{1}{1-\alpha}}$ . For purposes of land transactions we can identify land-rich households with such a medium-land household.

The definition of a stable land distribution must now include the condition that no two cultivating households should want to enter into a profitable land transaction.<sup>7</sup> This restricts the range of variation of factor proportions among all cultivating households (after

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<sup>7</sup>We ignore the possibility of purchases of land by landless households from cultivating households. Such transactions are empirically rare. Possible reasons include a large fixed cost  $F$  of operating a farm. These necessitate a large amount purchase of land by the landless, which they may be unable to finance owing to credit constraints. Moreover these fixed costs would be duplicated, eroding the potential benefits of the transaction: it would not be profitable if  $F$  is sufficiently large relative to  $w$ . Additional complications arise when we consider possible combinations of exits or divisions with land market transactions, so we stop short of providing a characterization of stable land distributions and instead focus on necessary conditions.

setting the factor proportion of land-rich households to  $b$ ) to lie within a cone of width which varies with  $\frac{t}{a(1-\alpha)}$ , as shown in Figure 2. The stable region, i.e., support of a stable land distribution (for cultivating households) must now be contained within the intersection of such a cone with the areas bounded below by the IC and IR curves. If  $t$  is small, this cone may be contained entirely within the medium-land region. In that case there is a stable distribution containing only medium-land households. For the same value of  $t$ , there could be multiple cones consistent with the stability condition: there could be another which includes the factor proportion  $b$  and other medium-land households in the interior of the medium-land region. In this case a stable distribution could include both medium-land and land-rich types of households. Note in particular that for any  $t$  there exists a stable distribution containing only land-rich households, as there are no incentives for any pair of land-rich households to trade land.

Demographic growth in some households may now trigger a land transaction rather than an exit or division. This is shown in Figure 2(b), where a household with a relatively high initial ratio of labor to land (represented by vector  $h$ ) moves to  $h_1$ . It then enters into a land purchase from another household  $h_2$  with a relatively low labor-land ratio, with respect to whom condition (16) is now violated. As a result of the transaction,  $h_1$  moves up back to  $h_3$  into the equilibrium cone, while  $h_2$  drops down to  $h_4$  and continues to remain in the stable region. Clearly, the likelihood of buying land is increasing in  $\frac{n}{L}$  and in  $a$ , while the likelihood of selling land is decreasing in  $\frac{n}{L}$  and increasing in  $a$ .

### 3 West Bengal Context and Survey Data

#### 3.1 Land Reform Programs

There were two principal land reform programs in West Bengal since the 1960s. The first represented appropriation of lands (a process known as *vesting*) above the legislated ceilings from large landowners, and subsequent distribution of this land to the landless in the form of titles to small land plots (called *pattas*). For the state as a whole, P.S. Appu (1996, Appendix IV.3) estimates the extent of land distributed until 1992 at 6.72% of its operated area, against a national average for the rest of India of 1.34%. In our sample villages, approximately 15% of all households in 1998 had received land titles (Bardhan and Mookherjee (2010)). However, many of the distributed land titles pertained to very small plots: in our sample, the average plots distributed were approximately half an acre in size. According to most accounts, these plots were of low quality. Recipients were unable to use them as collateral for obtaining loans from banks.

The other land reform program was Operation Barga, involving registration and regulation of tenancy contracts. In order to plug loopholes on prior legislation, a new Land Reform Act was passed in the West Bengal state legislature in 1971. This was subsequently amended in 1977 by the incoming Left Front government to lend further legislative teeth

to the program. The 1977 Amendment made sharecropping hereditary, rendered eviction by landlords a punishable offense, and shifted the onus of proof concerning identity of the actual tiller on the landlord. The state government subsequently undertook a massive drive to identify and register tenants with the aid of local governments and farmer unions. Registration was accompanied by a floor on the share accruing to tenants, amounting to 75% (replaced by 50% if the landlord paid for all non-labor inputs). Over a million tenants were registered by 1981, up from 242,000 in 1978 (Lieten (1992, Table 5.1)), increasing to almost one and a half million by 1990. Estimates of the proportion of tenants registered by the mid-90s vary between 80% (Lieten (1992, p. 161)) and 65% (Banerjee, Gertler and Ghatak (2002)). In the villages in our sample approximately 48% tenants had been registered; these amounted to about 6% of all households by the late 1990s (Bardhan and Mookherjee (2010)). The average size of plot registered averaged 1.5 acres, and registered tenants could use the registration document as collateral for a loan from a state financial institution. As with the land title distribution program, most of the implementation of Operation Barga was carried out between the late 1970s and late 1980s.

Banerjee, Gertler and Ghatak (2002) found a significant positive effect of the tenancy registration rate on district rice yields in a double difference OLS regression after controlling for district and year dummies, crop patterns, infrastructure provided by the state government. Using a farm cost of cultivation survey for a sample of 89 villages, Bardhan and Mookherjee (2011) also found a significant positive effect of the cultivation area within a village registered under the program on farm value added per acre, after controlling for farm and year dummies and a range of controls for other farm support programs implemented by local and state governments.<sup>8</sup> No significant effects of the reform on wage rates or employment for hired labor were found, except in farms leasing in land (which constituted less than 5% of all farms by the mid-1980s). The productivity increases accrued to farms of all sizes, except the smallest, with substantial spillover effects on owner cultivated farms. This spillover was explained in Bardhan, Mookherjee and Neha Kumar (2012) by effects of the reform in reducing the cost of groundwater owing to induced investments in minor and medium irrigation. There were no significant effects of the land title program on farm productivity, nor on wage rates.

### 3.2 Household Survey Details

The survey on which this paper is based covers the same set of 89 villages in West Bengal studied in Bardhan and Mookherjee (2010, 2011) and Bardhan, Mookherjee and Neha Kumar (2012). This is a sub-sample of an original stratified random sample of villages selected from all major agricultural districts of the state (only Kolkata and Darjeeling are excluded) by the Socio-Economic Evaluation Branch (SEEB) of the Department of Agriculture, Gov-

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<sup>8</sup>The magnitude and significance of this effect was however diminished in a parallel IV regression where potential endogeneity of the tenancy reform implementation was additionally controlled for.

ernment of West Bengal, for the purpose of calculating cost of cultivation of major crops in the state between 1981 and 1996.<sup>9</sup> Our survey teams visited these villages between 2003 and 2005, carried out a listing of landholdings of every household, then selected a stratified random sample (stratifying by landownership) of approximately 25 households per village (with the precise number varying with the number of households in each village). 2 additional households were selected randomly from middle and large landowning categories respectively, owning 5-10 acres and more than 10 acres of cultivable land, in order to ensure positive representation of these groups. The stratification of the sample of households was based on a prior census of all households in each village, in which demographic and landownership details were collected from a door-to-door survey.

Representatives (typically the head) of selected households were subsequently administered a survey questionnaire consisting of their demographic and land history since 1967.<sup>10</sup> Response rates were high: only 15 households out of 2400 of those originally selected did not agree to participate, and were replaced by randomly selected substitutes.

We combine the household-level data with data on the extent of land reform carried by the land reform authorities in each of these villages since 1971 (available until the year 1998). Additional village-level information is available from previous surveys concerning various agricultural development programs implemented by local governments, productivity in the farm panel drawn from these villages for specific subperiods. Data concerning total number of households in each village, household size, land areas owned and cultivated by each household in 1978 and 1998 is available from an ‘indirect’ survey in which village elders compiled household land distributions for each of these two years, based on an enumeration of voters for each village for those years.

The household survey data includes each household’s land holding at the time of being surveyed (2004) and as of 1967. Respondents were subsequently asked to list all land transactions the household participated in between these two dates, for each of the following categories: acquisitions (purchases, *patta* (land titles received), gifts and others), disposals (sales, transfers, appropriation by land reform authorities, and natural disaster), and household division (involving both exits of individual members and household splits). We focus on agricultural land, both irrigated and unirrigated (in order to determine the relevant ceiling imposed by the land reform laws, which incorporate irrigation status and household size). Corresponding changes in household demographics on account of births, deaths, and marriages were also recorded.

An effort was made in the questionnaire design to distinguish between exit of individual

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<sup>9</sup>The village selection procedure used by SEEB was the following: a random sample of blocks was selected in each district. Within each block one village was selected randomly, followed by random selection of another village within a 8 Km radius.

<sup>10</sup>Other questions in the survey included economic status and activities, benefits received from various development programs administered by GPs, involvement in activities pertaining to local governments (gram panchayats (GPs)), politics and local community organizations.

members and household splitting (where a household sub-unit consisting of at least two members left the original household). But the questionnaire responses indicate that the interviewers and respondents tended to lump the two together. In order to avoid double-counting, we merged the observations that were both in the individual exit and household splitting datasets. We classified the cause of individual exit and household division into four categories: death of the member of the household, exit of the spouse of the head due to death of the head of the household, out-marriage, and exit/division due to other reasons (such as change in household size, change in income/expenditure, disputes, registration of tenants and threat of land reforms). Table 1 shows that the latter category is by far the most relevant, both in terms of frequency of occurrence and amount of land involved.

Our primary unit of analysis is agricultural land owned by a household for a number of reasons. The focus on land is natural given its pre-eminent role in determining incomes, consumption and occupational patterns, and the fact that its measurement is prone to less error than income or consumption. Table 2 provides evidence of the correlation between land ownership and income, consumption and occupation patterns. In panel A, which shows sources of income by land category, we can observe that total income is highly correlated with land ownership, due to the relevance of farm income in total income. Wage earnings constitute the main source of income for landless households. Panel B shows patterns of consumption, where we observe a similar pattern as in panel A: landed households have more access to durable goods. Finally, in panel C we see that similar to panel A, the main occupation of adults in landless households is non-agricultural work, while large and big landowners dedicate most of their time to own cultivation.

Choosing the household as the unit of observation is conventional in studies of land inequality, in India and elsewhere, since land is typically cultivated jointly with sharing of resulting incomes by household members. Table 3 shows evidence of joint production, since we observe that more than half of the medium, large and big households are formed of at least a pair of siblings engaged in own cultivation. Moreover, problems of attrition are low at the level of households, owing to low rates of migration of entire households which co-exist with substantial migration of individuals. In a follow-up survey conducted in 2011 with the same set of households in the 2004 survey, only 15 households out of the original sample of 2402 households could not be traced owing to all its members having moved out. Over a seven year period this amounts to an attrition of 0.62%. Extrapolating this to the 35 year period covered by the survey, the attrition is estimated at 3.12%.<sup>11</sup> And even if all members of a household were to move out, they could not carry their land with them: they would have to sell or gift it to others remaining in the village. Hence land transactions would not be under-measured owing to attrition.

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<sup>11</sup>This compares favorably with 4.7% attrition in the Indonesian Family Life Survey for a seven year period (1993-2000), and an 8.2% attrition in the National Longitudinal Survey of Youth (NLSY) in the US for 1979-1986.

