Property Rights and Gender Bias:
Evidence from Land Reform in West Bengal *

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Abstract:

There is growing evidence that the formalization of land rights raises productivity and lowers poverty, but limited recognition of its potential impact on gender inequality in communities in which sons have stronger property rights. We document male-biased infant survival improvements flowing from a major land reform programme initiated in 1978 in the Indian state of West Bengal. We focus upon the component that awarded sharecropping tenants heritable rights to agricultural land which previous work has established was associated with a significant increase in agricultural productivity. Our finding that the sex ratio at age one is more male-biased after land reform is evident in two independently gathered data sets. We use representative individual data from the National Family Health Surveys conducted in 1992/3 and 1998/9 that include complete retrospective fertility histories to generate a sample of more than 20,000 births (and any childhood deaths) that occurred in 1967-1993 to model impacts of the within-district progression of registration reform over time in West Bengal districts. We also use purposively gathered data from a survey of 2400 households in 89 villages in West Bengal conducted in 2004 (described in Bardhan et al. 2014). The survey gathered retrospective histories of land ownership and tenancy status (along with data on household size and composition) that stretch back to 1967, together with unique information on area registered at the village level. Importantly, controlling for productivity makes no difference to the coefficients of interest, suggesting that income is not a mechanism. Our results are also robust to controlling for rainfall, irrigation, measures of health and road infrastructure, rural credit, and indicators of the simultaneously implemented land re-distribution program. The reform created an increase in child survival in Hindu and Muslim families but the relative deterioration of girl survival chances after the reform is more evident in Hindu families with a first-born daughter. The identified effects are concentrated among landless and marginal landowning (Hindu) families that immigrated before the reform was implemented. We argue that important weaknesses of each of our data sources are allayed by the other, and that they provide compelling complementary evidence.

JEL Classification: I14, I24, J71, O15

Keywords: Land reform, property rights, infant mortality, gender bias, India

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1. Introduction

Secure property rights are a cornerstone of economic development. There is an extensive body of work specifically regarding the importance of tenancy and ownership security on agricultural land in increasing agricultural productivity, facilitating access to credit, and reducing poverty in India and other developing countries (E.g. see Besley & Burgess, 2000; Besley, 1995; Besley & Ghatak, 2010; Besley et al., 2012; Goldstein & Udry, 2008). However there is comparatively little research on the impact of increased household land security on gender discrimination in child health investments. More rights on agricultural land may lead to diverging returns to health investments by child gender, and thereby to greater gender inequality in adult income and human capital as an unintended consequence of land reform. There is growing evidence that gender differences in health, education, and mortality respond to changes in the gender gap in labour income and rights over property in developing countries (Deininger et al., 2013; Jensen, 2010; Roy, 2012; Almond et al., 2013). Existing work also shows that greater economic development encapsulated by improved property rights and income growth is often not enough to reduce gender discrimination, unless women themselves earn the income or receive their own property rights (Duflo, 2012; Qian, 2008). We address this gap in the literature by examining how sharecropper registration to protect tenancy carried out during the land reform programme Operation Barga initiated in 1978 affected infant mortality by gender in the Indian state of West Bengal.

