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

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Abstract

This paper uses recall data from a household survey to evaluate the roles of land reforms and demographic changes in explaining changes in land distribution in West Bengal between 1967-2004. The direct role of the land reforms was insignificant relative to household division, migration and land market transactions. We develop a model of how household division and market transactions are affected by demographic changes and land reforms, and find the evidence consistent with these predictions. However the tenancy registration program did not significantly reduce inequality, while the land title program reduced inequality by reducing landlessness directly.

1 Introduction

Land is the pre-eminent asset in rural sectors of developing countries, the primary determinant of livelihoods of the poor. Many developing countries have recently experienced marked reductions in per capita and per household landownership, a factor that has reduced the ability of the rural poor to sustain their livelihoods from traditional agricultural occupations, inducing a 'push' towards non-agricultural occupations. Over the past half century various parts of India have witnessed a rapid increase in proportion of small landowning households

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vis-a-vis large landowning households.[1] This paper focuses on the eastern Indian state of West Bengal, and documents striking reductions in land owned per household as well as per capita, accompanied by sharp increases in landlessness from one-third of village populations in the late 1960s to nearly a half by 2004. Land inequality has risen sharply as a consequence, with possibly adverse impacts on agricultural productivity, poverty, local governance and social capital as argued by a large literature (Berry and Cline (1979), Binswanger et al (1993), Banerjee et al (2001), Banerjee, Gertler and Ghatak (2002), Bardhan (2004)). This raises the question of the possible role of land reform programs in lowering land inequality.

This paper uses recall data from a 2004 household survey from 89 villages spread throughout agricultural areas of West Bengal to estimate changes in land distribution at the household level over the period since 1967, and their underlying causes. We find high rates of household division, immigration, and land market transactions each of which affected the land distribution. This period also witnessed two major land reform programs, a tenancy registration program called Operation Barga, and a program for distributing titles (*pattas*) over small plots of land to the poor. The former program capped rents paid to landlords and protected registered tenants from eviction. The latter program distributed plots of land previously appropriated from large landowners owning more land than a permitted ceiling, to landless and marginal landowning households. The coverage of these programs was large compared with other Indian states. For the state as a whole, P.S. Appu (1996, Appendix IV.3) estimates the extent of land distributed in West Bengal until 1992 at 6.72% of its operated area, against a national average of 1.34%. In our sample, approximately 6.7% of agricultural land had been distributed in the form of land titles to the poor by 1998. The demographic coverage of the program was much larger, with 27% of households in 1978 (and 15.6% of households in 1998) in the villages in our sample receiving land titles over the subsequent twenty years. The Barga program registered a significant proportion of tenants (two thirds for the state as a whole in 1993 according to Banerjee et al (2002), and 51% in our sample in 1998), amounting to 4.5% of the 1998 population, and covering 5.7% of agricultural land.[2] These programs have been studied by a number of authors such as Banerjee, Gertler and Ghatak (2002), Bardhan and Mookherjee (2010, 2011), Lieten (1992), Saha and Swaminathan (1994), Sengupta and Gazdar (1996). These studies have mostly focused on the impacts of these reforms on measures of agricultural productivity such as rice yields or value added per acre at the district or farm levels, rather than on the land distribution itself.

A small number of village case studies (e.g., Lieten (1992), Sengupta and Gazdar (1996), Rawal (2001)) have examined changes in land distribution and land market transactions.

[1] See for instance Banerjee et al (2001) and Das and Mookherjee (2004) for states of Maharashtra and Uttar Pradesh respectively.

[2] These are weighted averages of 87 villages in our sample, where we drop two villages owing to some obvious mistakes in the land reform data where the area coverage of the program greatly exceeded the total cultivable area in those villages. This explains the slight discrepancy of these numbers from those reported in Bardhan and Mookherjee (2010, 2011).

Some commentators (e.g., Lieten (1992) have informally argued 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. Yet Bardhan and Mookherjee (2010, 2011) have noted that the land reforms involved a relatively small fraction of agricultural land, and that the bulk of the observed changes in the land distribution reflect changes in landownership owing to household division and market transactions. This raises the question of the extent to which these social and market processes may have been indirectly affected by the land reforms.

The effect of land reforms on the land distribution is a complex issue since these programs are likely to affect processes of household division, land market transactions and immigration all of which play an important role in the evolution of land distributions. This paper develops a theoretical framework to analyze this issue, and subsequently uses the West Bengal survey data to examine various channels of influence. Besides, we are also interested in understanding the role of demographic factors driving changes in the land distribution, such as population increases owing to natural reasons besides immigration. Whether or not the land market is active is another classic question in development economics on which empirical evidence is rare. Even if it is active, whether the land market tends to equalize or disequalize the land distribution has an important bearing on debates concerning regulation of land markets.[3]

We utilize data from a survey of approximately 25 households in each village which was conducted in 2004-05. It was designed to trace the land histories of each household since 1967. These include details of land purchases and sales, land appropriated or distributed by land reform authorities, household divisions, immigration, exits of family members as well as major demographic changes such as marriages, births and deaths. Further details of the survey are provided in Section 2. One fourth of the households surveyed provided responses with some internal inconsistency across the time span covered by their respective land histories. Accordingly we explore robustness of all results in the paper to the choice of the full sample (with a particular procedure used to create a consistent history for every household) as well as the restricted sample which drops households with inconsistent responses. Section 3 presents key descriptive statistics, which show significant declines in mean household and per capita landholdings, rising landlessness and inequality.

A decomposition analysis of changing inequality shows that the most important factor underlying changes in the land distribution was division of households, defined to include

[3]Arguments for regulation typically argue that the land market is thin, and most transactions tend to take the form of distress sales wherein small and marginal landowners sell their land to large landowners. Proponents of deregulation emphasize the role of a vibrant land market in allowing more able farmers to expand their operations by buying out the land of less productive farmers, and argue that the land market tends to equalize landholdings as small farms tend to be more productive than large farms. See, for instance, the 2008 World Development Report (Chapter 6) or DFID (2004)).

both household splits and exit of individual members.[4] Much of the increased inequality was associated with rising landlessness, induced by high rates of division of small and marginal landowning households, and immigration. Division of large landowning households tended to reduce inequality, but these were dominated by division of smaller landowning households. A non-parametrically estimated density of the land distribution at different points of time shows increased concentration at a peak of around half an acre throughout the sample period, with a sharp drop of the density below this level. Hence division of small landowning households resulted in a rising proportion of cultivating households at the minimum landholding scale that remained roughly stationary, along with rising landlessness. A secondary contributory factor was immigration. Land markets were active, and tended to reduce inequality somewhat by an extent sensitive to the choice of inequality measure. A decomposition analysis indicates the effect of the land reforms on inequality to be sensitive to the choice of inequality measure. To understand the effect of land reforms better, the remainder of the paper explores various channels, indirect as well as direct, through which they may affect changes in inequality.

Section 4 provides a simple theoretical model of household division, including both exits and splits, which illustrates the role of changing demographics, agricultural profitability and land reforms. The model focuses on problems faced by households when they share ownership of productive resources such as land (similar to Guirkinger and Platteau (2009)), rather than from the consumption of household collective goods and heterogeneity within the household (stressed by Foster and Rosenzweig (2002)).[5] Households are characterized by their labor and land endowments, defined by household size and landownership respectively. Household members are assumed to work jointly on their farm, share the returns equally and divide their time between the family farm and a local labor market with an exogenously determined wage. Household production is subject to constant returns to scale in land and labor, but cultivation entails a fixed cost which creates a source of scale economy and a minimum viable landholding size (which is endogenously determined).[6] With limited altruism within the household, a classic free riding problem emerges, which becomes more acute as the number

[4] In the data we found it difficult to distinguish between splits and exits, despite designing the survey to make an effort to do so.

[5] The main difference from the Guirkinger-Platteau theory is that we model households as involving a symmetric relationship among members, whereas they assume a patriarch faces a problem of maximizing residual claims after paying other household members. Their main interest is to use the model to explain observed phenomena in Mali, wherein collective plots co-exist with individual plots within the same household. We are concerned instead to explain circumstances under which households will be induced to split into smaller households, or individual members to exit. Foster and Rosenzweig (2002) provide an interesting analysis of household division based on shared consumption of household public goods and heterogeneity within the household, rather than problems with free riding in joint production efforts on commonly owned lands. They apply this to structurally estimate household division in an all-India household sample.

[6] However, such a minimum viable size would arise even in the absence of fixed costs of cultivation, owing to the need to ensure that members attain a payoff that is not dominated by the option of working full time on the labor market.

of household members rises relative to the land owned. When the number of household members rises sufficiently owing to (exogenous) demographic factors, the equilibrium payoffs of each member declines owing both to diminishing returns to labor as well as heightened free riding within the household. This creates pressure either for some members to exit, or for the household to split into two smaller households. A stable distribution entails no incentives for household splits or exits for any household in the support of the distribution. When land market transactions are introduced subject to a fixed transaction cost per unit land, it additionally entails no incentives for households to buy and sell land to one another, which reduces to a bound on land-labor ratios across cultivating households. Starting with a stable distribution, the model explains how demographic growth which results in rising household sizes within cultivating households results in either an exit, a split or a land purchase, resulting in a move to a new stable distribution. Increases in agricultural profitability attenuate the incidence of household division (defined to be either exits or splits), while raising the likelihood of land transactions.

Extending the model to accommodate land reforms as well as political effects, we obtain the following predictions. There are two important channels by which these reforms can affect the process of household division and land market transactions. One is through their effect on agricultural profitability, the other through their effects on further redistribution anticipated in the future. Consider Operation Barga. The evidence from earlier work on West Bengal (Bardhan and Mookherjee (2011)) indicates a uniform rise in agricultural profitability across farms of all sizes. This ought to reduce the extent of household division across both small and large landowning households. Households owning large amounts of land are more likely to lease some of their lands out to tenants; for such households the returns to land are likely to fall, which would hasten division. Moreover, implementation of Operation Barga is likely to signal to large landowning households that the local government is politically aligned with tenants vis-a-vis landlords, therefore likely to engage in further redistributive policies in the future,[7] which would accelerate division among large landowning households.