### 3.3 Data Recall Problems

Nevertheless, the land history constructed for each household over the period 1967-2004 on the basis of a one-time survey in 2004 is potentially prone to serious recall problems, as recalling the details of past changes in landholdings over the past three decades can be a challenging task. Investigators were specially trained to conduct interviews in a manner that would help respondents remember and relate the land histories of their household in a consistent manner. In order to gauge the significance of recall problems, we checked the consistency of reported landholdings in 1967 and 2004 with reports of land changes in the intervening period. Starting with the 2004 land holdings, we added in all transactions for any given year to compute the total land holding in the previous year. Repeating this iteratively, we calculated landholdings for every previous year until 1967.<sup>12</sup> We compare the estimated landholding in 1967 with that actually reported for that year. For households immigrating into the village since 1967, we carry out the match for the initial year that the household arrived in the village.

An additional difficulty arose with the individual exit data: no distinction was made in the questionnaire between agricultural and non-agricultural land lost thereby (i.e., associated with the exit). This complicated our calculation of agricultural landholdings. To deal with this problem we considered three different alternatives. The first assumes that all land reported in individual exits involved non-agricultural land, and is thereafter dropped. The second assumes the opposite, i.e. that all land reported in individual exits corresponds to (unirrigated) agricultural land. Finally, the third alternative assumes that whenever there is “missing” agricultural land (by the iterative procedure described above), it is accounted by land lost because of individual exits.

When all land lost owing to individual exits is assumed to be non-agricultural (alternative 1), around 88% of the households matched their reported landholdings in 1967, upto a 0.2 acre margin of error. This figure increased to 91% when allowing for a 0.5 acre margin of error. The fact that we were able to reconstruct the land history for many households implies that imperfect recall problems were negligible. The match rate fell to 82 and 86% respectively when we assume that land lost from individual exits was entirely agricultural land (alternative 2). Therefore it seems that land lost from individual exits corresponds to other uses of land, such as homestead, ponds or orchards. Finally we consider the implications of assuming that the gap between the reconstructed agricultural land holdings and the self reported in 1967, if any, had to come from agricultural land reported in the individual exit data (alternative 3). For this case 89% of the households matched their reported landholdings in 1967, upto a 0.2 acre margin of error. This 1% improvement in comparison with the first alternative corresponds to only 26 households. Hence we do

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<sup>12</sup>For example, consider a household with 2 acres in 2004 that lost 1 acre due to household division in 1995 and bought 3 acres in 1970. Then, we would list the household as owning 2 acres each year from 1995-2004, 3 acres from 1970-1995, and 0 acres from 1967 until 1970.

not believe our lack of knowledge of type of land lost in exits is of any significance. In the rest of the paper, we use the data implied by the third alternative in order to construct the agricultural land time series for each household.

Finally, since there was no distinction between irrigated and unirrigated land in the individual exit dataset, we assumed that all land coming from this dataset was unirrigated. Whenever possible, we apportioned unirrigated to irrigated land to match initial and final holdings of irrigated and unirrigated land. There were a few household-year observations in which households still had negative land holdings, which were set equal to zero.

A similar check for household size and composition indicated consistent reports for 82% of all households. And when we seek consistent reports of both demographics and land histories, we end up with 73% of the sample.

We thereafter proceed on the basis of two samples. One is the restricted sample formed by those households with consistent reports regarding both land and household size. The other is the full sample. The differences between these two samples are presented in Table 4, where we ignore discrepancies of less than 0.2 acres. It shows the restricted sample contains a larger fraction of immigrants and a smaller fraction of medium, large and big landowners. This is consistent with the expectation that recall problems are less likely for immigrants or those owning less land. All subsequent results in the paper are shown for both samples, to gauge the sensitivity of results to possible recall problems.

## 4 Descriptive Statistics

### 4.1 Average Landownership, Household Size and Immigration

Table 5 provides average household size, ownership of agricultural land and immigration for select years between 1967 and 2004. Panel A shows statistics for the full sample, while panel B displays the statistics for the restricted sample. We see a sharp drop in the mean land owned from nearly 3 acres per household to a little over 1 acre. The median dropped by less, from 0.7 acre to 0. The drop is equally dramatic when we look at the restricted sample: for instance the 75th percentile landownership dropped from 2.86 to 0.66 acres. With regard to household size, there was some reduction but it was not as dramatic as the drop in land owned: the median fell from 6 to 5, and the mean also fell by 1 unit, resulting in a reduction of the order of 16%. Consequently land per capita fell by nearly three times in the full sample, and more than halved in the restricted sample.

To what extent was the reduction in average landownership the result of immigration? Table 5 shows that approximately one third of all households in 2004 had immigrated into the village since 1967. Approximately one third to one fourth of these immigrants came from Bangladesh. Hence immigrant inflows were sizeable. Immigrating households typically arrive with no land, and lag behind natives with respect to landownership. Nevertheless, trends in average landholdings for native households were similar to those for the full sample,

as shown in table 5. This suggests that the declining patterns of landownership cannot be attributed to rising immigration.<sup>13</sup>

Could the decline in landholdings per household have resulted from conversion of agricultural land to non-agricultural purposes? Table 6 shows changes in cultivable land and number of households over two decades of the 1980s and 1990s, using the indirect household survey used in Bardhan and Mookherjee (2006, 2010). The number of households rose sharply, while the amount of cultivable land per village remained approximately the same. Hence conversion of agricultural land into forests or other non-agricultural purposes was not the cause of the decline in land availability per household. This table also shows that village population increased sharply, as the number of households per village rose approximately 70%, significantly outweighing the 16% drop in average household size. Our theory suggests that the increase in the number of households resulted from the growth in population which spurred increased rates of household divisions.

Returning to the direct household survey, immigration accounted for a 15% drop in land per household, while for natives it dropped by about 40%. Table 7 decomposes the latter change between different channels. For the full (restricted) sample, 81% (85%) of the decline in land for native households was accounted for by land lost owing to household division, 6.6% (11%) to land market transactions, 6.3% (7%) to gifts and transfers, 4.6% (-1.1%) for land reforms, and 3.6% (1.3%) for other miscellaneous reasons. Hence land lost owing to household splits and migration of household members was the dominant source, followed by immigration, land market transactions and transfers. The direct effect of land reforms was negligible, measured by the proportion of land redistributed.

## 4.2 Land Inequality Changes

We turn now to trends in land inequality. Panel A of table 8 shows land inequality measures for select years between 1967 and 2004. For the restricted sample within-village inequality (averaged across villages) rose by 17% for the Gini and 29% for the coefficient of variation.<sup>14</sup> Panel B of Table 8 shows changes in the proportion of households in different size classes. Landlessness rose from one-third to half of all households. The rising landlessness was principally responsible for the rise in land inequality: inequality among the set of landowning households in 2004 did not change much. The proportion of households that were either landless or marginal (owning less than 1 acre) rose from 60% to 81% among the entire population.<sup>15</sup> This was accounted for by a drop mainly of small landowners (owning between

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<sup>13</sup>This is what one would expect if most of these immigrant flows were from other West Bengal villages, the effects of which would tend to wash out on average. However, our questionnaire did not ask immigrants where they had been living originally, except whether they had arrived from Bangladesh. So we do not know the extent to which the non-Bangladeshi immigrants came from within West Bengal rather than other parts of India.

<sup>14</sup>The full sample shows a milder increase for both the Gini and the coefficient of variation.

<sup>15</sup>This proportion also increases among natives (i.e. excluding immigrants) to 75% of the households.

1 and 2.5 acres) and big landowners (owning more than 5 acres).

Figure 3 shows the density of the distribution of land for those households owning between 0 and 3 acres of land (i.e. landless households were excluded for both the full and restricted sample, for three different years (1970, 1985 and 2000). There are two striking results here. First the density at each of these dates peaks at 0.5 acres, with a sharp drop below this level. It suggests a minimum viable landholding size around half an acre. Second, changes in the distribution involve a lowering of the density between one and three acres, and a rise in the density at the half acre peak. Combined with the rising incidence of landlessness, it suggests that there was an increasing tendency for the bottom tail of the land distribution to have two peaks, one at the half acre mark, and the other at zero. It suggests a process whereby land owned by most landed households drifted downwards (following division of the household over time), until it hit the half acre threshold, whereupon the household struggled to preserve its landholding or joined the ranks of the landless.

Next, we decompose the changes in inequality across the three principal channels (household division, land market transactions, and land reform) using the following accounting exercise. For each of these channels, we calculate the amount of land the household would have owned in any given year had the landholding change associated with the corresponding channel not occurred, and all other changes in landholding would have occurred as observed. We then calculate the average within-village inequality that would have resulted, and subtract this from the observed inequality to estimate the contribution of this channel. Figure 4 shows the results for the restricted sample, which indicate clearly that the dominant source of rising inequality was household division, particularly after the mid-1980s. Land market transactions contributed to an increase in inequality measured by the Gini coefficient, while leaving the coefficient of variation unchanged. The role of land reforms was to reduce the Gini coefficient by a magnitude comparable to the land market for the period as a whole. For the coefficient of variation, by contrast, the direct effect of the land reform was slightly negative for the period as a whole. Hence the land reforms exercised a substantially weaker direct effect on both the Gini coefficient and the coefficient of variation compared to household division or land market transactions.<sup>16</sup>

### 4.3 Household Divisions, Land Transactions and Land Reforms

We conclude this section with some additional facts concerning household divisions, land transactions and land reforms. As mentioned earlier, Table 1 shows that household splits and other exits accounted for the vast majority of changes in household size, dominating births, deaths and marriage. Since the splits and exits for ‘other’ reasons predominate to such a large degree, we define household division to be any event resulting in a reduction in number of household members.

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<sup>16</sup>The results for the full sample show similar trends, with land reforms even increasing both measures of inequality.

The impact of household divisions on land inequality is not *a priori* obvious. Division of big landowning households would tend to reduce inequality, while division of small landowners would raise landlessness and inequality. Hence the effects of household division on the land distribution depend on the size classes in which they are particularly pronounced. To examine this issue, Table 9 shows division rates and land lost owing to division in the restricted sample, for different size classes over the entire period. Big landowners divided at a slightly higher rate than other households. Big and small landowners lost land at roughly the same rate owing to division, and at a slightly higher rate than marginal, medium or large landowners. The net effect on inequality is unclear from this.

Figure 5 shows the size and frequency of land market transactions. These are not necessarily balanced because we are working with a sample of households rather than the entire village population. Besides we exclude non-residents who may own some land, as well as those who may have left the village between 1967 and 2004. Nevertheless it is apparent that the sales and purchases approximately balance each other in the data, except the last 5 years or so when the sales outstrip the purchases (which may reflect an increasing tendency for non-residents to purchase land). However the extent of excess sales towards the end is of the order of 0.2–0.25 acres, not large enough to explain the mean reduction in land per resident household in excess of 1 acre for the period as a whole.