West Bengal is one of the only Indian states to have achieved notable success in land reform, and the impacts of Operation Barga on economic and demographic outcomes have been closely studied (E.g. see Banerjee et al., 2002; Bardhan & Mookherjee, 2011; Bardhan, Mookherjee, & Kumar, 2012; Bardhan et al., 2013; Deininger et al., 2011). Additionally, India has institutionally high prevailing son preference in the majority Hindu community due among other things to son-biased inheritance practices, reliance on sons in old age, and a Hindu dowry custom that can make a daughter's marriage cripplingly costly for parents. There is a large body of research documenting parental discrimination against girl children in health and educational investments in India, as well as a highly skewed sex ratio in favour of males due to such discrimination as well as sex selective abortions (Anderson & Ray, 2010; Babu et al., 1993; Barcellos et al., 2013; Behrman, 1988; Bhalotra, 2010; Bhalotra & Cochrane, 2010; Borooah, 2004; Chakravarty, 2010; Jayachandran & Kuziemko, 2011; Murthi et al., 1995; Oster, 2009; Rose, 2000). We contribute to both these literatures by investigating how improved land rights, which are advocated as inequality-reducing and growth-promoting, may actually exacerbate existing gender inequalities if these are not accounted for during the reform process. Gender inequality in India is of particular relevance in this context as son preference norms are derived in part from a historical economic dependence on land and male agricultural labour for a majority of the country's population (Bardhan, 1974; Rahman & Rao, 2004). Our findings are also significant given the role of maternal human capital in bettering welfare outcomes for future generations (E.g. see Black, et al., 2003; Currie & Moretti, 2003; Rosenzweig & Wolpin, 1994). The only other paper we are aware of that investigates a similar question is Almond et. al. (2013), which shows that son-biased sex selection in China increased following land reform. Our findings for India are very much in the same vein.

First, we combine the 1992-93 and 1998-99 waves of DHS survey data with district sharecropper registration rates from Banerjee et al. (2002), and use a quadruple difference-in-differences strategy to ascertain impacts of the programme on infant mortality risk by child gender and the gender of the firstborn child in the household. Firstborn children's gender in India has been shown to be random and plausibly exogenous. This therefore allows us to identify programme impacts without confounding bias from differential mortality trends by child gender across districts that may correlate with registration rates. We find that Hindu boys experience a significant decline in infant mortality risk following high rates of tenancy registration in the district. Hindu girls with firstborn older brothers face no parental discrimination and experience the same decline in infant mortality risk as boys. Hindu girls with firstborn older sisters however are significantly likelier to die in infancy following high district registration than before, suggesting that they face greater discrimination when the sex ratio among their siblings is less male. Amongst Non-Hindu families, who are traditionally less son-preferring, we find all children experienced largely similar declines in mortality risk as a result of the programme regardless of their gender or that of the firstborn child.

Second, we present results using survey data from 2,400 households in West Bengal with unique information on household immigrant status, land holdings, and the village-level share of land that was registered under the programme. Using household fixed effect regressions, we show that an increased share of registered village land significantly increases the likelihood of a surviving boy being born in the family and reduces the likelihood of the birth of a girl. These effects are concentrated amongst landless and immigrant households who were likeliest to benefit from sharecropper registration, and are again primarily found for Hindu households.

Our findings are robust to the inclusion of land productivity measures as controls, ruling out rising income from tenant registration and other programmes such as HYV minikit distribution as a mechanism for increased gender bias. Rather, institutional biases against women in land inheritance and marital practices are the likely mechanisms behind our findings. Differences in such institutions between communities therefore fundamentally determine who gains from improved land rights.

The rest of the paper is organised as follows. Section 2 provides a background discussion of land reform in India, Operation Barga in West Bengal, and prevailing son preference norms. Section 3 presents the proposed mechanisms of impact that motivate the empirical analysis. In Section 4 we discuss the data that we use in our estimations. Section 5 outlines our empirical methodology, and in Section 6 we present our results. Finally, our conclusions and discussion of the results are presented in Section 7.

2. Background

Upon national independence in 1947, the Indian central government began three main types of land reforms to address large historical inequalities in land distribution. These were abolition of intermediaries, new tenancy laws to protect against eviction and extraction of excessive rental crop shares by landlords, and land ceilings to limit the amount of land held by any one household with the aim of vesting and redistributing surplus land to small farmers. Implementation of the reforms was left to individual state governments, and barring intermediary abolition in nearly all states landlords were able to subvert the remaining reform measures by way of pre-emptive tenant evictions and parcelling land to relatives to avoid state confiscation of above-ceiling holdings (Appu, 1996). Variation in state-level reform implementation and legislation over time has been used in previous studies to empirically estimate land reform impacts on poverty, equity, and human capital (Besley and Burgess, 2000; Ghatak & Roy, 2007; Ghosh, 2008).