The *patta* program is likely to have different effects. First, the evidence from Bardhan and Mookherjee (2011) indicates that it had a statistically insignificant and substantially smaller effect on agricultural profitability compared with Operation Barga.[8] Second, land titles were distributed free of cost, mosly to landless and marginal landowning households. This would increase the incentives for medium and small households to subdivide to increase

[7]The latter might include (i) barriers to access of large farmers to scarce inputs such as subsidized credit, seeds or fertilizers, (ii) greater likelihood of expropriating lands owned above legal limits by large landowners and (iii) distributing these to the landless in the *patta* program which would restrict the supply of hired labor and/or raise costs of hiring labor by large farmers.

[8]This was mainly because the plots distributed were small, of low quality and did not qualify recipients to get low interest loans from the state-owned banks. In contrast tenant farms were larger, of higher quality land and registration enabled recipients to receive low interest loans.

their eligibility to receive land titles.[9] Third, the land titling program would be expected to restrict supply of labor from poor households to large households, raising hired labor costs for the latter.[10] This would encourage division of large farms that rely on hired labor to a significant degree.

A household panel regression confirms these predictions. Specifically, after controlling for lagged household size and lagged land owned: (a) implementation rates of Operation Barga in the past three years in the village reduced rates of division of small landowning households, (b) raised division rates among large landowning households; while (c) the effects of the *patta* distribution program on division rates are not robust with respect to the specification. But (d) these effects were overshadowed by the effects of demographic growth. Increases in (lagged) household size raised the likelihood of division, controlling for lagged landownership. The effect of expanding household size by 1.3 members (based on population growth in these villages during this time) was between four and thirty times the effect of either land reform program.

With regard to their effects on land market transactions, the theory predicts that Operation Barga would raise the likelihood of large landowning households selling land to small landowning households (owing to increased profitability of farming in the village, the reduced value of leasing out land, as well as the anticipated political effects). The *patta* program would also be expected to have similar effects, owing to upward pressure on wage rates which lower profitability of large landowning households, in addition to anticipated redistribution. Consistent with these, the empirical results show a significant positive effect of Operation Barga on the likelihood of land purchases by small households, and a significant positive effect of the *patta* program on the likelihood of land sales by large landowning households.

The preceding results suggest that the indirect effects of Operation Barga would be to reduce inequality overall, by raising division rates of large landowning households relative to small ones, and encouraging purchases by small households. However, a reduced form regression at the village level of changes in land inequality and landlessness shows no significant effect on either inequality or landlessness of the Barga program. Hence the aggregate magnitude of the indirect effect of the Barga program was negligible. On the other hand, the *patta* program lowered landlessness significantly since the late 1970s, but the overall impact twenty years later was much lower than could be accounted by the direct effect of the program, suggesting the indirect effects (e.g., through the higher division rates of marginal and small landowning households) raised landlessness. In sum, we do not obtain evidence that the indirect effects of either land reform program accounted for a substantial reduction in inequality. However the direct effect of the *patta* program was to reduce inequality and landlessness by an extent that varies with the choice of inequality measure.

[9] Approximately one in five households in 1978 eventually received land titles in the subsequent twenty years.

[10] Consistent with this, Bardhan and Mookherjee (2011) find a positive but statistically insignificant effect of the *patta* program on the wage rate, and a significant substitution of family for hired labor.

The next section describes the nature of the data. Section 3 presents descriptive statistics and decompositions of inequality changes. Section 4 presents the theory, followed by regression results in Section 5. The final section summarizes the main findings and discusses their implications.

2 Data

The survey involved 2,402 households in a sample of 89 villages in West Bengal. The village sample 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, Government of West Bengal, for the purpose of calculating cost of cultivation of major crops in the state between 1981 and 1996. The same village sample is used in Bardhan and Mookherjee (2006, 2010, 2011) and Bardhan, Mookherjee and Parra-Torrado (2010) for earlier studies of targeting of local government programs, political economy and productivity effects of the land reforms.

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. 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.[11] 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 a farm panel drawn from these villages for subperiods, and in indirect household land

[11] 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.

survey for each village corresponding to 1978 (or 1983) and 1998 (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).

2.1 Constructing Land and Household Size Time Series: Key Problems

The survey data included each household's land holding at the time of being surveyed (2004) and as of 1967. In subsequent blocks the respondents were asked to list all land transactions that occurred 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 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 5 shows that the latter category is by far the most relevant, both in terms of frequency of ocurrence and amount of land involved.

Recalling the details of past changes in landholdings over the past three decades can be a challenging task. 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.[12] 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 arises with the individual exit dataset: no distinction was made in the questionnaire between agricultural and non-agricultural land lost thereby (i.e., associated

[12]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.

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 therefore is not considered in the analysis. 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 problems were not very important in this context. 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 correponds 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 dataset (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 not believe our lack of knowledge of type of land lost in exits is of any signficance. 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 column 7 of Table 1. It shows the restricted sample contains a larger fraction of immigrants and a smaller fraction of medium, large and big landowners. This is to be expected as 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.

3 Descriptive Statistics

3.1 Trends in Land per Household

Figure 1 shows trend in agricultural land per household for the full and restricted sample, averaged across all villages. In the full sample there is a sharp drop in the mean from nearly 3 acres per household to a little over 1 acre. The median drops by less, from 0.7 acre to 0. The third quartile drops from 3.6 acres to slightly above 1. The drop in mean, median and third quartile is less dramatic in the restricted sample, but significant nonetheless: both the median and the third quartile are more than halved. By 2004 less than one quarter of households had more than 1 acre of land.

Figure 2 shows corresponding trends for household size. The median falls from 6 to 5, and the mean also falls by 1 unit, resulting in a reduction of the order of 16%. The steepest fall is in the third quartile. The distribution of household size shrinks over time, with the largest households shrinking by more. The inter-quartile range fell from 4–8 to 4–6.

The drop in household size was thus less dramatic than the drop in land per household. Consequently land per capita fell by a factor of three, as shown in Figure 3. In the restricted sample, the mean and third quartile dropped from 0.4 and 0.5 to near 0.2 acres per capita. This confirms the view commonly expressed in rural West Bengal that it is increasingly difficult for rural households to derive their livelihood from agriculture, creating an urgent need to generate non-agricultural employment opportunities in the state. It is also evident that the changes observed are gradual, with no noticeable fluctuations across different years.

3.2 Determinants of Decreases in Land Holdings per Household

To what extent were these the result of immigration? Figure 4 shows changes in the average proportion of households residing in the village over time, as well as those arriving from Bangladesh. Approximately one third of all households in 2004 had immigrated into the village since 1967. Approximately one third to one fourth of these came from Bangladesh. Hence immigrant inflows were sizeable. Immigrating households typically arrive with no land, and lag behind natives with respect to landownership. Nevertheless, Figure 5 shows patterns of landholdings for native households are similar to those for all households in previous figures. So the declining patterns of landownership cannot be attributed to rising immigration, probably because much of these immigrant flows were within West Bengal from one village to another, the effects of which must wash out on average.[13]

Could the decline in landholdings per household be the result of rising conversion of agricultural land to non-agricultural purposes? Table 2 shows changes in cultivable land

[13]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.

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.

Returning to the direct household survey, immigration accounted for a 15% drop in land per household for both the full and restricted samples, while for natives it dropped by about 40%. Table 3 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. We return to the issue of the scope and coverage of the land reform program in further detail below.

3.3 Changes in Land Distribution

Table 4 shows the distribution of land across different size classes in 1967 and 2004. Landlessness rose from 38% to 46% for natives, and 56% for the population including immigrants. The proportion of households that were either landless or marginal (owning less than 1 acre) rose from 61% to 75% among natives, and 81% among the entire population. This was accounted for by a drop mainly of small landowners (between 1 and 2.5 acres) and large and big landowners (owning more than 5 acres).

Figure 6 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 tended to drift downwards (following division of the household over time), until it hit the half acre threshold, whereupon the household would either struggle to preserve its landholding or rapidly progress to landlessness.

In order to gauge the effect of rising landlessness on land inequality, we also examined the distribution of land among households owning land in 2004. These are not shown here,

in order to conserve space. Briefly, the coefficient of variation within landowning households declined in the first half of the period, and rose thereafter to neutralize the earlier decline. In the case of the Gini coefficient there was a significant decline. Hence the rise in inequality observed for either inequality measure was primarily accounted for by rising landlessness.

3.4 Trends in Inequality and Landlessness

Figure 7 shows that for the full sample within-village inequality (averaged across villages) rose by 10% for the Gini and somewhat more (15–20%) for the coefficient of variation. The restricted sample shows a steeper increase for both the Gini and the coefficient of variation. Figure 8 shows trends in the proportion of landless households. In the full sample this rose from one-third to half of all households, and from a little over a quarter to 45% in the restricted sample. Indeed, 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.[14]

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.

Figures 9 and 10 display the estimated contribution of these channels to changes in the Gini coefficient and coefficient of variation respectively. These figures show clearly that the source of rising inequality was household division, particularly after the mid-80s. Land market transactions contributed to a reduction in inequality, by an extent depending on the precise inequality measure used and the sample in question. In the case of the coefficient of variation, the inequality reduction effect of land market transactions was more pronounced, mostly occurring by the mid-80s. However if we use the Gini coefficient instead, the land market had a more modest effect on inequality, and nearly zero in the case of the restricted sample.

The role of the land reforms was to reduce the coefficient of variation by a magnitude comparable to the land market for the period as a whole, though the effect was weaker in the first half of the period. For the Gini coefficient, by contrast, the direct effect of the land reform was near zero for the period as a whole, in both restricted and the full sample. Hence the land reforms exercised a substantially weaker direct effect on the Gini coefficient, compared to household division.

We turn now to the role of immigration in contributing to inequality changes, which

[14] We do not present this graph in order to conserve space.

is illustrated by comparing the rise in inequality within native households with the rise in inequality in the village as a whole. The Gini rose by about 4% instead of 10%, and the rise in coefficient of variation is also halved. *Hence the two main factors accounting for the observed rise in inequality were household division and immigration, whose combined effect outweighed the inequality reducing effects of land reform and market transactions.* During the first half of the period (until 1985) inequality among natives actually fell (for CV) and remained stationary (for the Gini), owing to the greater effect of the market and land reform. Subsequently household divisions accelerated to cause inequality to increase overall, both among the native population as well as for the village as a whole.