Note also that the land transactions are considerable in frequency, and occur throughout the period. Hence the land market has been quite active. Table 10 shows 26% of all households engaged in land sales, while 23% engaged in land purchases. In the full sample there is a tendency for rising extent of transactions in the first half, with some noticeable spikes between 1980–85, the period of heightened land reform activity. In the restricted sample these spikes are muted, with no evident tendency to be bunched in the earlier period.

Since there may be recall problems with regard to land reforms, we rely instead on the official land records. Figure 6 uses data from the local land records offices for both tenancy registration (*barga*) and land title distribution (*patta*) for the village as a whole, until the year 1998 (the year when the official village level data on land reform was collected). The figure on the left expresses the extent of land reform as percent of cultivable land, and the latter as a percent of households. These data series are taken from Bardhan and Mookherjee (2006, 2010), with the land area and household numbers calculated on the basis of interpolation of estimates from the indirect household survey for years 1978 and 1998. Both sets of land reforms were pronounced between the late 1970s and mid-80s, with the tenancy reform more significant in terms of cultivable land area and the land titling program more significant in terms of the number of households directly benefitting.

## 5 Determinants of Household Division and Land Transactions: Empirical Results

We start by summarizing the predictions of our model concerning the impact of the land reforms on household division and land transactions, and then explain the regression specifications. This is followed by the regression results.

### 5.1 Implications of the Theoretical Model for Effects of Land Reform on Division and Land Transactions

Our model implies that land reforms will affect division and land sales through two sets of channels. The first set comprises economic channels: changes in profitability of farms (the parameter  $a$  and the wage rate  $w$ ). The second channel is political, consisting of anticipated redistribution in the near future as signaled by recent actions of land reform authorities.

The tenancy reform raised value added per acre of cultivating farms of all sizes uniformly, as shown in Bardhan and Mookherjee (2011). Moreover, to the extent that large landowning families are more likely to lease out their lands to tenants, the reform would have lowered profits of the former by raising crop shares of tenants and limiting the ability of landlords to evict them. Hence the returns from land to landlords would have declined. We expect therefore that the economic channel would cause  $a$  to rise, but by less for large landowners. A second possible channel of economic impact would be the change in  $w$ , but as noted previously these effects were found to be empirically insignificant. The political channel would likewise reduce profitability for large landowners whose tenants have not yet been registered but expect them to become registered (or renegotiate existing contracts) in the near future owing to stepped up implementation of the program. Moreover, those with lands in excess of the legal ceiling could expect a greater likelihood of implementation of land ceiling regulations by a current local government that is vigorously implementing the tenancy reform.

Aggregating these different effects, we therefore expect that a higher rate of implementation of the tenancy program would lower division rates for medium and small landowning households, but this would be attenuated (and maybe even reversed) for those owning more lands. After controlling for household size and landownership in the recent past, this will be captured in the regression specification by an effect of recent implementation of the tenancy program which is expected to be negative, and an interaction with land owned by the household which is expected to be positive.

The land title distribution program turned out to have substantially smaller effects on farm productivity in the findings of Bardhan-Mookherjee (2011) that were statistically insignificant. Nor were there any appreciable effects on wages. On the other hand, the political channel would have caused division rates to accelerate especially for small landowning households into fragments owning little or no land, in order to increase their eligibility to

receive a land title. The political signaling effects would also be expected to raise division rates among large landowning households, as they anticipate stepped up implementation of both programs in the future. We therefore expect division rates to rise for all categories of households, the extent of which could vary across land sizes.

With regard to land market transactions, the tenancy program is expected to raise the likelihood of purchase (sale) of land by households with small (resp. large) amounts of land relative to the number of household members, both because of a rise in  $a$ , as well as a decline in relative profitability of households leasing out land, and anticipated redistribution which would adversely affect large landowning households in the future. The land distribution program is likely to have similar effects, except that there may be a decline in purchases of land from landless or marginal landowners owing to their receiving free land plots from the government. So for either program we need to include interactions of their effects with land owned by the household in the recent past.

## 5.2 Regression Specification

Following the discussion of determinants of household division above, we use the following regression specification:

$$\begin{aligned}
 DIV_{ivt} = & \beta_i + \delta_t + \beta_1 HS_{i,t-1} + \beta_2 L_{i,t-1} + \beta_3 TR_{v,t-k} + \beta_4 TR_{v,t-k} * L_{i,t-1} \\
 & + \beta_4 LD_{v,t-k} + \beta_5 LD_{v,t-k} * L_{i,t-1} + \beta_6 C_{it} + \epsilon_{ivt}
 \end{aligned} \tag{17}$$

where  $DIV_{ivt}$  denotes a dummy for division, or lands lost owing to division, by household  $i$  located in village  $v$  in year  $t$ . The regressors include apart from household fixed effects and year effects, lagged household size  $HS$ , landownership  $L$ , measures of implementation of the tenancy reform  $TR$  and the land distribution program  $LD$  in the village lagged by a few ( $k$ ) years<sup>17</sup>, interactions of these with lagged land owned by the household, and a dummy  $C$  for whether the household owned land in excess of the legal ceiling. We run both logit and linear probability versions of this regression. Standard errors of residuals  $\epsilon_{ivt}$  are clustered at the village level.

We also use a similar specification for dummies for whether a household bought or sold land. The theory indicated that the likelihood of buying or selling would be related to the ratio of (lagged) household size to land owned, so we include a specification where the log of this ratio is used as a single regressor apart from household and time effects. This corresponds to a different functional form, representing differences in endowment compositions that motivate land market transactions.

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<sup>17</sup>We take the average of these in three preceding years.

### 5.3 Logit Regression Results for Household Division

Table 11 presents a logit regression predicting the event that a household experienced a division in any given year. Columns 1 through 3 show the results for the full sample and 4 through 6 for the restricted sample. Columns 3 and 6 present the specification described above, with the other columns showing a more parsimonious specification which drop some of the land reform variables and some interaction terms.

Focusing on columns 3 and 6, we find growth in household size significantly raised the likelihood of household division, controlling for land owned. This confirms the notion that demographic growth was a key determinant of division. In column 1, the effect of land owned itself was positive and insignificant, in contrast to the theoretical prediction of a negative effect (based on economic reasons). The positive effect could be the result of anticipated land reform actions in the future which would principally affect large landowning households, motivating them to sub-divide in order to evade such actions. This interpretation is confirmed by the significance of the above-ceiling dummy in column 2 in the full sample (and column 5 in the restricted sample), which causes the size of the land coefficient to halve in magnitude compared with column 1 and become insignificant.

Columns 2,3,4,5 show that the effects of tenancy program are as anticipated by the theory: an increase in the proportion of cultivable area registered under the program was associated with a significant fall in division rates for small landowning households, and less so for larger landowning households. The intercept and slope effects are significant at the 1% level in the full sample and either 5% or 1% in the restricted sample. For households owning more than four acres of land, the implied effect is positive. A separate regression interacting program coverage with a dummy for households owning more than 4 acres of land confirmed the fact that the tenancy program induced a significant rise in division rates for large landowning households.

Columns 3 and 6 show effects of the land distribution program: a positive effect on division rates which is significant at 1%, and an interaction with land size which is negligible and insignificant. Hence the land title program raised division rates uniformly, which is consistent with the theoretical predictions (arising out of anticipated redistribution effects). The implied effect on land inequality is ambiguous (abstracting, of course, from the direct effect which would have reduced inequality owing to reduced landlessness).

Table 12 shows a corresponding OLS regression for the amount of land lost by a household as a consequence of division. While household size and land owned continue to be significant, the land reform variables are not significant. Hence the main effects of the land reform on division was mainly through whether or not division occurred.

## 5.4 Instrumental Variable Estimates of Effect of Tenancy Reforms on Household Division Rate

A possible concern with the preceding regression is possible endogeneity of land reforms: their implementation rates may be correlated with time-varying village-level unobservables that affect division rates. We now address this concern with a corresponding instrumental variable estimator of the effect of the tenancy reform.

We use the same set of instruments for the tenancy program implementation rate as in Bardhan and Mookherjee (2011), based on district, state and national political determinants of the land reforms. We recapitulate the logic for this. Bardhan and Mookherjee’s (2010) analysis of the political economy of the land reforms argued that political competition between the Left Front (LF) and the Indian National Congress (INC), the two principal competing parties in West Bengal politics played an important role in determining local implementation rates. This gives rise to an inverted-U relationship between reform implementation rate and the proportion of local government seats secured by the LF in the previous election, with a peak located around 50%. Moreover, in villages where one of the two parties, say the LF, was already strongly entrenched (as indicated by a share of the LF in the current local government seats that significantly exceeded 50%), a further increase in voter loyalties to the LF at the district or state level (measured by average vote share difference (AVSD) between the LF and INC in the district in question in most recent elections to the state legislature) would lower competitive pressure for re-election, and thus reduce implementation rates. Hence implementation of the tenancy reform in village  $v$  in year  $t$  can be predicted as follows:

$$\begin{aligned} TR_{vt} &= \gamma_1 LS_{vt} + \gamma_2 LS_{vt}^2 + \gamma_3 AVSD_{vt} \\ &+ \gamma_4 LS_{vt} * AVSD_{vt} + \gamma_5 LS_{vt}^2 * AVSD_{vt} + \gamma'_v + \gamma''_t + \epsilon_{vt}^1 \end{aligned} \quad (18)$$

where  $LS_{vt}$  denotes the LF share of local government seats in village  $v$  in year  $t$ . The composition of the local government in turn can be predicted on the basis of lagged incumbency and recent swings in popularity of the two parties at the state or national levels:

$$LS_{vt} = \delta_1 LS_{v,t-k} + \delta_2 INC_{t-l} * LS_{v,t-k} + \delta_3 AVSD_{vt} + \delta'_v + \epsilon_{vt}^2 \quad (19)$$

where  $LS_{v-k-1}$  is the LF proportion in the previous local government (i.e., prior to the current local government) elected in year  $t - k$ ,  $INC_{t-l}$  is the number of seats the INC secured in year  $t - l$ , the date of the last election to the national Parliament<sup>18</sup>,  $\delta'_v$  is a village fixed effect, and  $\epsilon_{vt}^2$  is an i.i.d. village-year shock.

Combining equation (18) with (19), we obtain a prediction for tenancy reform implementation in terms of district and national-level loyalties of voters, interacted with lagged

<sup>18</sup>Only the INC had a significant presence in the national Parliament during the period studied, so we focus only on the national popularity of this party.

incumbency:

$$\begin{aligned}
TR_{vt} = & \nu_1 LS_{v,t-k} + \nu_2 LS_{v,t-k}^2 + \nu_3 INC_{t-l} * LS_{v,t-k} + \nu_4 AVSD_{vt} \\
& + \nu_5 AVSD_{vt} * LS_{v,t-k} * INC_{t-l} + \nu_6 AVSD_{vt} * LS_{v,t-k} \\
& + \nu_7 AVSD_{vt} * LS_{v,t-k}^2 + \nu_8 P_{vt} + \nu'_v + \nu''_t + \epsilon_{vt}^3
\end{aligned} \tag{20}$$

with some higher order interaction terms dropped in order to limit collinearity problems, and  $P_{vt}$  denotes some additional village-year varying predictors such as local infrastructure, rainfall and the price of rice. This regression predicts implementation rate of the tenancy program for any given year, which has to be cumulated across past years to predict the total coverage of the program so far. Hence the instruments are the cumulative totals of these predictors across past years.