Reforms in the state of West Bengal were spurred by the results of the 1977 state assembly election. The Left Front coalition headed by the CPM won an absolute majority, which it retained until 2011. This new government promptly created a three-tier system of local governments called *panchayats*, which for the first time would be democratically elected. These tiers in descending order of size of jurisdiction were district, block, and finally the *gram panchayat* that operated at the village level with a jurisdiction of 10-15 hamlets (*mouzas*). Many national development programmes as well as aspects of new state welfare initiatives such as Operation Barga were then decentralised to these *gram panchayats*, who were largely responsible for selecting local eligible beneficiaries and lobbying the upper tiers of the new system for funds (Bardhan & Mookherjee, 2011).

2.1 Operation Barga and the Green Revolution

West Bengal, along with Kerala, is an exceptional state in terms of the effort with which the state government pursued land reform implementation. The Left Front implemented Operation Barga rigorously to consolidate its rural vote base among small farmers, leading to higher sharecropper registration in areas where it faced greater competition in newly instituted local elections (Bardhan & Mookherjee, 2010). Registration gave sharecroppers permanent, hereditary tenancy rights, and limited the share of the crop payable as rent to landlords to 25 percent.[1] By 1981 over 1 million sharecropper tenants were registered due to the reform, and almost 1.5 million by 1990 (Lieten, 1992). Estimates of the fraction of sharecroppers registered in the state via the operation range from 45% (Bardhan & Mookherjee, 2011), to 65% (Banerjee et. al., 2002), to as high as 80% (Lieten, 1992).

As part of Operation Barga, the state also aimed to vest land held by households above the stipulated ceiling of 12.5 acres and redistribute it to the landless and small landowners. Most vesting of land had already taken place by 1978, so the new Left Front government's main role was in redistributing this land. Appu (1996) estimates that 6.72 percent of state operated area was distributed by 1992; several times the national average of 1.34 percent. However this land was redistributed in very small plots (less than half an acre on average in the sample of farms in Bardhan & Mookherjee, 2011), and was likely of low quality for cultivation as landlords would only part with their lowest quality above-ceiling holdings. Hence unlike tenant registration, land redistribution had virtually no impact on agricultural productivity.

Importantly, there were other government rural initiatives launched in the state at the same time that were aimed at boosting agricultural productivity and reducing poverty. Alongside Operation Barga, the state government also distributed minikits containing high yield variety (HYV) seeds,

[1] This share rose to 50 percent if landlords provided all non-labour inputs.

fertilisers, and insecticides to farmers throughout the state via *gram panchayats*.[2] Land reform in combination with minikit distribution led to a substantial increase in agricultural yields in West Bengal over the 1980s, transforming the state into one of the best agricultural performers in the country and leading this period to be called West Bengal's Green Revolution. This period is also associated with significant declines in poverty and growth in rural employment. Banerjee et. al. (2002) attributed the increase in yields to land reform, citing decreased Marshall-Mill sharecropping distortions from increased tenancy security. Bardhan & Mookherjee (2011) however shows that while decreased inefficiencies played a role in increasing yields, it was largely minikit distribution that was responsible for the agricultural growth in this period.[3] Other programmes administered in the 1980s with *gram panchayats* targeting local beneficiaries include the Integrated Rural Development Programme that provided subsidised credit, and employment initiatives such as the Food for Work programme, the National Rural Employment Programme, and the National Rural Employment Guarantee Programme.

2.2 Community Differences in Son Preference

The majority Hindu community in India traditionally exhibits greater son preference than other religious communities, as evidenced by conditional sex ratios in the population and empirical evidence on child mortality and education that reflect childhood parental investments (Bhalotra & Zamora, 2009; Bhalotra & Cochrane, 2010; Bhalotra, et al., 2010). The literature in this regard has focused on Hindu-Muslim differences, as other religious communities make up a very small part of the population.[4]

While no definitive explanation has been agreed upon for the differing degrees of son preference between the Indian Hindu and Muslim communities, existing arguments such as the Dyson-Moore hypothesis base them in marital institutions and inheritance practices. In North India including West Bengal, Hindu marriage is exogamous for women, who leave their natal family village to marry into families in villages much further away to avoid marrying a possible relative. The distance from natal family after marriage reduces Hindu women's bargaining power and also their claim to natal family land, which is seen as bringing no reciprocal benefit and lost

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[2] The crops for which seeds were distributed were rice, potatoes, oilseeds, and some other vegetables according to Bardhan & Mookherjee (2011).