3.5 Land Market Transactions

Figure 11 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 shown in Figure 1. It is within the margin of variation observed from year to year during the period in question, thus unlikely to be statistically significant.

Note also that the land transactions are considerable in frequency, and occur throughout the period. Hence the land market has been quite active. Recall from Table 3 that the average household gained about 0.47 acres through purchases, while losing 0.56 acres through sales, compared with average landholding of 2.86 acres at the beginning of the period. Table 6 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. The earlier decompositions indicated that the land market transactions tended to reduce the coefficient of variation, and did not have a significant impact on the Gini. Hence they appear to have been equalizing the land distribution, or at leaving inequality unaffected.

3.6 Land Reform

Since there may be recall problems with regard to land reforms, it is better to rely on official land records. Figure 12 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.[15] The number of direct beneficiaries of Operation Barga was smaller compared with the *patta* program because (as described in Bardhan and Mookherjee (2011)) tenants involved in the reform were cultivating fertile plots in excess of an acre, while land titles distributed were typically low quality land well under an acre in size.

Tables 3 and 6 nevertheless show that the land reforms accounted for a substantially smaller share of changes in landholdings reported by the households themselves compared with household division or land market transactions. Since it is plausible that self-reported changes of land in different categories will be equally subject to recall problems, the relative frequencies of different sources of land changes are more reliable. These numbers indicate that the direct impact of the land reforms on changes in landholdings were small relative to the impacts of household division, land market transactions and immigration.

3.7 Household Division

What were the sources of household division? Table 5 gives a breakdown of changes in household size into different sources: births, in-marriages (i.e., those who join the household via marriage), household splits and other exits (including deaths, out-migration and out-marriages). The last of these was clearly the dominant component. Births rose over the period, while in-marriages had a steady effect on household size. These were outweighed by household splits and other exits, generating a negative overall impact. 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.

The impact of household divisions on land inequality is not *a priori* obvious. To the extent that big landowning households are more prone to such divisions than the rest of the village, and that they tend to divide into smaller landowning units, land inequality tends to decline. However if small and marginal landowning households divide, it reduces their landholdings to below minimum viable sizes of cultivation, raising landlessness and

[15]Specifically, the official land records show that the proportion of land registered under Operation Barga until 1998 was 5.7%, while the *patta* program accounted for 6.7% of land. On the other hand, a much larger proportion (15.6%) of households in 1998 had received land titles, while 4.5% households had become registered bargadars.

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 7 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, and we see that annual division rates exceeded 4% for all 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. To the extent that changes in landlessness was the leading cause of the observed rise in inequality, high rates of division of marginal and small landowners would have led to increasing inequality. This would have been offset to some degree by high rates of division among large landowners. The rising impact of divisions on within-village inequality is likely yo have arisen owing to the former phenomenon.

4 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 the subsequent section we will 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. All adults are identical in all respects: abilities and preferences. Individual effort cannot be monitored, resulting in a classic moral-hazard-in-teams problem. Collective income is therefore shared equally among household members. If the household engages in cultivation, this collective income is given by

$$Y = aL^{1-\alpha}(\sum_{i=1}^{n} l_i)^{\alpha} - F \tag{1}$$

where a is a parameter representing crop price and agricultural productivity, l_i is the labor effort of member i of the household, $\alpha \in (0, 1)$ and F is a fixed cost of running a farm (representing costs of acquiring information about technology and prices, or engaging in market transactions). Hence agricultural production is subject to constant returns to land and labor input, while the fixed cost creates a source of scale economy.

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. It earns a payoff $\frac{Y}{n} + w(1 - l_i)$. Here we assume that each household member cares only about his own income. The results will extend in the presence of some altruism within the household,

as long as each member puts a sufficiently larger weight on its own income compared with the income of others.[16]

We focus on symmetric equilibria in labor supply, where $l(n, L)$ maximizes

$$\frac{a}{n}L^{1-\alpha}[(n-1)l(n,L)+l]^{\alpha}+w(1-l) \tag{2}$$

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

$$l(n)=\begin{cases}1 & \text{if } n \leq (\frac{a\alpha L^{1-\alpha}}{w})^{\frac{1}{2-\alpha}},\\ L(\frac{a\alpha}{w})^{\frac{1}{1-\alpha}}n^{-\frac{2-\alpha}{1-\alpha}} & \text{otherwise.}\end{cases} \tag{3}$$

generating payoff per member

$$\Pi(n,L)=\begin{cases}\frac{1}{n}[aL^{1-\alpha}n^{\alpha}-F] & \text{if } n \leq (\frac{a\alpha L^{1-\alpha}}{w})^{\frac{1}{2-\alpha}},\\ w-\frac{F}{n}+L(\frac{a\alpha}{n})^{\frac{1}{1-\alpha}}w^{-\frac{\alpha}{1-\alpha}}[\frac{1}{\alpha}-\frac{1}{n}] & \text{otherwise.}\end{cases} \tag{4}$$

This is provided the household decides to engage in cultivation. If it does not, each member works full time on the labor market and earns w. So the payoff of each household member is actually $\max\{\Pi(n,L), w\}$, but we shall abuse notation slightly in what follows and use Π instead under the presumption that it is engaging in farming.

We shall abstract from general equilibrium considerations, by assuming fixed crop prices and wages i.e., households in any given village operate in large external product and labor markets. We shall initially also abstract from the possibility of a land market, in order to focus on household division. Later we shall describe how to extend the model to incorporate land markets within the village.

4.1 Stability of Households

A household (n, L) engaging in cultivation can experience change in a variety of ways. Some members may exit, or it may divide into two smaller households. These changes may be classified as follows.

First, every member of the household may decide to quit and go work full time on the labor market. Call this a *shutdown*. Second, some members quit while others remain in cultivation: call this *exit*. Finally, the household divides 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 gnore this for the time being, but

[16]Suppose each member assigns weight β to household collective income, and maximizes the sum of this and his own personal income. Then there is a free-riding problem as long as $\beta < 1-\frac{1}{n}$, i.e., in any household with at least two members if $\beta < \frac{1}{2}$.

it can be shown that to analyze stable households it suffices to consider these three kinds of changes.

An important assumption we make is that two households cannot merge into a single large household. There may be incentives to do so, as we shall see, in order to economize on 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. Two households from distinct families cannot live and work together.[17] It would be nice to extend the theory to incorporate altruism within families that is absent across families and endogenously explain this phenomenon. But for the interests of simplicity we shall abstract from it.

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:*

$$\Pi(n, L) \geq w \tag{NS}$$

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

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

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 $n\Pi(n, L) \geq n_1 w + (n - n_1)\Pi(n - n_1, L - L_1)$. Since Π is increasing in L, this condition is implied by (NE).[18]

[17] Of course it may be possible that the same family which initialy divides into two households may later want to merge again. We are ignoring this possibility.

[18] 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

In the absence of a land market or any other market interaction between different households in a village, the stability of a household is independent of any other. 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 at all: it would be natural to expect such a household to 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.*

Our main result below provides a near-complete characterization of the set of stable cultivating households. The proof is presented in the Appendix.

PROPOSITION **1.** *A cultivating household (n, L) is stable if both of the following conditions are satisfied:*

$$n \leq \underline{n}(L) \equiv (\frac{a\alpha}{w})^{\frac{1}{2-\alpha}} L^{\frac{1-\alpha}{2-\alpha}} \tag{IC}$$

$$L \geq \underline{L}(n) \equiv a^{-\frac{1}{1-\alpha}} n^{-\frac{\alpha}{1-\alpha}} [F + nw]^{\frac{1}{1-\alpha}} \tag{IR}$$

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

$$n > \lfloor \underline{n}(L) \rfloor \tag{IC'}$$

where $\lfloor x \rfloor$ denotes the smallest integer exceeding x.

Proof of Proposition 1: We start with sufficiency. If $n < \underline{n}(L)$ then there is no free-riding and so $n\Pi(n, L) = aL^{1-\alpha}n^{\alpha} - F$. Then (IR) implies $aL^{1-\alpha}n^{\alpha} > F + nw$ which is (NS). To show (NE) holds, note that for any $m \geq 1$ we have $n - m < \underline{n}(L)$ so each member of a household with $n - m$ members and L land will select $l = 1$ in his own self-interest. This implies $\frac{1}{n}$ of the marginal product of labor of any member exceeds w, so the marginal contribution of m members will exceed mw, which implies (NE). And (ND) also holds, since CRS implies additivity of the production function: $aL^{1-\alpha}n^{\alpha} = aL_1^{1-\alpha}n_1^{\alpha} + aL_2^{1-\alpha}n_2^{\alpha}$ if $(n_1, L_1) + (n_2, L_2) = (n, L)$, and $n_i\Pi(n_i, L_i)$ equals $aL^{1-\alpha}n^{\alpha} - F$ for $i = 1, 2$ if there is no free-riding and is smaller than this otherwise (because presence of free-riding implies each member is supplying less than one unit of labor).

other words, what about the possibility of division into three or more households, or combinations of exits and division? This will indeed turn out to be the case. 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.

To show necessity of (IC'), suppose this condition is violated and we have $n > \{\underline{n}n(L)\}$. We will show that the household is unstable. Suppose this is false, and it is stable instead. Now the condition on n implies that there is free riding at both n and $n-1$. Without loss of generality $n\Pi(n,L) = nw - F + H(n) \geq nw$, where $H(n) \equiv a^{\frac{1}{1-\alpha}} w^{-\frac{\alpha}{1-\alpha}} (\frac{\alpha}{n})^{\frac{1}{1-\alpha}} (\frac{n}{\alpha} - 1)L$, since if this inequality is violated it must be the case that $H(n) < w$ in which case the household violates (NS). Then condition (NS) reduces to the condition that $H(n) \geq F$.

Now note that $H(n)$ is strictly decreasing in n, since $(\frac{n}{\alpha} - 1)n^{-\frac{1}{1-\alpha}}$ is decreasing in n over the range $n \geq 1$. So $H(n-1) > H(n) \geq F$ and the household $(n-1, L)$ is also stable, implying $(n-1)\Pi(n-1,L) = (n-1)w - F + H(n-1)$. This implies $n\Pi(n,L) - (n-1)\Pi(n-1,L) > w$, so (NE) must be violated with $m = 1$, a contradiction.