The logic for this IV strategy can be explained as follows. Elections to the national and state legislatures typically occur two or three years prior to the local government elections. Swings in  $INC_t$  and  $AVSD_{vt}$  represent the effect of state and national level events on the relative loyalties of voters to the two parties, which affect their competitive position in local elections. Since a district typically contains about 2000 to 3000 villages, these measures of popularity of the parties are unlikely to be driven by factors specific to any given village. The IV estimator will thus capture the effect of variations in tenancy program implementation predicted on the basis of these external determinants. Table 13 presents the results of the first stage for small (owning less than 2.5 acres) and large (more than 2.5 acres) landowning households. We observe the inverted-U relationship between LS and TR for both small and large landowners.

Table 14 presents instrumental variable as well as OLS estimates of the effects of the tenancy reform in a linear probability regression of division rates for small and large landowning households, controlling for the land distribution program, lagged household size and landownership besides household fixed effects, year dummies and additional village-year controls. These controls reduce the sample significantly, since they are available only for years 1982-1996.<sup>19</sup> The F-test from the first stage regression ranges between 8 and 9, showing that these instruments have moderate predictive power, but there is indication of under-identification as judged by the Kleibergen-Paap test. On the other hand, the Hansen test of overidentifying restrictions is comfortably passed.

OLS results are provided in columns 1 and 3 for the two groups of landowners, with corresponding IV results in columns 2 and 4. Consistent with the results of the logit in the previous Table, tenancy reform implementation rates significantly reduce division rates among small landowners and raise them among large landowners. The gap between the OLS and IV estimates is not large, with the test of endogeneity bias failing to reject the hypothesis of absence of endogeneity at any significance level below 0.2. This assures us

<sup>19</sup>This is the same time period considered in Bardhan and Mookherjee (2011).

that the OLS estimates of the effects of the tenancy reform are reliable.<sup>20</sup>

The quantitative effect of the land reforms on the division rates implied by these estimates are not large. They are small especially when compared to the effects of demographic growth. We estimate growth in population of native households would have been associated with an increase in household size by approximately 1.3 members in the absence of division.<sup>21</sup> The linear probability model IV estimates in Table 14 implies that this would have increased the likelihood of household division in any given year by .135, whereas the tenancy program would have lowered this by .006.<sup>22</sup> Hence the effect of demographic growth was more than twenty five times the impact of tenancy registration.<sup>23</sup> The effect of land titles distributed is statistically insignificant in this Table. If we nevertheless use the estimated coefficient of -.354, we obtain a predicted impact of -.024 on the likelihood of household division. The total effect of the two land reform programs is -.03, which is still a quarter of the effect of demographic growth. The scale of the land reform program was thus far too small compared to the extent of population growth for it to matter quantitatively.

## 5.5 Regression Results for Land Market Transactions

Table 15 presents a logit regression for the event that a household engaged in a land sale. There is no evidence of any significant effects of lagged household size, but lagged landownership clearly matters. Consistent with the theory, columns 1 and 4 show a negative effect of the (log of the) ratio of lagged household size to landownership. The corresponding regression using household size and land as separate regressors shows landownership rather than household size to be the important determinant. Columns 3 and 6 show that the only significant effect of the land reforms appeared with the land distribution program raising likelihood of sales among large landowning households (consistent with the interpretation

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<sup>20</sup>Unfortunately, we have not succeeded in finding a set of instruments that can help predict land distribution implementation, so we cannot test for endogeneity bias with regard to that program specifically.

<sup>21</sup>We estimate native village population grew 22% between 1978 and 1998, using the number of village households from the indirect survey in Bardhan and Mookherjee (2006, 2010) and the average household sizes in these two years from the direct household survey. Applied to a mean household size of 5.7 in 1978, this implies household size would have expanded by approximately 1.3 members, in the absence of any division.

<sup>22</sup>The coefficient with respect to lagged household size is .104, which multiplied by 1.3 yields .135. The coefficient with respect to tenancy registration is -.102, which multiplied by the cumulative proportion of area registered of .057 yields -.006.

<sup>23</sup>Similar results obtain upon using the results of the logit specification. The marginal effects implied by Table 11 in the restricted sample (averaged across all households, with fixed effects set at zero) of household size was .046, of tenancy registration was -.023 and the land title program was .089. While the effect of household size is smaller than in the linear probability specification, the effects of the two land reform programs run in opposite directions and thus neutralize each other. This implies that adding 1.3 members to household size would imply a rise in division rates by approximately .059. In contrast, the cumulative effect of the tenancy reform was to lower division rates by .0017, while the land distribution program raised them by .0017, with an aggregate effect of zero.

of anticipated redistribution in the future). The tenancy reform did not have a significant effect on likelihood of sales.

Next, Table 16 presents the corresponding regression for likelihood of buying land. We see a converse negative effect of land owned. The tenancy reform raised probability of land purchases by small landowning households, while reducing it for large landowning households (those owning more than four acres). The land distribution program has significant effects only in the full sample, where it attenuated the reduction in the probability of purchase by large landowners. However this last result is not robust to the choice of sample.

In summary, the evidence shows that the land reforms induced greater activity in the land market. The tenancy reform raised (resp. lowered) the likelihood of small (resp. large) landowners buying land, while the land distribution program increased the likelihood of large landowners selling. These would have induced a drop in land inequality.

## 5.6 Immigration: Regression Results

Table 17 considers the determinants of village demographic share of post-1967 immigrants, in subsequent years. Columns 1 and 3 regresses the proportion of immigrants in the village sample, on contemporaneous average land per household in the village, and measures of land reform implemented so far, besides village and year dummies. Columns 2 and 4 present corresponding Arellano-Bond regressions with a lagged dependent variable. The first two columns use the proportion of land area covered by the two programs to measure program coverage, while the last two columns use proportion of the number of households residing in 1978 that were covered by the program after 1978. We use this latter measure because the demographic coverage of the programs may be more relevant to determining their impact on future immigration flows into the village. Even if the total amount of land distributed to the poor may be small in relation to the amount of land in the village, a high probability of receiving a land title to a small plot of land may induce potential immigrants to settle in the village. Moreover, wage rates and employment opportunities for hired labor may be more sensitive to the demographic measure of program size, as land title recipients are likely to switch from supplying labor on the local market to working on their own plots. The demographic measure of program coverage normalizes using as base the number of households residing in 1978, rather than the current number of households, to avoid the possibility that the latter may be endogenously affected by the reforms through their effect on division rates. Hence the regressions reported in the third and fourth columns are run with post-1978 data.

There is a significant negative coefficient on land availability, possibly reflecting a greater tendency for immigrants to settle in areas of high population density (owing to their concern for finding employment as workers). The fixed effect regressions without a lagged dependent variable in the first and third columns show contrasting effects of different measures of tenancy program coverage. The area-based measures in column 1 show that Operation

Barga implementation discouraged immigration (significant at 10%), while the demographic coverage measure in column 3 encouraged immigration (significant at 5%). Both measures of *patta* coverage, however, increased immigration (significant at 10%). These effects become statistically insignificant when a lagged dependent variable is included in the regression. Hence the results concerning effects on immigration are not robust to the specification.

## 5.7 Reduced Form Impact of Land Reforms on Land Inequality and Landlessness

From the preceding results, we expect tenancy reforms to have had a negative effect on inequality via their impact on division and market transactions.<sup>24</sup> The indirect effect of the land distribution program is less clear. Another important difference is that unlike the tenancy program, the latter program will have a direct impact on lands owned by the poor, reducing landlessness and inequality.

Table 18 presents a cross-village regression predicting 1998 inequality (measured either by the Gini coefficient or coefficient of variation) by the land reforms implemented since 1968, controlling for the level of inequality in 1968. Here the land title program (measured by the proportion of land area distributed) registers a significant negative coefficient, except in the Gini regression in the restricted sample. The predicted impact of the land distribution program on the coefficient of variation, for instance, ranges from a reduction of .019 to .053, which is approximately one-third to five-sixth of the observed increase in this inequality measure. However, the tenancy registration area does not have a significant effect on the change in inequality.

The significant inequality reducing impact of the land distribution program is likely to result from the direct effect of that program on landlessness. Approximately one in seven households in 1998, and one in five in 1978 had received a land title, so the direct impact on the proportion of landless population was sizeable. We have already seen from the decompositions that changes in landlessness was the principal factor driving rising inequality. To verify this interpretation, Table 19 runs a regression of the landlessness in 1998 on the proportion of households that were registered under Operation Barga and received land titles respectively, controlling for landlessness in 1978. All variables are expressed as a proportion of the number of 1978 households, to avoid the problem arising from endogeneity of the the number of households with respect to the land reforms. This regression shows that the *patta* program had a significant negative effect on landlessness, unlike Operation Barga.

However the estimated regression coefficient is 0.1, indicating that titles distributed to 27% of the 1978 population resulted in a decline in landlessness by approximately 2.7% twenty years later. On the other hand, the coefficient on the 1978 landlessness ratio is 0.88, implying that the direct effect of the program (assuming it all happened in the year

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<sup>24</sup>Using the area-based measure of tenancy registration, the same is true for the impact of the program on immigration, which was negative (column 1 in Table 17), implying a negative impact on landlessness.

1978) ought to have reduced landlessness in 1998 by 23.8%.<sup>25</sup> Since the actual impact is so much lower, this indicates that the indirect effects of the land distribution program, if anything, served to *increase* landlessness. This could have happened owing to the effect of the program in raising immigration into the village, or raising division rates among small landowners (though the evidence here is less clear, owing to the conflicting results from different specifications of the division regressions). In any case, we do not find evidence that the indirect effects of either land reform program accounted for a significant reduction in land inequality. The direct effects of the land distribution program on reducing landlessness, on the other hand, helped reduce land inequality.

## 6 Relation to Existing Literature

Papers by Foster and Rosenzweig (2002) and Guirkinger and Platteau (2011,2012) share our focus on the process of household division.

Foster and Rosenzweig's theory of household structure is based on a tradeoff between the benefits of grouping within the same household to take advantage of risk-sharing and scale economy benefits of household collective goods, with the costs in terms of resulting lack of diversity in consumption patterns. Their explanation predicts a rise in household division rates as a result of rising agricultural yields that result from technological progress, which increase the preference for consumption variety and reduce the need to stay together in a single household to realize the benefits of scale economies. They test their theory structurally using an all-India household panel. Our explanation of household division focuses instead on problems of land scarcity resulting from demographic growth, owing to rising incidence of free-riding in joint production activities. Moreover, we abstract from considerations of risk-sharing. Our approach predicts that rising agricultural yields owing to technical progress will reduce the rate of household divisions by reducing the tendency for free-riding in joint production activities, in contrast to their prediction that it will raise divisions by heightening intra-household conflict over joint consumption activities. In our field work we found many instances of households which continued to live in the same homestead and carry out production on commonly owned land jointly, while different units within the household cooked and ate in separate kitchens. This could reflect co-existence of both phenomena stressed by our respective approaches.