[3] A companion paper Bardhan, Mookherjee, & Kumar (2012) also shows that tenancy reform crowded in large private investments in irrigation, the growth-inducing effects of which were far greater than those of reduced Marshall-Mill distortions.

[4] We do the same in this section, as Hindu and Muslim children constitute 97.98% of our estimation sample.

to the family when daughters inherit. Sons on the other hand care for parents and natal family members in their old age by remaining with the natal family and working the family land, eventually inheriting it upon the death of the family patriarchs. Cultural taboos against Hindu women sharing public spaces with men and working agricultural land also often prevent them from claiming and cultivating land (Agarwal, 2003).

Under the *Mitakshara* Hindu doctrine followed in North India, women in fact have no claim to joint family property, whereas men are entitled at birth to a share of such family property held by their fathers, paternal grandfathers, and paternal great-grandfathers.[5] In South India close-kin marriages are more prevalent for Hindu women, allowing them to inherit a greater share of ancestral land despite prevailing *Mitakshara* doctrine as they reside close enough to participate in cultivation on natal family land after marriage. These marital institutions have been used to explain more favourable female-male sex ratios in South India compared to North India (Chakraborty & Kim, 2010). In West Bengal the *Dayabhaga* Hindu system of inheritance is followed where the concept of joint family property is absent, and all of a Hindu male's property is subject to equal claims by his widow, sons, and daughters upon his intestate death (Lingat, 1973). While this appears more gender-equal than the *Mitakshara* system in theory, in practice Hindu women nearly always relinquish their inheritance claims to their brothers and sons so as to avoid social exclusion, intimidation, and losing the family safety net in times of financial crisis (Agarwal, 2003). Hindu upper caste women also do not physically work agricultural land due to prevailing social norms. Lower caste women have higher work-force participation rates in agriculture as wage labourers, but still female employment rates in agriculture in the state have been persistently low.[6] Hindu women therefore are very much financially dependent on their male kin, leading them to give up their rights to family land to avoid losing that support.

Muslim communities follow inheritance practices based in the Shariat, which guarantees women at least half as much inheritance as their closest male counterpart inheritors. Consanguineous marriage is also practiced to keep all ancestral property within the family, allowing Muslim women to remain close to their natal families after marriage and inherit more family property in

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[5] Some Indian states have since made reforms to the Hindu Succession Act of 1956 to give women equal inheritance rights to joint family property, but these reforms still explicitly exclude agricultural land from their purview.

[6] In the 1991 Census of India only 11.1 percent of women in West Bengal reported having any form of employment, and only 54.1% of the employed women were cultivators or agricultural labourers. National Sample Survey data also reflects decreasing female rural employment and increased casualisation of female agricultural labour since the late 1980s.

practice similar to Hindu women in South India.[7] Marital dowry is also less prevalent among Muslims, and abortion, sex selective or otherwise, is strictly forbidden under the Shariat. The effect of these institutions arguably reduces parental neglect of Muslim female children compared to Hindu female children in many parts of the country including West Bengal, despite the fact that the Muslim minority population experience nationally higher levels of poverty than the Hindu majority and Muslim female labour force participation in West Bengal is even lower than that of Hindu women (Nasir & Kalla, 2006; Chakraborty & Chakraborty, 2010).