Finally, we show violation of (IR) implies the household is not stable. If $n \leq \underline{n}n(L)$ then there is no free-riding and $n\Pi(n,L) = aL^{1-\alpha}n^{\alpha} - F$. So violation of (IR) implies violation of (NS). If $n > \underline{n}n(L)$ then there is free-riding and $n\Pi(n,L) < aL^{1-\alpha}n^{\alpha} - F$, so again violation of (IR) implies violation of (NS). This concludes the proof.

Proposition 1 is illustrated in Figure 13. 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 $\underline{L}(n)$ for any given number n of household members, which is increasing in the fixed cost F and the outside wage w. It is easily checked that $\underline{L}(n)$ tends to infinity as n tends to zero, is decreasing until $n = \frac{\alpha}{1-\alpha}\frac{F}{w}$ and increasing thereafter, going to ∞ as n tends to ∞. Hence it is U-shaped, achieving a minimum of $\underline{L}^* \equiv F^{\frac{1}{1-\alpha}} a^{-\frac{1}{1-\alpha}} [(\frac{\alpha}{1-\alpha}\frac{F}{w})^{-\alpha} F + (\frac{\alpha}{1-\alpha}\frac{F}{w})^{1-\alpha} w]$. Stable households must own land of at least $\underline{L}^*$, irrespective of how many members they have. Hence a stable land distribution must exhibit a 'hole' in-between 0 and $\underline{L}^*$ quantities of land. Note also that the minimum landholding size needed to satisfy (IR) depends both on F and w. Even if F were equal to zero, a minimum land size would be needed to ensure that per capita earnings are above the wage rate.

Condition (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. 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 whenever there is free-riding with non-maximal effort supplied by members, collective household income is strictly decreasing in the number of members. Hence condition (NE) is violated: it pays for one member to exit with a suitable compensation paid by the remaining household members.

The sufficiency of the two conditions now stems from the fact that with absence of any free-riding, a cultivating household realizes maximal agricultural income from its endowment of labor and land, equal to $aL^{1-\alpha}n^{\alpha} - F$, which is increasing in n and L and 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)). Also the best-case scenaro for division is when neither fragment is characterized by any free-riding. But in that case owing to the constant returns feature of the production function, collective production would remain the same, and collective income would decline on account of the duplication of fixed cost F.[19] 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 where $n = n^* \equiv \frac{1+(1+4\frac{F}{w})^{\frac{1}{2}}}{2} > 1$. To the right (left) of this, the IC curve lies above (resp. below) the IR curve. In case A of Figure 13 where $\frac{F}{w}$ is high enough (relative to α), they intersect to the right of the bottom of the IR curve (i.e, $n^* > \frac{\alpha}{1-\alpha}\frac{F}{w}$). In the other Case B when $\frac{F}{w}$ is low, they intersect to the left of the bottom. The implications of demographic growth of the number of household members can differ between the two cases, as we discuss next.

4.2 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 13, 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. Just 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 $\underline{L}^*$.

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.The following argument shows

[19] For the same reason, division into three or more fragments would not be valuable, when it is not worthwhile to fragment into two fragments.

that either can happen, depending on parameter values.

Suppose that the IC constraint is the first one that is violated, with n close enough to $\underline{n}(L)$ after the demographic expansion, and small fixed costs F. Then the collective income of the original household had it remained intact would be approximately $aL^{1-\alpha}n^{\alpha}$, and the marginal contribution of any member to collective income will be approximately n times w.[20] Hence exit of any member would result in a reduction in total income by approximately $(n-1)w$. On the other hand, if F is small enough 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 $(n-1)w$. 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. Note that exit is always feasible, as the extra number of household members that caused IC to fail can exit so as to leave a cultivating household of 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 $\underline{L}^*$, since each of the fragments will have to have at least $\underline{L}^*$ amount of land in order to be viable. At the lower end of the land distribution, thus, demographic growth will result in exits (and hence growing landlessness).

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. Hence this will tend to slow down exits and divisions occurring due to demographic changes.

4.3 Land Market Transactions

Now suppose land can be bought and sold, but 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 lemons problem. We abstract from these here, and focus on the role of high costs of registering land transactions in many developing countries, and West Bengal in particular.

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 household (n, L) equals $(1-\alpha)a(\frac{n}{L})^{\alpha}$, it follows that there is an incentive for the two households above to

[20] The reason is that $\underline{n}(L)$ is characterized by the property that the portion of this contribution that accrues to the member in question — the marginal contribution to collective income divided by n — equals w.

enter into a land transaction if and only if

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

i.e, the ratio of labor endowment to land must differ sufficiently, relative to transaction costs and profitability parameter a.

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. This restricts the range of variation of factor proportions among all cultivating households to lie within a cone of width which depends on $\frac{t}{a(1-\alpha)}$, as shown in Figure 14. 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. Additional conditions are needed to rule out the possibility of purchases of land by landless households from cultivating households. These will necessarily involve purchases of large amounts of land by the landless (to ensure they have enough to be viable following the purchase), so conditions cannot simply be imposed on the marginal valuations of land. In what follows we abstract from this problem (e.g., by assuming that the landless are prevented by credit constraints from entering into such large purchases). Additional complications arise when we consider possible combinations of exits or divisions with land market transactions, so we stop short of providing a near-complete characterization of stable land distributions and instead focus on necessary conditions.

Demographic growth in some households may now trigger a land transaction rather than an exit or division. This is shown in Figure 14(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 (4.3) 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.

4.4 Implications for Effects of Land Reform

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). The second consists of anticipated redistribution in the near future, as signaled by recent actions of land reform authorities.

Operation Barga raised value added per acre of cultivating farms of all sizes uniformly, as shown in Bardhan and Mookherjee (2011). Some large landowning families lease out their lands to tenants, and the reform would have lowered their profits by raising crop shares of tenants and limiting the ability of landlords to evict them. Hence 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 (since landownership and leasing out are likely to be positively correlated). 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 Operation Barga. Moreover, those with lands in excess of the legal ceiling would also expect a greater likelihood of implementation of land ceiling regulations by a current local government that is vigorously implementing Operation Barga. We therefore expect the effect of Operation Barga would be to lower division rates, but less so 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 Operation Barga which is expected to be negative, and an interaction with land owned by the household which is expected to be positive.

The *patta* program turned out to have substantially lower effects on profitability in the findings of Bardhan-Mookherjee (2011), about half the size of the effects of Operation Barga and were statistically insignificant. There is also some weak evidence of a positive effect on wage rates for hired labor. Hence we do not expect a to have risen appreciably as a result of the *patta* program, especially compared with Operation Barga. The increase in wage rates would be expected to lower profits of large landowning farms that rely on hired labor. 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. And 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, Operation Barga 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 *patta* 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 Indirect Effects of Land Reform: Regression Results

5.1 Regression Specification

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

$$DIV_{ivt} = \beta_i + \delta_t + \beta_1 HS_{i,t-1} + \beta_2 L_{i,t-1} + \beta_3 OB_{v,t-k} + \beta_4 OB_{v,t-k} * L_{i,t-1} + \beta_4 P_{v,t-k} + \beta_5 P_{v,t-k} * L_{i,t-1} + \beta_6 C_{it} + \epsilon_{ivt}$$

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 Operation Barga OB and the *patta* program P in the village lagged by a few (k) years,[21] 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 ϵ_{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.

5.2 Household Division

Table 8 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.

Focusing on columns 3 and 6, we find growth in household size significantly raising the odds of household division, controlling for land owned. This confirms the notion that demographic growth was a key determinant of division. The effect of land owned itself was positive and insignificant, in contrast to the theoretical prediction (based only on purely economic reasons). The positive effect could be the result of anticipated land reform actions in the future which would be focused especially on large landowning households, thus motivating larger landowners to subdivide in order to evade such actions. This interpretation is confirmed by the significance of the above-ceiling dummy in columns 2 and 3 in the full

[21] We take the average of these in three preceding years.

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 Operation Barga are as anticipated by the theory: division rates fell significantly 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 'bargaland' with a dummy for households owning more than 4 acres of land confirmed the fact that Operation Barga induced a significant rise in division rates for large landowning households. This suggests that the net effect on inequality would be negative.

Columns 3 and 6 show effects of the *patta* program: a positive effect on division rates which is significant at 1%, and an interaction with land size which is negiligible and insignificant. Hence the land title program raised division rates uniformly, which is consistent with the theoretical predictions. 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 10 shows a corresponding 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.

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. To examine this issue, Table 9 presents instrumental variable as well as OLS estimates of the effects of Operation Barga, in a linear probability regression of division rates for small (owning less than 2.5 acres) and large (more than 2.5 acres) landowning households, controlling for the *patta* program, lagged household size and landownership besides household fixed effects and year dummies. We use the same set of instruments for Barga implementation as in Bardhan and Mookherjee (2011), based on the hypothesis that implementation rates were affected in a nonlinear way by political competition between the Left Front and its key rival the Indian National Congress (INC) in local government elections. This hypothesis was proposed and tested empirically in Bardhan and Mookherjee (2010), which showed a number of important determinants of local political competition: the share of seats in the national Parliament held by the INC, average vote share differences between the two parties in preceding elections to the state legislature in the district in question, interacted with the share of seats held by the Left Front in the previous local government administration. Additional predictors include local infrastructure, rainfall and the price of rice. In order to predict cumulative Barga rates, these predictors are also cumulated over past years. The first stage regressions show these instruments have moderate predictive power, with an F-ratio ranging between 8 and 9, but there is indication of underidentification as judged by the Kleibergen-Paap test. The Hansen test of overidentifying

restrictions is comfortably passed, on the other hand.

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, Barga 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 that the OLS estimates of the effects of Operation Barga are reliable.[22] Note, however, that the estimated effects of the *patta* program from the linear probability regressions in Table 9 differ considerably from the logit estimates in Table 8. This casts doubt on the reliability of the estimates of the effects of the *patta* program.