By focusing on problems of free-riding within household production activities and the role of land scarcity relative to household size, our theory of division is closer to that of Guirkinger and Platteau (2011). The main difference is that their intra-household model involves an asymmetric relationship involving rent extraction by a patriarch from other members. This is in contrast to the symmetric partnership among household members in our model, which

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<sup>25</sup>Of course the land titles were not all distributed in 1978 but later. Given the high degree of persistence in landlessness, the impact on the 1998 landlessness proportion would have been even higher.

is simpler as a result. Moreover, Guirkinger and Platteau's main interest is in predicting how land scarcity causes the patriarch to allocate a part of the household land as individual plots to other members. The latter divide their time between these individual plots and work on the collective family farm whose returns at the margin accrue to the patriarch. This is an asymmetric division of land and work between household members that we abstract from. Part of the reason is that our data does not identify such asymmetries within households. Guirkinger and Platteau (2012) test the predictions of their theory using a family survey from southern Mali, focusing mainly on allocation of land within the household between individual and communal plots. Our concern instead is to explain circumstances under which households will be induced to split into smaller households, individual members to exit, or the household to undertake land transactions.

A key feature distinguishing our paper from the ones cited above is the attention we devote to the question of the effect of land reforms on household division, land market transactions and land inequality. The effect of tenancy reforms on land inequality is addressed by Besley, Leight, Pande and Rao (2011) in the context of four south Indian states. Their theory emphasizes the reduced returns from tenancy and reduced willingness to lease out lands by landlords, encouraging them to sell land. More skilled farmers belonging to intermediate castes are able to buy more land as a result, hence land inequality declines. At the same time, less skilled farmers from lower castes are unable to lease in land, and are forced to become agricultural workers instead. Nevertheless the wage rate rises as a result of an increase in the demand for hired workers (owing to a rise in skill of cultivators). They confirm these predictions by comparing changes in land inequality, wage rates and occupational patterns across villages located near boundaries between states with differing tenancy regulations. Our paper differs from theirs owing to our focus on the process of household division. On the other hand it shares an interest in question of the indirect effect of tenancy regulations on land inequality, as well as the result that such regulations tend to lower inequality by increasing the likelihood of large landowners selling land. Our empirical work is in the context of a different state in India. Our analysis relies on longitudinal data, while theirs involves a cross-sectional analysis at state boundaries; accordingly the underlying identification assumptions are different. The land reform measures used are also different: we use area-based measures of land reforms implemented at the village level rather than the number of tenancy regulations at the state level.

## 7 Summary and Concluding Observations

The main question addressed by this paper concerns the effectiveness of land reforms in reducing land inequality, incorporating its effect on household division and land market transactions. We developed a theory of joint production within households whose members exhibit some degree of altruism toward one another, yet are not perfectly altruistic. This

implies that the household is subject to inefficient free-riding if the number of members exceeds a critical size, relative to the amount of land they own. This gives rise to division of the household, consisting either of a split into two cultivating households, or exit of some members to a labor market while others continue to cultivate, or a land market transaction (where it either purchases some land, or the household sells all its land and dissolves altogether). The size threshold for the household where it dissolves depends negatively on farm productivity and positively on the wage rate for hired workers.

The model implies that land reforms can affect household division and land market transactions through their impact on farm productivity and wages. Increases in farm profitability (via higher productivity or lower wages) reduce the likelihood of division, while raising the likelihood of land transactions between households of disparate ratios of land to household size. A tenancy regulation which reduces the profitability of leasing out land would similarly motivate landlords to sell their land. These economic channels of impact would be supplemented by political signaling effects, if implementation of land reforms signal an increased likelihood of stepped up implementation in the future. Households owning more land than the land ceiling regulation (and not yet affected by the regulations enacted so far owing to delays in enforcement) would be motivated to divide or sell land in order to pre-empt the application of the regulation to their own context.

While some of these effects are likely to reduce land inequality, others may increase inequality. Medium and small landholders would be motivated to divide so as to become eligible beneficiaries of land distribution programs. If farms are subject to some fixed costs or scale economies over some initial scale of cultivation, a household needs to own a minimum amount of land in order to remain viable cultivators. Increased division of small landholders owing to land reforms or population growth would then induce growing landlessness.

These predictions were tested in the context of West Bengal's experience over the last three decades of the 20th century. Measured in terms of proportion of land areas affected, the direct impacts of the land reforms in changing landownership patterns were negligible, compared with the effects of household division, market transactions and immigration. We subsequently estimated indirect effects of the reforms on land distribution through their impact on divisions, market transactions and immigration. We found evidence that they significantly affected household division rates and market transactions in ways consistent with theoretical predictions.

Yet these effects were quantitatively negligible owing to the small scale of the land reform, relative to the effects of population growth. The overall impact of the tenancy reform had no significant impact on observed changes in land inequality or landlessness. While by its very nature the tenancy reform does not affect the land distribution, it had indirect effects which reduced inequality but by a magnitude which was negligible in the face of the demographic growth. The land distribution program on the other hand had a direct effect in reducing landlessness and land inequality. But this was countered by higher rates of division among small landowning households which increased landlessness. The

land distribution program therefore reduced landlessness and inequality somewhat, but by an extent that was substantially smaller than would have been expected from the direct impact of that program on landlessness. These results stand in contrast to claims by some authors that the land reforms in West Bengal played an important role in reducing land inequality compared with neighboring states (see, e.g., Leiten, 1992).<sup>26</sup>

The results of this paper help one understand better some of the factors underlying growing landlessness in rural West Bengal, and the resulting pressure on its government to spur industrial growth in order to provide employment to the landless. These include the pressure of rising population, as well as a minimum viable scale of cultivation owing either to fixed costs or economies of scale over some initial scale of cultivation. The latter implies a possible scope for encouraging marginal landowning households to form cooperatives as a way of coping with the growing scarcity of land. Of course, such cooperatives would be prone to problems of free-riding, which may rationalize a management role for local governments.

A greater focus on demographic factors underlying the changing land distribution is also called for. In particular, the causes of high rates of division among small and marginal landowning households that induced rapid growth of landlessness need to be better understood. Did these arise from factors normally associated with later stages of demographic transition, wherein fertility rates drop among wealthier households but not to the same extent amongst poorer households? Or did mortality rates drop especially among poorer households? What was the role of health and education policies in generating these demographic patterns? What was the role of intra-household heterogeneity in education and age, or other conflicts within households with respect to collective consumption goods (stressed by Foster and Rosenzweig, 2002), rising incomes, insurance opportunities and changing cultural norms which undermined the traditional joint family?

Likewise, greater attention needs to be paid to determinants of land market transactions and immigration flows. We found evidence of an active land market, which served on the whole to equalize the land distribution. This suggests that fears regarding inequality-enhancing effects of deregulating land markets further may be unfounded. Immigration inflows seemed to respond positively to larger demographic coverage of land reforms, one of the reasons why landlessness may have increased as an indirect outcome of these reforms.

## References

- Appu P.S. (1996), *Land Reforms in India*, Delhi: Vikas Publishing House.  
Banerjee A., D. Mookherjee, K. Munshi and D. Ray (2001), 'Inequality, Control Rights and

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<sup>26</sup>Leiten argues on the basis of a number of village case studies that the land reforms in West Bengal were instrumental in lowering land inequality between 1970 and 1985, and in explaining why small and marginal landowners in the state own a larger proportion of land compared with neighboring states Bihar and Uttar Pradesh.

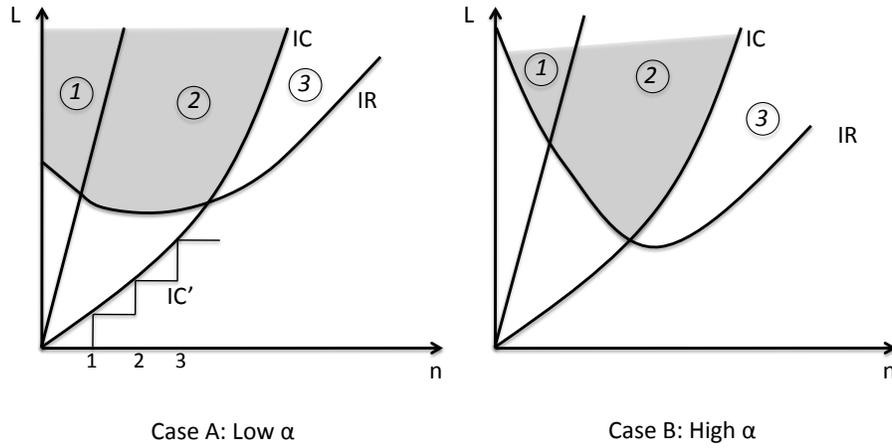
- Rent-Seeking: Sugar Cooperatives in Maharashtra,' *Journal of Political Economy*, 109(1), 138-190.
- Banerjee A., P. Gertler, and M. Ghatak (2002), 'Empowerment and Efficiency: Tenancy Reform in West Bengal,' *Journal of Political Economy*, 110(2), 239-280.
- Bardhan P. (2004), *Scarcity, Conflicts and Cooperation*, MIT Press, Cambridge MA.
- Bardhan, P. and D. Mookherjee (2010) 'Determinants of Redistributive Politics: An Empirical Analysis of Land Reforms in West Bengal, India,' *American Economic Review*, 100(4), 1572-1600.
- (2011), 'Subsidized Input Programs and Agricultural Performances: A Farm-Level Analysis of West Bengal's Green Revolution.' *American Economic Journal: Applied Microeconomics*, 3, 186-214.
- Bardhan, P., D. Mookherjee and Neha Kumar (2012), "State-Led or Market-Led Green Revolution? Role of Private Irrigation vis-a-vis Local Government Programs in West Bengal's Farm Productivity Growth," *Journal of Development Economics*, 99, 222-235.
- Berry A. and Cline W. (1979), *Agrarian Structure and Productivity in Developing Countries*, Baltimore: Johns Hopkins University Press.
- Besley T. and Burgess R. (2000) "Land Reform, Poverty Reduction and Growth: Evidence from India," *Quarterly Journal of Economics* 115, no. 2, 389-430.
- Besley T., J. Leight, R. Pande and V. Rao (2011), "The Regulation of Land Markets: Evidence from Tenancy Reform in India," working paper, World Bank Development Economics Research Division.
- Binswanger H., Deininger K., and Feder G. (1993), "Power, Distortions, Revolt and Reform in Agricultural Land Relations," in J. Behrman and T.N. Srinivasan (Ed.), *Handbook of Development Economics*, vol. III, Amsterdam: Elsevier.
- DFID (2004), 'Land Reform, Agriculture and Poverty Reduction,' Working Paper No. 5, Renewable Natural Resources and Agricultural Team, Department of Foreign Investment and Development, UK Government. <http://dfid-agriculture-consultation.nri.org/summaries/wp5.org>.
- Foster A. and M. Rosenzweig (2002), 'Household Division and Rural Economic Growth', *Review of Economic Studies*, 69(4), 839-869.
- Lieten G.K. (1992), *Continuity and Change in Rural West Bengal*, New Delhi: Sage Publications.
- C. Guirkingner and Platteau J-P (2011), 'Transformation of the Family under Rising Land Pressure: A Theoretical Essay,' working paper, University of Namur.
- (2012), "The Effect of Land Scarcity on Farm Structure: Empirical Evidence from Mali," *Economic Development and Cultural Change*, forthcoming.