3. Causal Impacts and Identification

3.1 Mechanisms of Interest

We first discuss the impact of sharecropper registration on infant mortality arising from mechanisms independent from increased productivity of land. Increased land productivity during the 1980s was driven only partially by registration and more so by the accompanying initiatives discussed previously, and make identification of registration impacts challenging. We deal with this econometric challenge by focusing on identification of sharecropper registration effects that are propagated through parental preference structures over child gender and are estimated *conditional* on crop productivity and acreage effects. Parental preference effects are determined largely by the institutional factors discussed in the previous section once the effects of rising productivity are controlled for, and are precisely what we are interested in estimating. It is also worth noting that our analysis focuses on the impacts of district-level sharecropper registration on individual mortality risk, and therefore captures general equilibrium effects of improved sharecropper tenancy security on infant mortality among all households in the district.

Considering tenant sharecropping households first, Operation Barga increased their security on rented land and bargaining power over the share of output paid as rent via actual or the threat of registration. This undoubtedly increased future expected returns to rented land for tenant sharecropper households, even if land productivity is held constant. The increased expected returns generate income and substitution effects between sons and daughters in parental child health investments. The income effect benefits both sons and daughters as there are more resources to go around, thereby reducing infant mortality risk for both. The substitution effect however would lead parents to invest more in their sons at the cost of daughters if sons were

[7] Bittles (2002) reported that 23% of Muslims in India practiced consanguineous marriages in 1992–1993.

perceived to be a "better" investment. We know from consumer theory that whether or not the substitution effect dominates the income effect depends on the parental preference structure over child gender, and specifically on whether girls are considered "close" substitutes for boys. As the increased returns to land are derived largely from sons' labour and provision of old age security, parents are likely to consider daughters poor substitutes for sons from a purely economic standpoint. A male advantage will therefore manifest in infant mortality after registration if the greater economic returns from sons following land reform also yield parents greater utility than the utility they receive from daughters, causing the substitution effect to outweigh the income effect in child health investments. We can ex-ante expect that the substitution effect would be more dominant in Hindu families than in Non-Hindu families based on the community differences in inheritance and dowry practices, and existing literature on Indian gender discrimination in health investments discussed earlier.

For land owning households, sharecropper registration reduced the rent that they could extract from existing tenants or new tenants, abstracting away from land productivity increases. Hence landlordism had lower future profitability, and sons arguably became more important than daughters to keep remaining land holdings in the family and maximise returns from own-cultivation. Hence a decline in expected future landlord income is expected to shift resources towards sons in land owning families, which were mostly Hindu during the reform period.

Sharecropper registration also generated land market transactions and household division rates that potentially affected son-bias. Bardhan et. al. (2013) show that registration increased land purchases by smaller farmers, while households with larger landholdings increased sales of their land as landlordism became less profitable. In both sets of households division rates declined as a result of sharecropper registration conditional on family size, potentially reflecting increased joint cultivation of family holdings that were converging in size as land inequality declined. Increased land holdings for previously smaller farmers potentially increase son-bias as sons would keep the land within the natal family via inheritance, and bring in more land as dowry at marriage in Hindu families. Hindu daughters conversely potentially meant land being lost to the natal family if it was given to their grooms as dowry or had to be sold to cover marriage expenses. The selling and exchanging of land for marriage expenses and dowry of Hindu daughters formed a significant part of the land market transactions brought to life by Operation Barga, presumably increasing son preference (Gupta, 1993; Kodoth, 2005). This is more likely to be true for Hindu families than in Non-Hindu families where dowry was much less prevalent.

The income effect from larger holdings however could have benefited daughters as well in all communities. Smaller holdings for families with previously bigger plots of land would also make sons more important to prevent further reductions in holdings and work the remaining land, while income from land sales could benefit both sons and daughters.