The other point to note concerns the quantitative effect of the land reforms on the division rates implied by these estimates: they are not large, and 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.[23] The logit regressions in Table 8 imply the estimated marginal effect of a rise in household size by one member on the odds of dividing is .046, while the marginal effects of Operation Barga and the *patta* program on division odds are -.023 and .089 respectively.[24] 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 Operation Barga was to lower division rates by .0017, while the *patta* program raised them by .0017 with an aggregate effect of zero.[25] The linear probability model IV estimates in Table 9 implies that the Barga and *patta* programs caused division rates for small landowners to fall by .005 and .028 respectively, while adding 1.3 members would cause them to rise by .134.

5.3 Land Market Transactions

Table 11 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 re-

[22] Unfortunately, we have not succeeded in finding a set of instruments that can help predict *patta* implementation, so we cannot test for endogeneity bias with regard to that program specifically.

[23] 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.

[24] All marginal effects are calculated assuming zero values of fixed effects, and averaged across land sizes in the sample.

[25] The observed cumulative value of bargaland in 1998 was .057 and pattaland was .067.

gression 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 *patta* program raising likelihood of sales among large landowning households (consistent with the interpretation of increases in costs of hired labor and anticipated redistribution in the future). Operation Barga did not have a significant effect on likelihood of sales.

Next, Table 12 presents the corresponding regression for likelihood of buying land. We see a converse negative effect of land owned. Operation Barga raises probability of purchase by small landowning households, and reduces it for large landowning households (e.g., those owning more than four acres). The *patta* program has significant effects only in the full sample, where it raises probability of purchase among those owning more than two acres. It is natural to expect some crowding out of purchases made by landless and marginal landowners owing to distribution of free *pattas* from the government. Most likely the observed effect purchases amongst the non-marginal owners arises from the sales induced for large landowners (as seen in the previous Table). However this 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. Operation Barga seems to have induced transactions which would have caused inequality to fall. The evidence concerning the effects of the *patta* program is similar, but less clear.

5.4 Immigration

Table 13 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 the 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 Barga 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.

5.5 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.[26] The indirect effect of the *patta* program is less clear. Another notable difference is that unlike Operation Barga, the latter program will have a direct impact on lands owned by the poor, reducing landlessness and inequality.

Table 14 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 *patta* 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 Barga implementation rate does not have a significant effect on the change in inequality.

The significant inequality reducing impact of the *patta* 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 15 runs a regression of the landlessness in 1998 on the proportion of households that were registered under Operation Barga and received land titles respectively,

[26] Using the area-based measure of Barga implementation, the same is true for the impact of the program on immigration, which was negative (column 1 in Table 13), implying a negative impact on landlessness.

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 regression coefficient is of the order of 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 1978) ought to have reduced landlessness in 1998 by 23.8%.[27] Since the actual impact is so much lower, this indicates that the indirect effects of the *patta* 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 *patta* program on reducing landlessness, on the other hand, helped reduce inequality.

6 Summary and Concluding Observations

The main question addressed by this paper concerns the effectiveness of land reforms in reducing land inequality in the context of the West Bengal experience with these programs since the late 1960s. 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 the land distribution through their impact on divisions, market transactions and immigration. We found evidence that they did affect household division rates and market transactions in ways consistent with theoretical predictions.

Yet these effects were quantitatively insignificant, relative to the effects of population growth arising from excess of births over deaths. The overall impact of Operation Barga had no significant impact on observed changes in land inequality or landlessness. The *patta* program did reduce 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. The indirect effects, if any, of the *patta* program caused landlessness to increase rather than decrease.

The results of this paper indicate the need to focus on other determinants of the high rates of household division in future research. In particular, the causes of high rates of division

[27] Of course the *pattas* 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.

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 mortality rates drop especially among poorer households? 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 and 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 increase as an indirect outcome of these reforms. Besides, immigrants seem to be attracted into areas of high population density, suggesting that immigration tends to cause population concentrations in particular areas. A more thorough and careful analysis is needed to understand the determinants and implications of land markets and immigration flows to obtain a better understanding of land distribution changes as the West Bengal economy modernizes.

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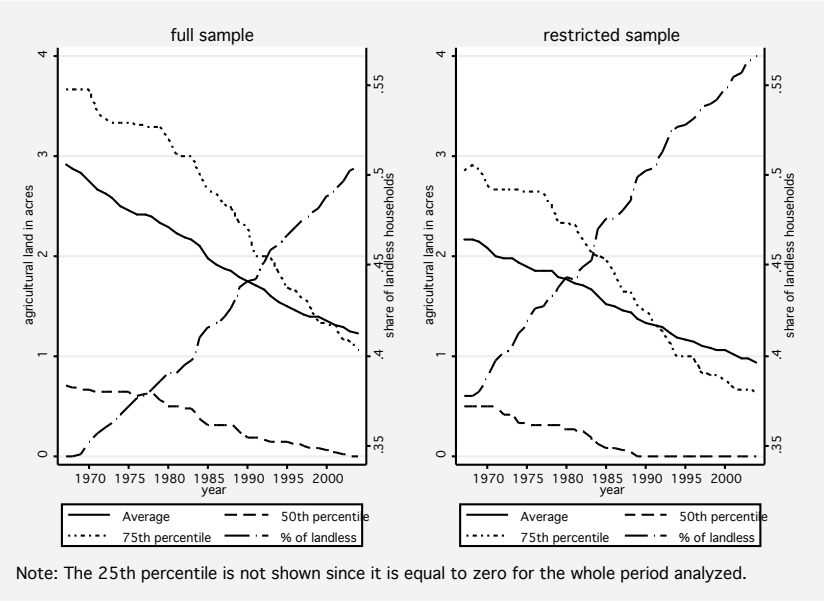
Figure 1: Agricultural land per household, various measures (1967-2004)



Note: The 25th percentile is not shown since it is equal to zero for the whole period analyzed.

Figure 2: Household size, various measures (1967-2004)

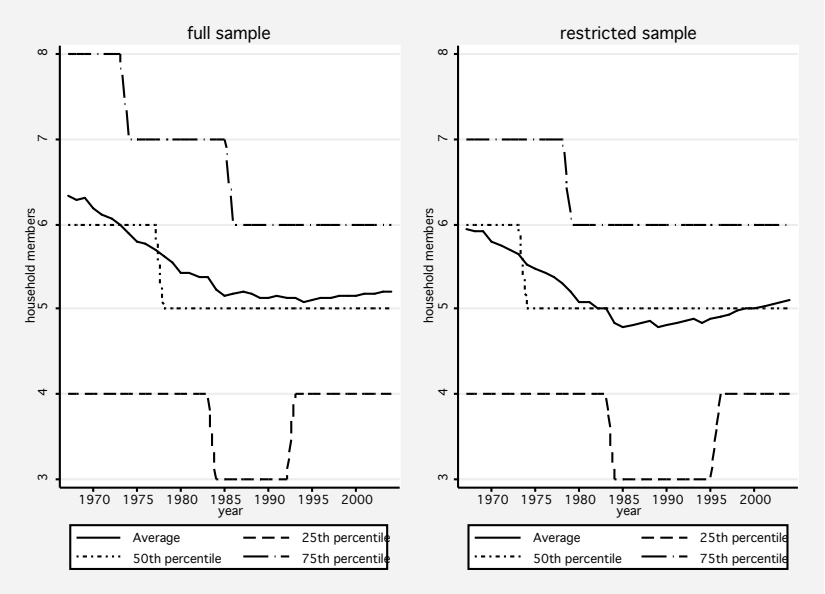
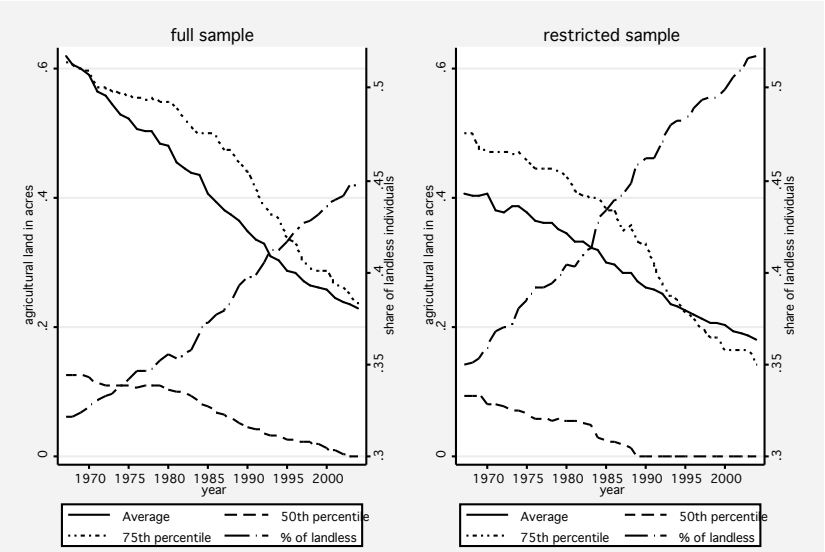


Figure 3: Agricultural land per capita, various measures (1967-2004)



Note: The 25th percentile is not shown since it is equal to zero for the whole period analyzed.