Rawal, V. (2001), 'Agrarian Reform and Land Markets: A Study of Land Transactions in Two Villages of West Bengal, 1977-1995,' *Economic Development and Cultural Change*, University of Chicago Press, vol. 49(3), pages 611-29, April.

Sengupta S. and Gazdar H. (1996), 'Agrarian Politics and Rural Development in West Bengal,' in J. Dreze and A. Sen (Ed.), *Indian Development Selected Regional Perspectives*, Oxford University Press and WIDER-United Nations University.

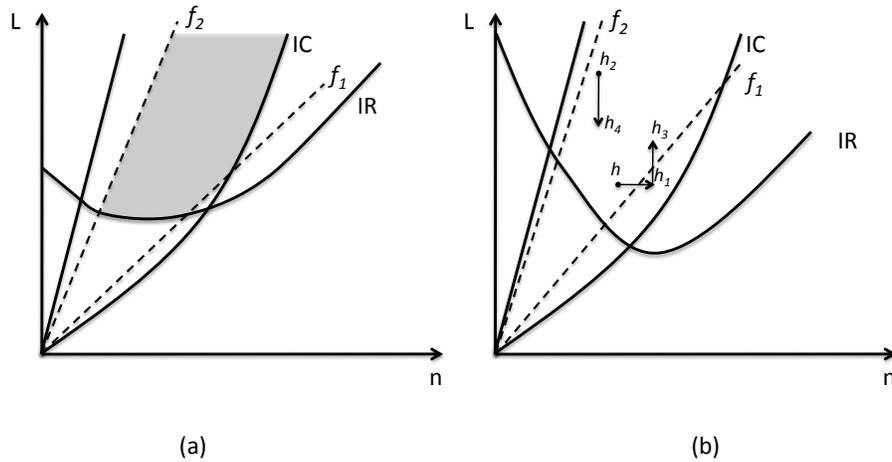
World Development Report 2008, *Agriculture for Development*, World Bank Publications, Washington DC.

**Figure 1:** Characterization of Stable Households without Land Market Transactions



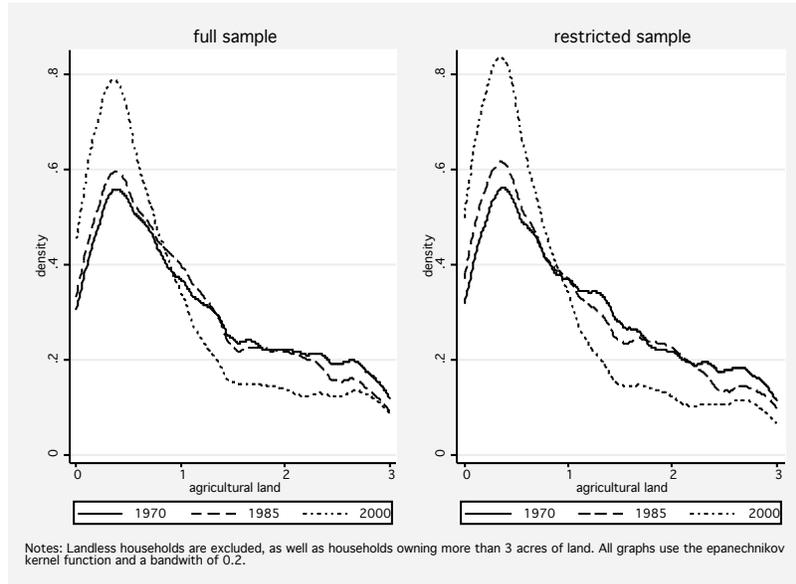
*Notes:* Stable areas are depicted in light grey. Area 1 is characterized by no free-riding ( $l^* = 1$ ), positive hired labor ( $h^* > 0$ ) and income increases in family size  $Y'(n) > 0$ . In area 2 there is no free-riding ( $l^* = 1$ ), no hired labor ( $h^* = 0$ ), and income increases in family size ( $Y' > 0$ ). Finally, in area 3 there is free-riding ( $l^* < 1$ ), no hired labor ( $h^* = 0$ ), and income does not increase in family size ( $Y' = 0$ ).

**Figure 2:** The Effect of Incorporating Land Market Transactions

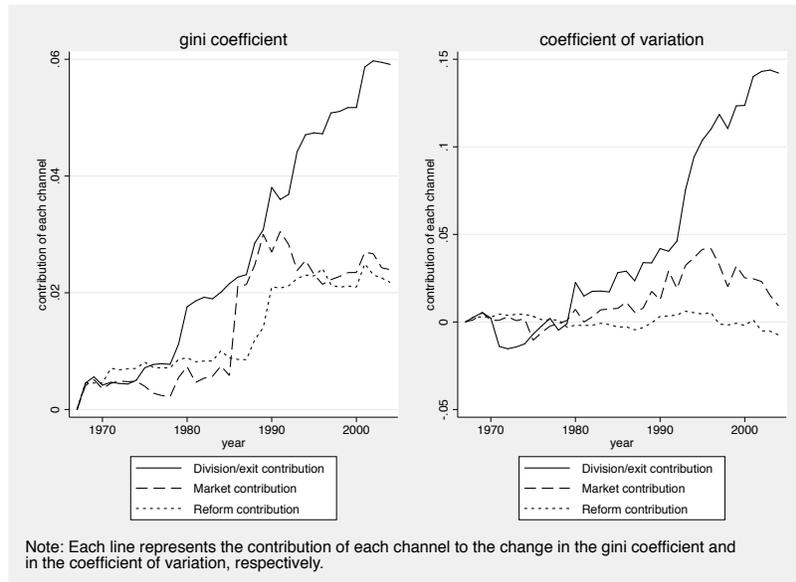


*Notes:* (a) Characterization of Stable Households with Land Market Transactions. (b) Land Transactions Induced by Expansion of Household Size.

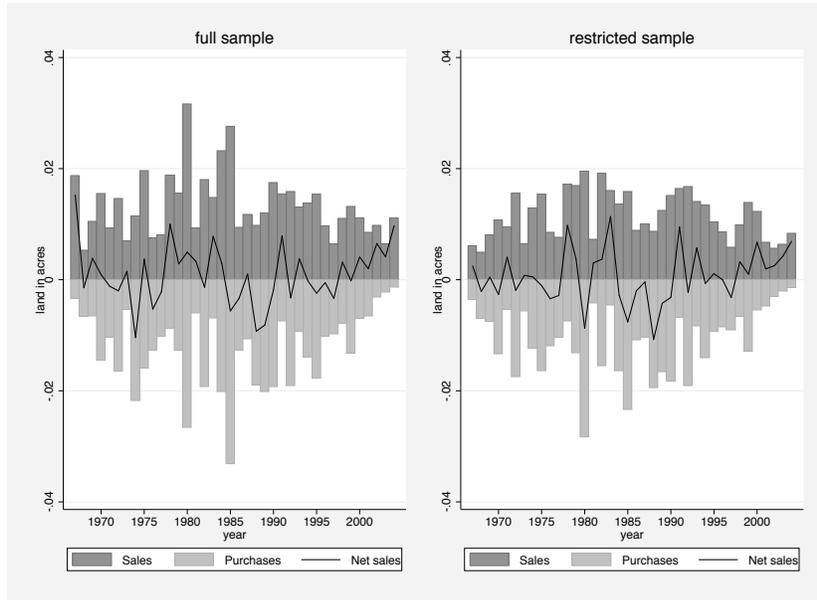
**Figure 3:** Agricultural land kernel densities, various years



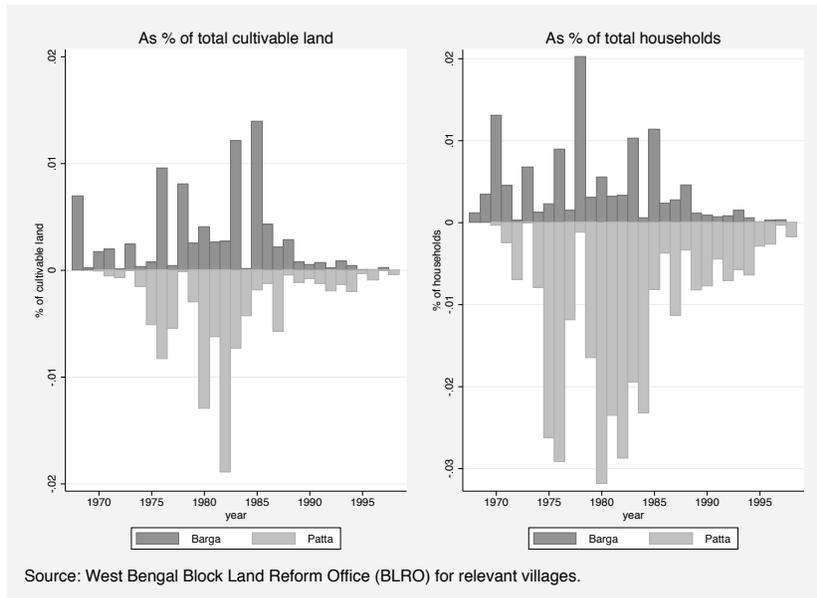
**Figure 4:** Average within-village land inequality, contribution by channel, restricted sample (1967-2004)



**Figure 5:** Land market: Sales and purchases per household (1967-2004)



**Figure 6:** Average land reform implemented, official land records (1968-1998)



Source: West Bengal Block Land Reform Office (BLRO) for relevant villages.

**Table 1:** Household division: Summary statistics

	#	Total	Mean	50th p.	75th p.	95th p.
(1) Death of member of the household	250	106.71	0.43	0.00	0.14	3.00
(2) Exit of spouse of head	18	15.88	0.88	0.03	2.00	2.82
(3) Out-marriage	365	203.96	0.56	0.01	0.66	2.00
(4) Division due to other reasons	3,940	3,648.24	0.67	0.06	0.70	3.16

*Notes:* All figures are in acres, except for #, the total number of events. Reasons stated in (4) include change in household size, change in income/expenditure, disputes, registration of tenants and threat of land reforms.