3.2 Other Programmes and Identification

Bardhan, Mookherjee, and Kumar (2012) find that sharecropper registration crowded in significant private irrigation investments that triggered large productivity spillovers across both tenant and non-tenant farms. Hence Operation Barga potentially had large indirect impacts on small cultivators and wage labourers who were not involved in sharecropping as landlords or tenants. The 1980s period of accelerated rice and foodgrains production in West Bengal also saw disproportionate increases in consumption expenditure by the poor and reduced consumption inequality, due mainly to rising agricultural employment, productivity, and wages (Chattopadhyay, 2005). Reduced groundwater costs from irrigation investments undoubtedly played a role in this period of high agricultural growth and labour-absorptive expansion. As men were the primary wage labourers and small cultivators in the state, their increased incomes from registration-induced irrigation investment could have increased son-bias in child health investments among these households if the substitution effect dominated the income effect of higher labour returns on these investments.

HYV minikit distribution was however the likely primary driver of yield increases and agricultural growth in West Bengal in the 1980s as noted earlier. Subsidised rural credit also played a complementary role. The simultaneity of these different programmes with sharecropper registration therefore makes it difficult to disentangle the impact of registration on son preference driven by increased land productivity.

We therefore use an estimation approach that conditions on the effects of land productivity, while estimating the impact of sharecropper registration on infant mortality risk.[8] By doing this we control for the combined income and substitution effects of any yield increases via HYV minikit distribution, rural credit disbursement, and other programmes on son-bias in parental health investments that determine infant mortality. At the same time, conditioning on

[8] Rice is the major crop in West Bengal, accounting for more than 70% of gross cropped area consistently during 1971-1991 according to state government economic reviews.

productivity effectively conditions on changes to income from increased agricultural output and employment arising from sharecropper registration as well, whether from crowded-in private irrigation investments or increased returns from improved input use on sharecropped land. This allows us to isolate the net effect of sharecropper registration on infant mortality through causal channels which are based in institutional preference structures and independent of the effects of increased yields, wages, and cropping intensity.

4. Data and Descriptive Statistics

4.1 DHS Survey Data

The first dataset we use is the Indian Measure DHS survey. The survey uses interviews with women aged 15-49 to collect a wealth of information on their fertility history, their children's health and mortality outcomes, household wealth, and their own health and education. Households are chosen for interview using stratified random sampling, with the probability of selection weighted by the area population as per the last Indian national census. We use the 1992-93 and 1998-99 waves of survey data for West Bengal women and children, and match their district of residence to district level data on sharecropping registration. The sharecropper registration data is the same as in Banerjee et. al. (2002), kindly granted to us by the authors.

Tables 1 and 2 outline some descriptive characteristics of Hindu and Non-Hindu mothers and children respectively, and how they change with increasing district sharecropper registration rate. For both communities we see increased maternal age at childbirth as well as increasing maternal education over time and with increasing registration. There is also evidence of declining fertility and increasing rural population with higher registration. Finally, there is suggestive evidence in both communities of declining infant mortality rates as sharecropper registration rises. In Table 3 we verify that the gender of the firstborn child is random in our sample households by testing differences in mother characteristics by whether they have firstborn sons or daughters. There are no statistically significant differences in maternal education, religion, caste, or other indicators by whether they have a firstborn son or daughter. In fact, these differences are close to zero indicating that firstborn child gender is indeed random and plausibly exogenous.

We use district-level data on yields and area under cultivation of rice and all other cereals in West Bengal from the ICRISAT Village Dynamics in South Asia (VDSA) database to construct measures of land productivity. Figure 1 plots annual sharecropper registration rate, total rice yield in thousands of tonnes, and the 3-year moving average of total rice yield for each of the 14 districts in our dataset. There is a visibly high degree of correlation between rice output growth and increasing sharecropper registration after 1980 across all districts reflecting the simultaneous implementation and complementary nature of HYV minikit distribution and land reform.

We also collect information from the annual Economic Survey reports of the West Bengal government to control for the effects of other programmes and infrastructure in our 14 districts. We specifically use information on the annual number of medical institutions, kilometres of surfaced roads, and the amount of *patta* land distributed in each district.

Finally, Figure 2 shows the evolution of the mean registration rate across our 14 districts over time. Sharecropper registration appears to have been occurring most quickly up to 1985, after which the pace of registration slows considerably and remains slow into the 1990s. We will exploit this fact in our robustness checks.