Figure 4: Immigration (1967-2004)

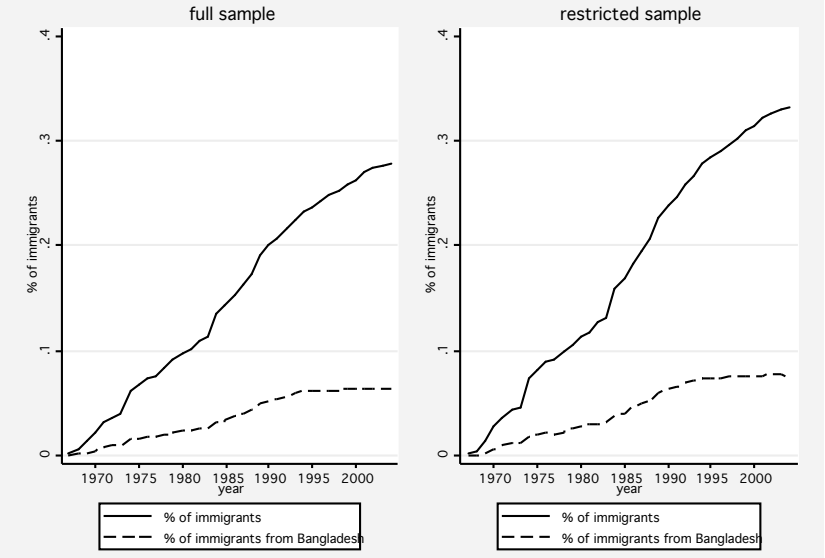
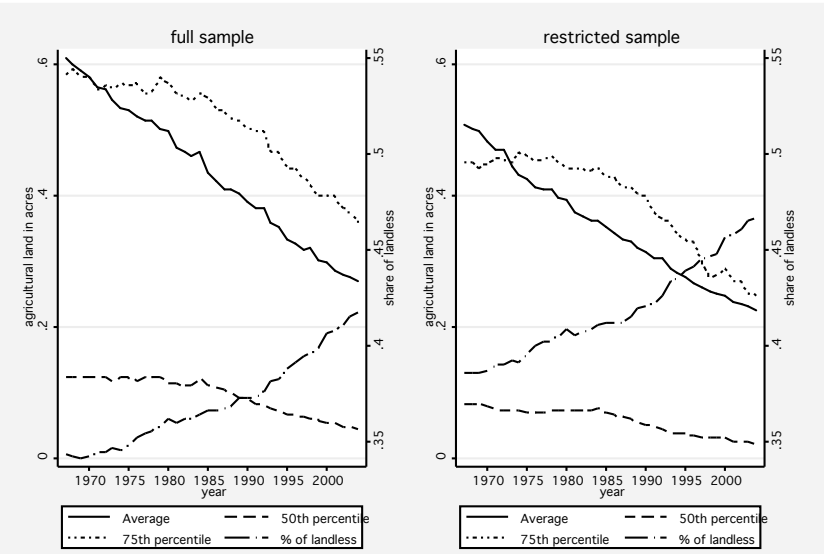
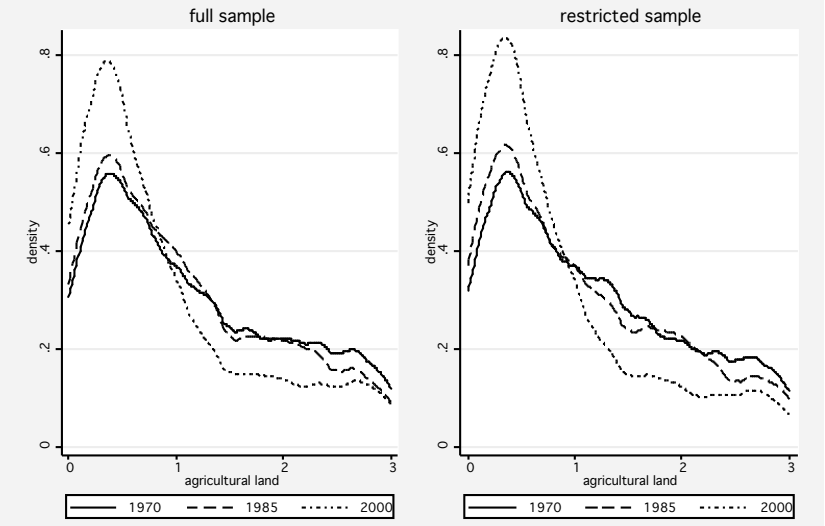


Figure 5: Agricultural land per capita, only natives (1967-2004)



Note: The 25th percentile is not shown since it is equal to zero for the whole period analyzed.

Figure 6: Agricultural land kernel densities, various years



Notes: Landless households are excluded, as well as households owning more than 3 acres of land. All graphs use the epanechnikov kernel function and a bandwith of 0.2.

Figure 7: Average within-village land inequality, various measures (1967-2004)

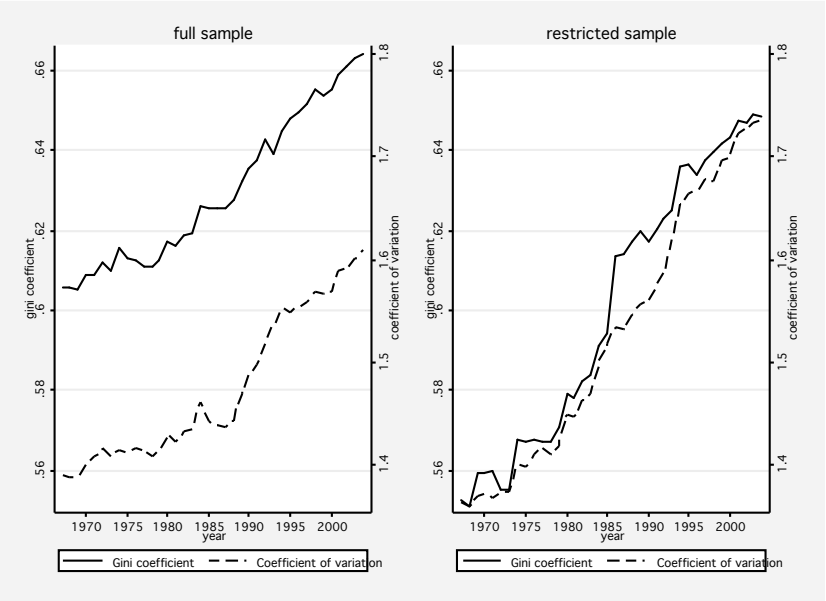


Figure 8: Proportion of landless households (1967-2004)

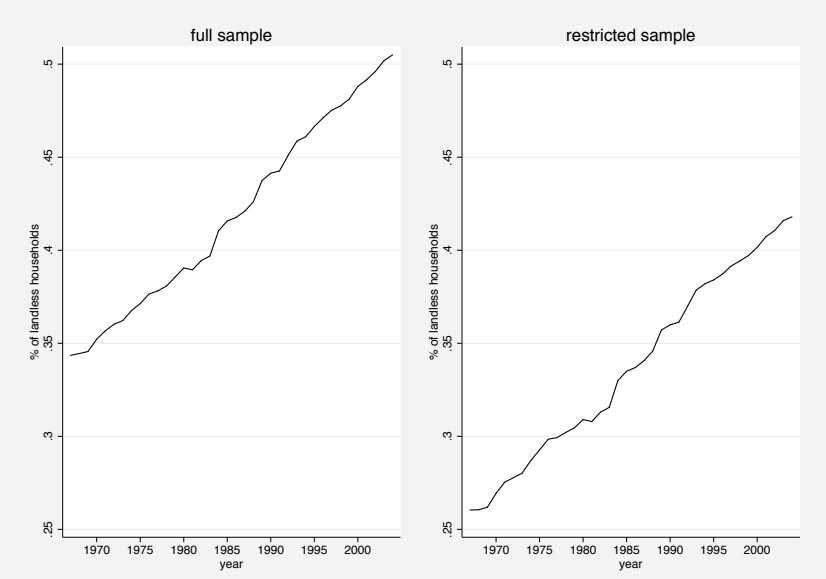
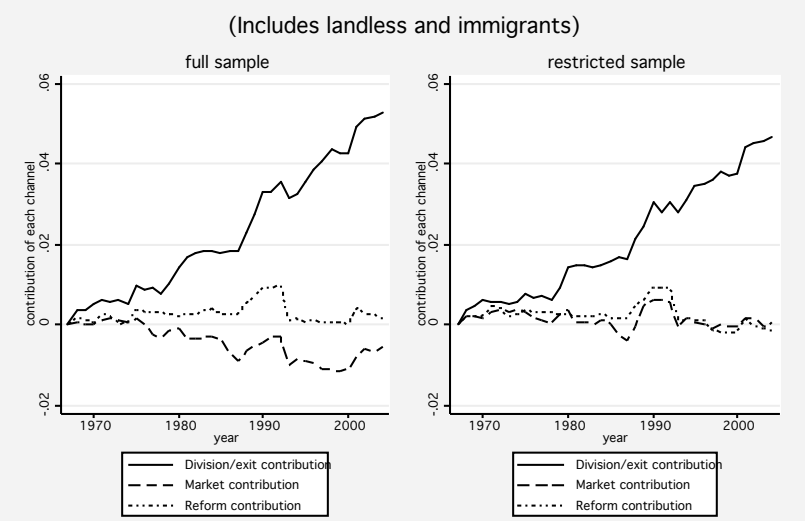
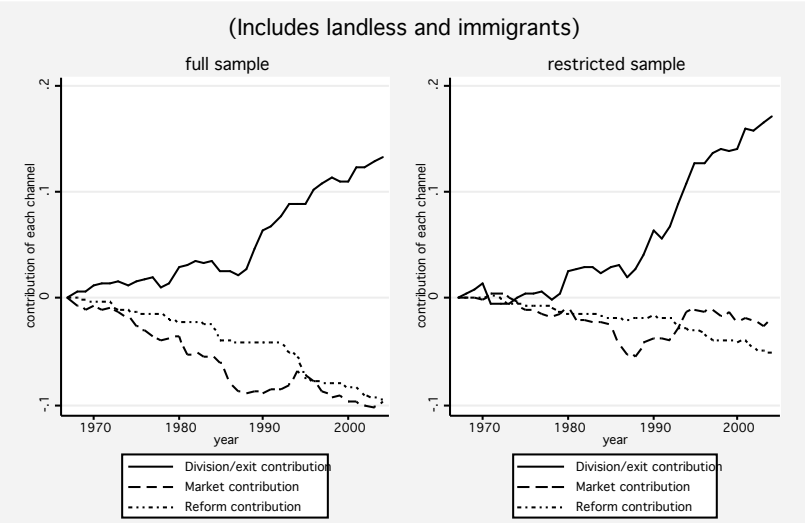


Figure 9: Average within-village land inequality, contribution to the Gini coefficient by channel (1967-2004)



Note: Each line represents the contribution of each channel to the change in the gini coefficient.
The restricted sample corresponds to Sample (2) in Table 3, i.e. only land history correct.

Figure 10: Average within-village land inequality, contribution to coefficient of variation by channel (1967-2004)



Note: Each line represents the contribution of each channel to the change in the coefficient of variation.
The restricted sample corresponds to Sample (2) in Table 3, i.e. only land history correct.