**Table 2:** Land, income, consumption and occupations

land category	Landless	Marginal	Small	Medium	Large	Big
A. Sources of Income (rupees)						
farm income	679	5,203	17,047	27,924	34,840	57,259
wage income	1,036	1,466	309	43	0	0
remittances	271	541	442	492	966	0
other income	139	52	454	1,022	765	0
total	2,126	7,262	18,251	29,481	36,572	57,259
B. Consumption (food and durable goods)						
Two meals a day (%)	88.22	91.01	96.92	97.66	97.99	92.59
Own house (%)	81.59	92.16	94.62	97.27	97.99	100.00
At least one cow (%)	55.56	65.85	80.00	87.50	90.60	92.59
TV (%)	26.76	25.16	49.23	53.91	72.48	85.19
Radio (%)	35.52	38.40	45.38	45.70	54.36	70.37
Refrigerator (%)	2.86	1.63	6.15	8.98	15.44	22.22
C. Occupation of adults in the household						
Housework (%)	37.38	37.40	35.88	36.73	36.90	34.31
Student (%)	6.86	8.20	12.81	12.54	12.61	17.05
Employee (%)	5.56	4.56	4.43	4.84	7.05	6.91
Non-agricultural worker (%)	39.12	25.96	17.91	14.54	16.26	17.64
Agricultural worker (%)	10.07	11.95	1.97	1.48	0.56	0.00
Own cultivator (%)	0.59	11.68	26.31	29.07	26.02	23.16
N	1,222	612	130	256	149	27

*Notes:* Data comes from responses at the time of the survey (2004). Land categories are defined as follows. Landless households do not own agricultural land, marginal households own between 0 and 1.25 acres, small households own between 1.25 and 2.5 acres, medium households own between 2.5 and 5 acres, large households own between 5 and 10 acres, and big households own more than 10 acres.

**Table 3:** Share of multiple-male households engaged in own cultivation with at least one pair of siblings

land category	Landless	Marginal	Small	Medium	Large	Big
mean	0	0.318	0.419	0.590	0.692	0.733
25th perc.	0	0	0	0	0	0
50th perc.	0	0	0	1	1	1
75th perc.	0	1	1	1	1	1
N	1,222	612	130	256	149	27

*Notes:* The numerator counts households with at least one pair of siblings engaged in own cultivation, while the denominator counts households with more than 1 male adult engaged in own cultivation. Land categories are defined in table 2.

**Table 4:** Comparing samples

	Full Sample (1)	Restricted Sample (2)	Difference between columns 1 and 2 (3)
Household size	5.159 (2.496)	5.098 (2.389)	0.065 (0.074)
Fraction of immigrant households	0.303 (0.460)	0.332 (0.471)	-0.046 (0.013)***
Total agricultural land	1.100 (2.265)	0.950 (2.081)	0.208 (0.063)***
Irrigated agricultural land	0.732 (1.785)	0.658 (1.582)	0.161 (0.051)**
Unirrigated agricultural land	0.368 (1.287)	0.346 (1.219)	0.047 (0.034)
% Landless	53.42	56.60	
% Marginal (between 0 and 1.25 acres)	25.11	24.46	
% Small (between 1.25 and 2.5 acres)	5.13	4.90	
% Medium (between 2.5 and 5 acres)	9.51	8.29	
% Large (between 5 and 10 acres)	5.58	4.74	
% Big (more than 10 acres)	1.26	1.01	
N	2402	1697	

*Notes:* Columns 1 and 2 report means with standard errors in parentheses. Means are computed using only survey answers for the year 2004. Column 2 includes those households for which both the constructed land holding and family size matched the reported in 2004. Column 3 reports tests for differences of means across columns 1 and 2. Robust standard errors are in parentheses. Tests are based on regressions with village fixed effects.

**Table 5:** Landownership, household size and immigration

Variable	statistic	1967	1976	1985	1994	2004
A. Full Sample						
Land per household	(mean)	2.908	2.418	1.973	1.557	1.228
	(50th perc.)	0.720	0.620	0.330	0.160	0.000
	(75th perc.)	3.662	3.320	2.660	1.840	1.060
Share of landless	-	0.344	0.376	0.416	0.461	0.505
Household size	(mean)	6.332	5.763	5.158	5.074	5.216
	(50th perc.)	6.000	6.000	5.000	5.000	5.000
	(75th perc.)	8.000	7.000	7.000	6.000	6.000
Land per capita	(mean)	0.621	0.509	0.407	0.306	0.230
	(50th perc.)	0.129	0.109	0.080	0.033	0.000
	(75th perc.)	0.611	0.556	0.500	0.370	0.238
Land per capita (only natives)	(mean)	0.622	0.531	0.446	0.355	0.270
	(50th perc.)	0.132	0.125	0.113	0.075	0.047
	(75th perc.)	0.611	0.600	0.563	0.472	0.364
Share of immigrants	-	0.002	0.073	0.143	0.233	0.278
Share of immigrants from Bangladesh	-	0.001	0.018	0.033	0.062	0.065
B. Restricted Sample						
Land per household	(mean)	2.170	1.869	1.523	1.204	0.950
	(50th perc.)	0.500	0.330	0.100	0.000	0.000
	(75th perc.)	2.865	2.640	1.980	1.000	0.660
Share of landless	-	0.378	0.426	0.475	0.527	0.566
Household size	(mean)	5.937	5.433	4.785	4.843	5.098
	(50th perc.)	6.000	5.000	5.000	5.000	5.000
	(75th perc.)	7.000	7.000	6.000	6.000	6.000
Land per capita	(mean)	0.407	0.366	0.303	0.234	0.184
	(50th perc.)	0.096	0.060	0.026	0.000	0.000
	(75th perc.)	0.500	0.447	0.383	0.244	0.143
Land per capita (only natives)	(mean)	0.408	0.385	0.340	0.285	0.222
	(50th perc.)	0.096	0.083	0.080	0.043	0.027
	(75th perc.)	0.500	0.500	0.473	0.350	0.250
Share of immigrants	-	0.002	0.089	0.169	0.278	0.332
Share of immigrants from Bangladesh	-	0.001	0.021	0.041	0.075	0.077

*Notes:* Land includes only agricultural land. Household size includes all members (adults and children).

**Table 6:** Changes in cultivable land and number of households, indirect survey

	Obs.	Mean	Std. Dev.	Min	Max
	Initial report prior to 1980				
Cultivable land in initial year	63	358.5	303.6	18.0	1265.5
Cultivable land in 1998	63	360.2	283.3	26.2	1304.0
No. households in initial year	63	231.0	219.5	24.0	1083.0
No. households in 1998	63	419.5	380.3	47.0	1692.0
	Initial report on or after 1980				
Cultivable land in initial year	26	230.6	170.1	4.6	642.7
Cultivable land in 1998	26	217.6	149.2	9.6	495.3
No. households in initial year	26	236.7	156.0	18.0	759.0
No. households in 1998	26	346.7	186.9	60.0	770.0

*Notes:* Cultivable land is measured in acres. Date of initial report varies by village. Among those with reports prior to 1980, 46 villages report cultivable land in 1977, 14 in 1978 and 3 in 1979. Among those with reports on or after 1980, 1 village reports cultivable land in 1980, 1 in 1981, 23 in 1983, and 1 in 1984.

**Table 7:** Determinants of decrease in land holdings: cumulative changes at the household level, only natives (1967-2004)

Sample:	full	restricted
Land in 1967	2.862	2.143
Land change	-1.370	-0.926
Lost due to land division	-1.108	-0.785
Lost through sales	-0.557	-0.475
Gained through purchases	0.467	0.373
Lost due to reform	-0.097	-0.018
Gained due to reform	0.034	0.028
Lost as a gift	-0.116	-0.097
Gained as a gift	0.030	0.032
Lost for other reasons	-0.060	-0.024
Gained for other reasons	0.011	0.012

*Notes:* All numbers indicate average acres gained or lost per household. The category *Lost for other reasons* includes forced transfer, mortgaged, and lost due to natural disasters. All data comes from the household survey.

**Table 8:** Changes in land distribution, selected years (restricted sample)

	1967	1976	1985	1994	2004
A. Within-village inequality measures					
gini coefficient	0.553	0.568	0.594	0.636	0.649
coefficient of variation	1.365	1.411	1.517	1.653	1.734
B. Share of households by land category					
Landless	37.77	42.64	47.52	52.66	56.60
Marginal	22.61	20.84	21.99	24.22	24.46
Small	11.97	11.06	9.55	6.06	4.90
Medium	13.48	13.60	11.39	9.30	8.29
Large	10.20	8.59	7.07	6.24	4.74
Big	3.99	3.26	2.48	1.53	1.01

**Table 9:** Division rates and proportion of land lost, in different size classes 1967-2004 (restricted sample)

Land Class	% of households	% land lost
Landless	4.46	0.21
Marginal	4.43	1.07
Small	4.83	1.52
Medium	4.53	1.19
Large	4.19	1.05
Big	5.03	1.51

*Notes:* The first column shows the annual proportion of households that divided in a given period of time. The second column indicates the proportion of land that households lost due to division. Division means one or more members left the household. Numbers are percentages.

**Table 10:** Proportion of households experiencing transactions, land reform and divisions (1967-2004)

Sample:	full	restricted
Sales	0.257	0.238
Purchases	0.229	0.211
Lost due to reform	0.007	0.004
Gained due to reform	0.036	0.036
Exits and division	0.685	0.638

*Notes:* All numbers indicate the proportion of households with at least one event (sale, purchase, etc) between 1967 and 2004.