4.2 Village Survey Data

The second dataset we use comes from surveys conducted of household heads in West Bengal regarding their family history, land ownership, and immigration status. The survey questionnaire was designed to ask the head about all members residing in the household in 2004, and the year they were born or joined the household. Reported births in this data can be interpreted as births of children who have survived till 2004.

The survey data was used to construct a household panel for a sample of 2400 households from 89 villages, as explained further in Bardhan et al (2014). For about two-thirds of this sample, a consistent history of household landholdings and demographics could be constructed (comprising the 'restricted sample'). For the rest a consistent history could be constructed under specific assumptions of nature of recall errors. Accordingly we present results for both samples, and where we report only results from the restricted sample we verify independently that the results do not differ qualitatively in the full sample.[9]

We combine the household data with village level data on land reforms implemented for each year from 1971-2003 (collected from Block Land Records offices) for both *patta* and *barga*

[9] The results from the full sample are available from the authors upon request.

programs. The extent of each reform activity in the previous three years is represented by percent village land distributed (as pattas), and percent village land registered (under barga).

5. Empirical Strategy

5.1 DHS Data: Quadruple Difference-in-Differences

Using the DHS surveys and the accompanying data on sharecropper registration, we exploit the variation in registration intensity across districts along with variation in child gender and the gender of the firstborn child in the household in a quadruple difference-in-differences strategy to identify programme effects on infant mortality. We implement the following specification,

$$\begin{aligned} y_{it} = a &+ \beta_1 \, SCROP50_{it-1} * FIRSTSON_i * FEMALE_i + \beta_2 \, SCROP25_{it-1} * FIRSTSON_i * FEMALE_i \\ &+ \delta_1 \, SCROP50_{it-1} * FEMALE_i + \delta_2 \, SCROP25_{it-1} * FEMALE_i \\ &+ \eta_1 \, SCROP50_{it-1} * FIRSTSON_i + \eta_2 \, SCROP25_{it-1} * FIRSTSON_i \\ &+ \varphi_1 \, FIRSTSON_i + \varphi_2 \, FEMALE_i + \varphi_3 \, FIRSTSON_i * FEMALE_i \\ &+ \gamma_1 \, SCROP50_{it-1} + \gamma_2 \, SCROP25_{it-1} + \lambda X_{it} + d_t + \theta_i + \varepsilon_{it} \qquad (1) \end{aligned}$$

where y_{it} is a dummy variable taking value 1 if child i born in year t dies aged 0-12 months and 0 otherwise when we are considering infant mortality. We define dummy variables $SCROP25_{it-1}$ and $SCROP50_{it-1}$ which take value 1 if sharecropper registration rate in the district where child i resides reaches at least 25% or 50% respectively in the year preceding his birth year, and 0 otherwise. These are our measures of low and high intensity sharecropper registration.[10] It is worth noting that these measures are such that $SCROP25_{it-1}$ is always equal to 1 when $SCROP50_{it-1}$ is equal to 1, so that high intensity sharecropper registration captures a cumulative effect of programme intensity on infant mortality. The omitted category of children constitutes those born in districts where registration is less than 25% in the year preceding birth. We further define a gender indicator $FEMALE_i$ taking the value 1 if child i is a girl, and the indicator $FIRSTSON_i$ taking value 1 if the firstborn child born to the mother of child i is male.

Table 4 shows the evolution of sharecropper registration rates for the 14 districts in our sample. The light grey cells indicate the year that 25% registration of all sharecroppers is achieved, and

[10] We chose these levels of registration as cut-offs for our treatment indicators based on estimates from a flexible specification that tested for significant effects of cumulative sharecropper registration rates in 10 percent increments. These results are available from the authors upon request.

dark grey cells indicate the year when 50% registration is achieved. There is a lot of variation across districts in the years in which these thresholds are achieved in programme implementation that we exploit in specification (1). This also alleviates concerns that these years coincide closely across districts, which would mean we have little dynamic variation in implementation and our estimates are largely driven by cross-sectional variation across districts.