Figure 11: Land market: Sales and purchases per household (1967-2004)

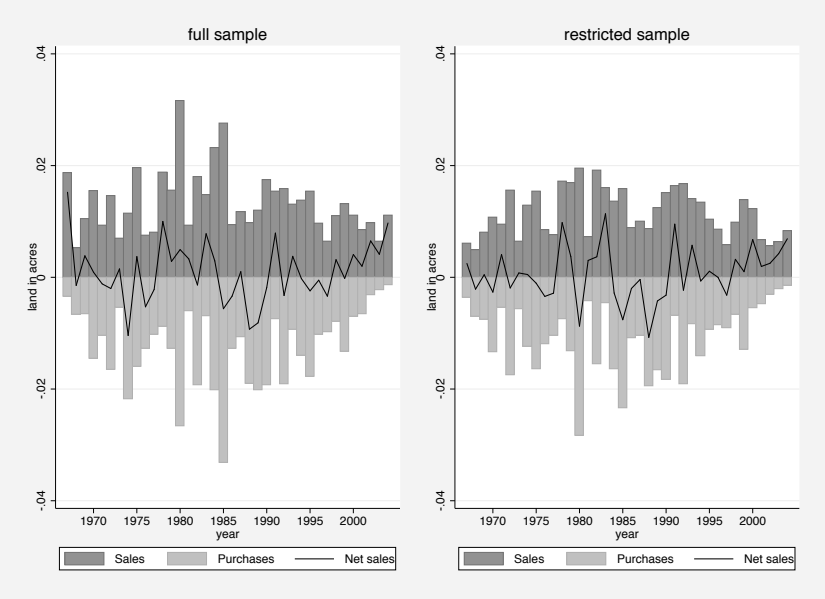
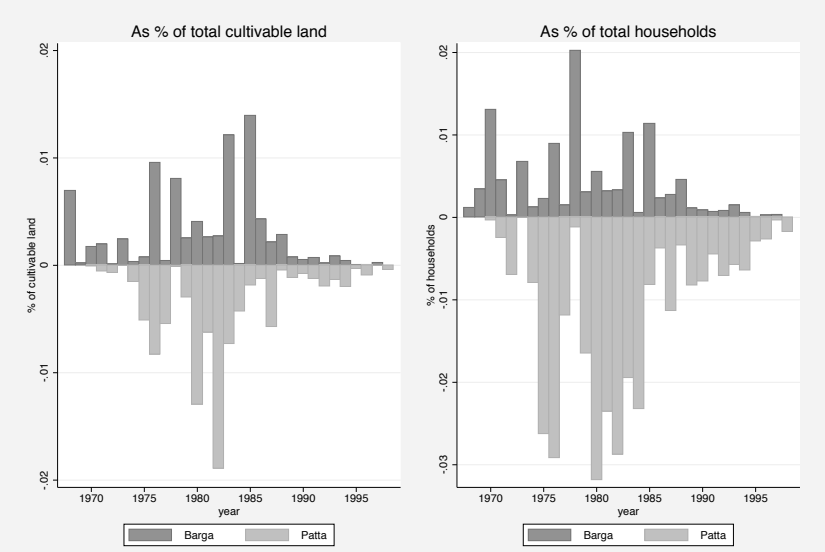


Figure 12: Average land reform implemented, official land records (1968-1998)



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

Figure 13: Characterization of Stable Households without Land Market Transactions

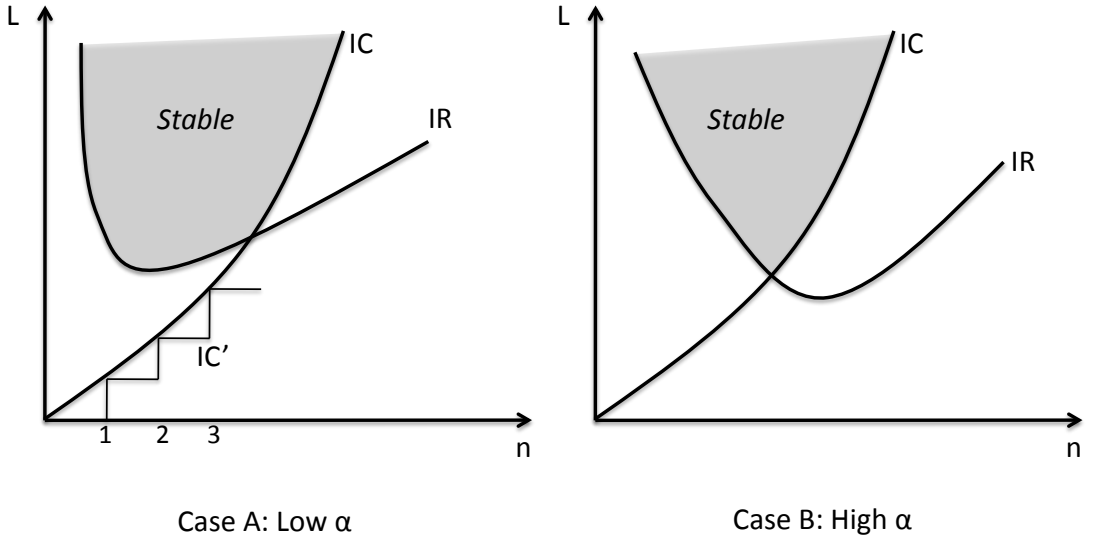
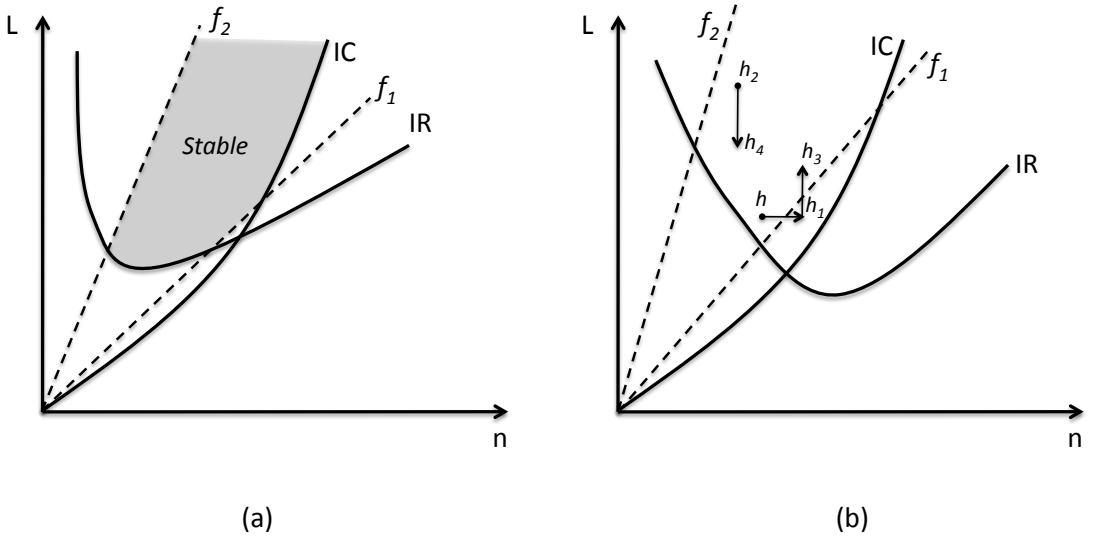


Figure 14: The Effect of Incorporating Land Market Transactions



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

Table 1: Comparing samples

	Full Sample (1)	Land history Correct (2)	Household size history correct (3)	Both land and household histories correct (4)	Diff. between columns (1) and (2) (5)	Diff. between columns (1) and (3) (6)	Diff. between columns (1) and (4) (7)
Household size	5.159	5.083	5.228	5.098	0.115	-0.051	0.065
	(2.496)	(2.380)	(2.600)	(2.389)	(0.071)	(0.076)	(0.074)
Fraction of immigrant households	0.303	0.296	0.314	0.332	-0.012	-0.035	-0.046
	(0.460)	(0.457)	(0.464)	(0.471)	(0.012)	(0.013)**	(0.013)***
Total agricultural land	1.100	1.006	1.181	0.950	0.175	0.019	0.208
	(2.265)	(2.167)	(2.361)	(2.081)	(0.062)**	(0.066)	(0.063)***
Irrigated agricultural land	0.732	0.658	0.792	0.618	0.136	0.019	0.161
	(1.785)	(1.685)	(1.875)	(1.582)	(0.050)**	(0.053)	(0.051)**
Unirrigated agricultural land	0.368	0.346	0.388	0.333	0.039	0.001	0.047
	(1.287)	(1.261)	(1.315)	(1.219)	(0.033)	(0.034)	(0.034)
% Landless	53.42	55.06	52.33	56.60			
% Marginal (between 0 and 1.25 acres)	25.11	25.23	24.85	24.46			
% Small (between 1.25 and 2.5 acres)	5.13	4.82	5.32	4.90			
% Medium (between 2.5 and 5 acres)	9.51	8.94	9.74	8.29			
% Large (between 5 and 10 acres)	5.58	4.82	6.34	4.74			
% Big (more than 10 acres)	1.26	1.12	1.42	1.01			
N	2402	2099	1911	1697			

Notes: Columns (1)-(4) 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 the constructed land holding matched the reported in 2004, up to a 0.2 acres margin of error. Column (3) includes those households for which the constructed family size matched the reported in 2004, up to a 1 member margin of error. Column (4) include those households for which both the constructed land holding and family size matched the reported in 2004. Columns (5), (6) and (7) report tests for differences of means across column (1) and columns (2), (3), and (4), respectively. Robust standard errors are in parentheses. Tests are based on regressions with village fixed effects.

Table 2: 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
Change in cultivable land	63	1.7	148.2	-843.8	244.4
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
Change in No. households	63	188.5	192.6	-6.0	841.0
	Initial report 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
Change in cultivable land	26	-13.0	66.5	-225.3	109.9
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
Change in No. households	26	110.0	83.0	10.0	332.0

Notes: Cultivable land is measured in acres. 46 villages report cultivable land in 1977, 14 in 1978, 3 in 1979, 1 in 1980, 1 in 1981, 23 in 1983, and 1 in 1984.