**Table 11:** Determinants of household division, using past reform, average of last three years (logit)

Dep. Variable: Sample:	Probability of division					
	full			restricted		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged HH size	0.417*** (0.028)	0.448*** (0.032)	0.448*** (0.032)	0.496*** (0.037)	0.521*** (0.040)	0.521*** (0.040)
Lagged land	0.125*** (0.043)	0.067 (0.046)	0.068 (0.047)	0.117*** (0.040)	0.067 (0.053)	0.067 (0.053)
% land registered		-0.268*** (0.053)	-0.311*** (0.053)		-1.043** (0.483)	-1.690*** (0.600)
Lagged land*% land registered		0.074*** (0.027)	0.084*** (0.020)		0.258** (0.104)	0.394*** (0.120)
above-ceiling dummy		1.219** (0.497)	1.216** (0.497)		0.538 (0.689)	0.489 (0.666)
% land distributed			0.850*** (0.116)			1.425*** (0.301)
Lagged land*% land distributed			-0.000 (0.100)			0.112 (0.256)
Observations	40,621	36,870	36,870	28,011	25,442	25,442
Pseudo $R^2$	0.087	0.091	0.091	0.094	0.097	0.098

*Notes:* Logit coefficients reported with robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects. The variables % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village, using official land records. ( \*\*\* p<0.01, \*\* p<0.05, \* p<0.1)

**Table 12:** Determinants of land lost by households due to division

Dep. Variable: Sample:	Land lost due to division in acres					
	full			restricted		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged HH size	0.016*** (0.003)	0.019*** (0.004)	0.018*** (0.004)	0.009** (0.004)	0.013*** (0.003)	0.013*** (0.004)
Lagged land	0.051*** (0.010)	0.040** (0.016)	0.039** (0.016)	0.069*** (0.019)	0.038*** (0.007)	0.037*** (0.007)
% land registered		-0.002 (0.007)	-0.002 (0.007)		-0.007 (0.008)	-0.008 (0.008)
Lagged land*% land registered		-0.002 (0.006)	-0.002 (0.006)		0.002 (0.008)	0.003 (0.008)
above-ceiling dummy		0.176 (0.122)	0.172 (0.121)		0.091 (0.110)	0.075 (0.110)
% land distributed			-0.194 (0.168)			-0.166 (0.229)
Lagged land*% land distributed			0.096 (0.087)			0.215 (0.259)
Constant	-0.148*** (0.032)	-0.190*** (0.036)	-0.188*** (0.036)	-0.120*** (0.027)	-0.134*** (0.022)	-0.132*** (0.022)
Observations	58,765	54,175	54,175	41,536	38,190	38,190
R-squared	0.030	0.027	0.028	0.035	0.019	0.022
Number of households	2,304	2,268	2,268	1,681	1,649	1,649

*Notes:* OLS coefficients reported with robust standard errors in parentheses, adjusted for clustering on villages. The regressions include observations where there was no land lost (coded as a zero). All regressions include year dummies and household fixed effects. The variables % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village, using official records. ( \*\*\* p<0.01, \*\* p<0.05, \* p<0.1)

**Table 13:** First stage of IV regressions (full sample, 1982-1996)

Dep. Variable: Sample (landowners):	Cum. % Land Registered	
	small (1)	large (2)
$LS_{v,t-1}$	50.475*** (14.275)	42.852*** (11.903)
$LS_{v,t-1}^2$	-32.186*** (10.786)	-19.058* (11.078)
$INC_t * LS_{v,t-1}$	-43.248*** (12.232)	-49.428*** (10.059)
$AVSD_{vt}$	-46.802** (18.693)	-38.032** (16.919)
$AVSD_{vt} * LS_{v,t-1} * INC_t$	24.821* (14.683)	45.838** (20.920)
$AVSD_{vt} * LS_{v,t-1}$	-134.143 (99.664)	-112.481 (85.688)
$AVSD_{vt} * LS_{v,t-1}^2$	165.691* (94.534)	113.267 (92.387)
Observations	5,650	1,529
F-test	8.87	8.75
Number of households	1,319	383
Adjusted R-squared	0.550	0.623

*Notes:* Robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects, as well as the number of households, rainfall, GP local irrigation and road expenditures, log price of rice, canals and roads in district. Political variables (LS, INC, AVSD and interactions) are cumulated and scaled by the amount of cultivable land in the village. Small landowners are households with less than 2.5 acres of cultivable land. ( \*\*\* p<0.01, \*\* p<0.05, \* p<0.1)

**Table 14:** IV and OLS estimates of effects of tenancy reform on likelihood of household division (linear probability model, full sample, 1982-96)

Dep. Variable: Sample (landowners):	Probability of division			
	small		large	
Model:	OLS (1)	IV (2)	OLS (3)	IV (4)
Cumulative % Land Registered	-0.158*** (0.021)	-0.102** (0.048)	0.215*** (0.021)	0.316** (0.129)
Cumulative % Land Distributed	-0.364** (0.139)	-0.354 (0.224)	-0.206 (0.183)	-0.084 (0.345)
Lagged HH Size	0.104*** (0.010)	0.104*** (0.010)	0.081*** (0.011)	0.076*** (0.010)
Lagged Land	0.048 (0.065)	0.057 (0.065)	0.004 (0.003)	0.006 (0.004)
Observations	5,768	5,650	1,583	1,529
Number of households	1,437	1,319	437	383
R-squared <sup>a</sup>	0.093	0.095	0.082	0.079
Kleibergen-Paap under-id test (p-value)		0.988		0.989
Hansen's J over-id test (p-value)		0.588		0.609
Endogeneity test for Barga (p-value):		0.262		0.191
First stage F-test		8.87		8.75
First stage F-test (excl. inst.)		7.74		8.37

*Notes:* Robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects. The variables % land registered and distributed are computed as the cumulative percentage of total land, using official land records. Small landowners are households with less than 2.5 acres of cultivable land. % land registered is instrumented using cumulative lagged share of Left share in local government and its square, cumulative % of INC seats in parliament, cumulative average vote share difference in the district, as well as the number of households, rainfall, GP local irrigation and road expenditures, log price of rice, canals and roads in district, as described in the text. <sup>a</sup> Adjusted R-squared in (1) and (3), and centered R-squared in (2) and (4) ( \*\*\* p<0.01, \*\* p<0.05, \* p<0.1)

**Table 15:** Determinants of land sales, using lagged land reform, average for past 3 years (logit)

Dep. Variable: Sample:	Pr(land sale)					
	full			restricted		
	(1)	(2)	(3)	(4)	(5)	(6)
$\log\left(\frac{\text{Lagged HH Size}}{\text{Lagged land}}\right)$	-0.908*** (0.184)			-1.086*** (0.161)		
Lagged HH Size		0.038 (0.039)	0.038 (0.043)		-0.020 (0.047)	-0.020 (0.050)
Lagged land		0.130** (0.053)	0.127** (0.050)		0.480*** (0.067)	0.482*** (0.077)
% land registered			0.028 (0.560)			-0.008 (0.810)
Lagged land*% land registered			-0.108 (0.251)			-0.085 (0.372)
% land distributed			-0.877 (1.042)			-2.492 (1.764)
Lagged land*% land distributed			0.433** (0.185)			0.334* (0.181)
above-ceiling dummy			0.317 (0.340)			0.371 (0.444)
Observations	12,612	12,612	11,483	8,623	8,623	7,837
Pseudo $R^2$	0.064	0.052	0.050	0.081	0.083	0.082

*Notes:* Robust standard errors in parentheses, adjusted for clustering on villages. Regressions include household fixed effects and year dummies. % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village. ( \*\*\* p<0.01, \*\* p<0.05, \* p<0.1)

**Table 16:** Determinants of land purchases, using lagged land reform, average for past 3 years (logit)

Dep. Variable: Sample:	Pr(land purchase)					
	full			restricted		
	(1)	(2)	(3)	(4)	(5)	(6)
$\log\left(\frac{\text{Lagged HH Size}}{\text{Lagged land}}\right)$	0.063** (0.028)			0.054 (0.036)		
Lagged HH Size		0.016 (0.038)	0.012 (0.038)		0.003 (0.048)	-0.010 (0.048)
Lagged land		-0.214*** (0.052)	-0.252*** (0.052)		-0.248*** (0.055)	-0.227*** (0.056)
% land registered			0.489*** (0.081)			0.482*** (0.078)
Lagged land*% land registered			-0.121** (0.056)			-0.143*** (0.045)
% land distributed			-1.495 (1.352)			0.479 (3.057)
Lagged land*% land distributed			0.715*** (0.250)			-0.054 (0.887)
above-ceiling dummy			0.926** (0.472)			-0.004 (0.541)
Observations	10,438	10,438	9,546	6,952	6,952	6,339
Pseudo $R^2$	0.0394	0.0532	0.0519	0.0459	0.0600	0.0572

*Notes:* Robust standard errors in parentheses, adjusted for clustering on villages. Regressions include household fixed effects and year dummies. % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village. ( \*\*\* p<0.01, \*\* p<0.05, \* p<0.1)

**Table 17:** Determinants of immigration, village panel (restricted sample)

Dependent variable: Proportion of post-1967 immigrant households in village				
	(1)	(2)	(3)	(4)
	Fixed	Arellano	Fixed	Arellano
	Effects	Bond	Effects	Bond
Lagged share of immigrants		0.428***		0.428***
		(0.120)		(0.120)
Lagged land per capita	-0.098*	0.016	-0.098*	0.016
	(0.053)	(0.027)	(0.053)	(0.027)
Lagged % land registered	-0.002*	-0.000		
	(0.001)	(0.001)		
Lagged % land distributed	0.030*	0.006		
	(0.015)	(0.010)		
Lagged % households registered			-0.010	0.002
			(0.027)	(0.005)
Lagged % households distributed			0.011	0.001
			(0.015)	(0.009)
Constant	0.082***	0.136***	0.094***	0.136***
	(0.027)	(0.033)	(0.026)	(0.033)
Adjusted R-squared	0.450		0.393	
p-value from test for f.o. autocorr.		0.000		0.000
p-value from test for s.o. autocorr.		0.599		0.192
Observations	2,666	2,577	1,869	1,869
No. villages	89	89	89	89

*Notes:* Robust standard errors in parentheses, adjusted for clustering on villages. Regressions include village and year fixed effects. In (1) and (2), % land registered and % land distributed are computed as the proportion of land affected by each program over the total cultivable land in each village. In (3) and (4), % households registered and % households distributed are computed as the proportion of households affected by each program over the total number of 1978 households per village. For these columns only data post-1978 is used. All measures of land registration and land distribution are computed on the basis of official land records. ( \*\*\* p<0.01, \*\* p<0.05, \* p<0.1)

**Table 18:** The effect of land reform on inequality: cross section village regressions

sample	full		restricted	
	Gini in 1998 (1)	CV in 1998 (2)	Gini in 1998 (3)	CV in 1998 (4)
Dependent variable:				
gini coefficient in 1968	0.652*** (0.126)		0.658*** (0.125)	
coefficient of variation in 1968		0.756*** (0.135)		0.897*** (0.137)
cumulative % land registered	0.002 (0.004)	0.028 (0.019)	-0.018 (0.015)	0.039 (0.052)
cumulative % land distributed	-0.063** (0.030)	-0.384** (0.147)	-0.103 (0.123)	-1.057** (0.488)
Constant	0.266*** (0.071)	0.559*** (0.163)	0.297*** (0.080)	0.539*** (0.166)
Adjusted $R^2$	0.344	0.418	0.563	0.442
Observations	89	88	88	83

*Notes:* Robust standard errors in parentheses. Cumulative % land registered and % land distributed are computed as the share of total land affected by each program over the total cultivable land in each village. ( \*\*\* p<0.01, \*\* p<0.05, \* p<0.1)

**Table 19:** The effect of land reform on the proportion of landless households: cross section village regressions (full sample)

Dependent variable: 1998 landless households as a proportion of 1978 households	
proportion landless in 1978	0.894*** (0.071)
barga registration as proportion of 1978 hhs	0.065 (0.040)
pattas distributed as proportion of 1978 hhs	-0.104** (0.035)
Constant	0.108*** (0.029)
Adjusted $R^2$	.71
Observations	89

*Notes:* Robust standard errors in parentheses. Dependent variable is number of 1998 landless households divided by number of 1978 households in each village. Regressors are corresponding number of households landless in 1978, numbers registered under Operation Barga and given pattas between 1978 and 1998 respectively, divided by number of 1978 households. ( \*\*\* p<0.01, \*\* p<0.05, \* p<0.1)