Table 3: 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 4: Changes in land distribution (restricted sample)

	Initial	Final (2002-2004)	
Land Class	(1967-1971)	natives and immigrants	only natives
Landless	38.47	56.23	46.05
Marginal	22.36	24.45	29.34
Small	11.76	4.96	6.16
Medium	13.56	8.38	10.63
Large	9.91	4.96	6.55
Big	3.94	1.02	1.27

Notes: Numbers indicate the pecentage of households in each category.

Table 5: 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 6: 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 7: 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 8: Determinants of household division, using past reform, average of last three years (logit)

Dep. Variable:	Probability of fragmentation					
Sample:	full			restricted		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged HH size	0.4169***	0.4480***	0.4479***	0.4962***	0.5207***	0.5205***
	(0.0282)	(0.0320)	(0.0320)	(0.0373)	(0.0401)	(0.0401)
Lagged land	0.1250***	0.0672	0.0676	0.1166***	0.0673	0.0674
	(0.0431)	(0.0465)	(0.0471)	(0.0401)	(0.0530)	(0.0529)
bargaland		-0.2675***	-0.3108***		-1.0433**	-1.6901***
		(0.0529)	(0.0534)		(0.4830)	(0.6000)
Lagged land*bargaland		0.0736***	0.0838***		0.2585**	0.3937***
		(0.0269)	(0.0201)		(0.1042)	(0.1196)
ceiling		1.2192**	1.2164**		0.5377	0.4892
		(0.4970)	(0.4969)		(0.6889)	(0.6662)
pattaland			0.8499***			1.4246***
			(0.1156)			(0.3007)
Lagged land*pattaland			-0.0001			0.1118
			(0.1003)			(0.2557)
Observations	40,621	36,870	36,870	28,011	25,442	25,442
Pseudo R^2	0.0868	0.0908	0.0911	0.0938	0.0973	0.0980

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 pattaland and bargaland 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 9: Determinants of household division, instrumenting for barga (linear probability model, full sample)

Dep. Variable:	Probability of division			
Sample (landowners):	small		large	
Model:	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Barga (cumulative)	-0.1223***	-0.0828***	0.2184***	0.2547**
	(0.0123)	(0.0313)	(0.0195)	(0.0990)
Patta (cumulative)	-0.0652	-0.4246**	0.2161	0.1604
	(0.1808)	(0.2138)	(0.2251)	(0.2270)
Lagged HH Size	0.1030***	0.1027***	0.0797***	0.0752***
	(0.0095)	(0.0094)	(0.0107)	(0.0104)
Lagged land	0.0484	0.0583	0.0045	0.0061
	(0.0653)	(0.0647)	(0.0034)	(0.0038)
Constant	-0.4337***		-0.4938***	
	(0.0424)		(0.0561)	
Observations	5,784	5,677	1,590	1,547
Number of households	1,431	1,324	429	386
R-squared[a]	0.0917	0.0935	0.0804	0.0777
Kleibergen-Paap under-id test (p-value)		0.9959		0.9968
Hansen's J over-id test (p-value)		0.6006		0.6169
Endogeneity test for Barga (p-value):		0.2002		0.4120
First stage F-test		9.03		9.61
First stage F-test (excl. inst.)		8.17		9.54

Notes: Robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects. The variables pattaland and bargaland 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. Barga is instrumented using interactions of the cumulative share of GP left share, cumulative % of INC seats in parliament, and the cumulative lagged 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 Bardhan and Mookherjee (2011). [a] 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 10: Determinants of land lost by households due to division

Dep. Variable:	Land lost due to division in acres					
Sample:	full			restricted		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged HH size	0.0159***	0.0187***	0.0185***	0.0089**	0.0130***	0.0132***
	(0.0034)	(0.0037)	(0.0037)	(0.0038)	(0.0035)	(0.0035)
Lagged land	0.0505***	0.0397**	0.0394**	0.0688***	0.0378***	0.0366***
	(0.0095)	(0.0156)	(0.0155)	(0.0190)	(0.0071)	(0.0073)
pattaland			-0.1941			-0.1658
			(0.1680)			(0.2292)
bargaland		-0.0025	-0.0018		-0.0074	-0.0076
		(0.0072)	(0.0074)		(0.0079)	(0.0079)
Lagged land*pattaland			0.0956			0.2146
			(0.0867)			(0.2594)
Lagged land*bargaland		-0.0015	-0.0022		0.0025	0.0026
		(0.0060)	(0.0063)		(0.0079)	(0.0079)
ceiling		0.1755	0.1721		0.0913	0.0749
		(0.1216)	(0.1206)		(0.1096)	(0.1096)
Constant	-0.1477***	-0.1901***	-0.1881***	-0.1198***	-0.1338***	-0.1321***
	(0.0316)	(0.0357)	(0.0357)	(0.0266)	(0.0217)	(0.0220)
Observations	58,765	54,175	54,175	41,536	38,190	38,190
R-squared	0.0305	0.0272	0.0283	0.0348	0.0187	0.0217
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. All regressions include year dummies and household fixed effects. The variabes pattaland and bargaland 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 11: Determinants of land sales, using lagged land reform, average for past 3 years (logit)

Dep. Variable:	Pr(land sale)					
Sample:	full			restricted		
	(1)	(2)	(3)	(4)	(5)	(6)
$\log\left(\frac{\text{Lagged HH Size}}{\text{Lagged land}}\right)$	-0.9077***			-1.0861***		
	(0.1843)			(0.1606)		
Lagged HH Size		0.0380	0.0377		-0.0199	-0.0199
		(0.0387)	(0.0429)		(0.0467)	(0.0503)
Lagged land		0.1303**	0.1271**		0.4801***	0.4821***
		(0.0527)	(0.0503)		(0.0665)	(0.0771)
pattaland			-0.8769			-2.4925
			(1.0416)			(1.7640)
bargaland			0.0281			-0.0077
			(0.5598)			(0.8096)
Lagged land*pattaland			0.4335**			0.3344*
			(0.1854)			(0.1807)
Lagged land*bargaland			-0.1083			-0.0849
			(0.2508)			(0.3718)
ceiling			0.3170			0.3708
			(0.3398)			(0.4442)
Observations	12,612	12,612	11,483	8,623	8,623	7,837
Pseudo R^2	0.0639	0.0517	0.0504	0.0805	0.0829	0.0823

Notes: Robust standard errors in parentheses, adjusted for clustering on villages. Regressions include household fixed effects and year dummies. pattaland and bargaland 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 12: Determinants of land purchases, using lagged land reform, average for past 3 years (logit)

Dep. Variable:	Pr(land purchase)					
Sample:	full			restricted		
	(1)	(2)	(3)	(4)	(5)	(6)
$\log\left(\frac{\text{Lagged HH Size}}{\text{Lagged land}}\right)$	0.0626**			0.0542		
	(0.0277)			(0.0356)		
Lagged HH Size		0.0161	0.0123		0.0027	-0.0103
		(0.0383)	(0.0384)		(0.0482)	(0.0477)
Lagged land		-0.2137***	-0.2523***		-0.2485***	-0.2274***
		(0.0522)	(0.0517)		(0.0553)	(0.0564)
pattaland			-1.4950			0.4786
			(1.3523)			(3.0567)
bargaland			0.4894***			0.4823***
			(0.0808)			(0.0781)
Lagged land*pattaland			0.7145***			-0.0535
			(0.2504)			(0.8874)
Lagged land*bargaland			-0.1207**			-0.1435***
			(0.0562)			(0.0446)
ceiling			0.9256**			-0.0039
			(0.4715)			(0.5406)
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. pattaland and bargaland 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 13: Determinants of immigration, village panel (restricted sample)

Dependent variable: Proportion of post-1967 immigrant households in village				
	(1)	(2)	(3)	(4)
	Fixed Effects	Arellano Bond	Fixed Effects	Arellano Bond
Lagged share of immigrants		0.4277***		0.6266***
		(0.1196)		(0.0897)
Lagged land per capita	-0.0980*	0.0162	-0.1423**	-0.0688**
	(0.0528)	(0.0269)	(0.0686)	(0.0272)
Lagged bargaland	-0.0024*	-0.0001		
	(0.0013)	(0.0006)		
Lagged pattaland	0.0297*	0.0063		
	(0.0152)	(0.0103)		
Lagged bargahh			0.0136**	-0.0010
			(0.0068)	(0.0024)
Lagged pattahh			0.0190*	-0.0039
			(0.0099)	(0.0096)
Constant	0.0822***	0.1358***	0.2246***	0.0927***
	(0.0273)	(0.0325)	(0.0266)	(0.0233)
Adjusted R-squared	0.4499		0.3928	
p-value from test for f.o. autocorr.		0.0000		0.0000
p-value from test for s.o. autocorr.		0.5990		0.1922
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), pattaland and bargaland are computed as the proportion of land affected by each program over the total cultivable land in each village. In (3) and (4), pattahh and bargahh 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 patta and barga are computed on the basis of official land records. (*** p<0.01, ** p<0.05, * p<0.1)

Table 14: The effect of land reform on inequality: cross section village regressions

sample	full		restricted	
Dependent variable:	Gini in 1998	CV in 1998	Gini in 1998	CV in 1998
	(1)	(2)	(3)	(4)
gini coefficient in 1968	0.6520***		0.6577***	
	(0.1259)		(0.1247)	
coefficient of variation in 1968		0.7559***		0.8974***
		(0.1352)		(0.1367)
cumulative bargaland	0.0024	0.0283	-0.0176	0.0388
	(0.0042)	(0.0187)	(0.0149)	(0.0521)
cumulative pattaland	-0.0630**	-0.3835**	-0.1025	-1.0571**
	(0.0302)	(0.1468)	(0.1231)	(0.4879)
Constant	0.2660***	0.5590***	0.2965***	0.5388***
	(0.0708)	(0.1629)	(0.0797)	(0.1655)
Adjusted R^2	0.3438	0.4176	0.5633	0.4417
Observations	89	88	88	83

Notes: Robust standard errors in parentheses. Cumulative pattaland and bargaland 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 15: 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 housholds 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)