The β parameters on the firstborn son-female child-registration rate interaction terms will therefore capture the impact of sharecropper registration intensity on infant mortality of female children with firstborn older brothers. These impacts are over and above registration impacts on infant mortality of girls with firstborn older sisters captured in δ parameter estimates, and on the infant mortality of boys with firstborn older brothers captured in η parameter estimates. The programme effects for boys with older sisters are captured in the γ parameter estimates, and the untreated counterpart estimates are captured in the φ estimates. The four dimensions across which we are taking differences to achieve identification are therefore districts, year of birth, child gender, and the gender of the firstborn child in the household. The impacts are identified independently of child birth year and district fixed effects captured in dummies d_{it} and θ_i. We also present estimates from mother fixed effect specifications, and after including a district-specific linear trend in child birth year to control for district time trends in unobservables that may simultaneously determine sharecropper registration rates and infant mortality risk. The covariate vector X_{it} includes indicators for child birth order, indicators for household religion and caste, whether the household is rural, mother's educational attainment, and finally linear and quadratic terms of the mother's age at which the child is born. ε_{it} is an idiosyncratic error term.

To explicitly control for the effects of minikit distribution, rural credit, and similar initiatives on infant mortality via increased agricultural acreage and yields, we estimate specifications including logs of district productivity of rice ($LN\ RICE\ PR_{t-1}$) and other cereals ($LN\ CER\ PR_{t-1}$) per 1000 hectares in the year prior to the child's birth as regressor, along with the corresponding interaction terms with the firstborn son and female child indicators. To further control for any confounding effects of public health improvements, infrastructural development, and the other arm of the land reform, we also include controls for the logs of medical institutions per capita, kilometres of surfaced road per capita, and hectares of *patta* land distributed per capita in the district in the year preceding the child's birth along with the necessary interaction terms.

Differential fertility-stopping by child gender may have increased due to sharecropper registration, and is a potential mechanism behind programme impacts on infant mortality that we explore. Again exploiting the fact that the gender of the firstborn child is random and plausibly exogenous, we re-estimate (1) with the new outcome variable indicator taking value 1 if child *i* has a younger sibling and 0 otherwise. However in this specification we are only concerned with how having a firstborn son alters fertility-stopping as sharecropper registration increases, and not how this varies with the gender of child *i*. We therefore do not include the firstborn son-female child-registration intensity interaction terms. We implement this estimation separately by child birth order to isolate the point in the fertility cycle where son biased fertility-stopping might be sharpened by the programme.

We estimate (1) and its variation for fertility-stopping using OLS on the sample of children of birth order two or higher born during 1978-93.[11] We carry out separate estimations for Hindu and Non-Hindu children when examining gender-specific mortality to account for the different preference structures over child gender between communities. As there are only 14 districts, we report results with wild cluster-bootstrapped p-values to accurately do inference on estimates.

5.2 Village Data: Fixed Effect Regressions

The main dependent variable we examine in the household head survey data is the event that a boy or girl who survived until 2003 was born into a household in a given year. Differences in effects between boys and girls are likely to reflect gender differences in mortality, as chances of sex-selective abortion during this period in rural West Bengal were low. Since reported births are of children who survived till 2003, this outcome measures both birth and survival probability. The specification we use is,

$$y_{ijt} = a + \beta_1\, BARGA\_LAND_{jt-1} + \beta_2\, PATTA\_LAND_{jt-1} + \lambda X_{ijt} + d_t + \theta_i + \varepsilon_{ijt} \qquad (2)$$

where the outcome y_{it} takes value 1 if a surviving boy (or girl, depending on the gender being investigated) is born in household *i* in village *j* in year t and 0 otherwise. $BARGA\_LAND_{jt-1}$ and $PATTA\_LAND_{jt-1}$ measure the share of cultivable land in village *j* that was registered and distributed respectively under Operation Barga in the three years preceding year *t*. The

[11] We also check for consistency of estimates by including firstborn children in the sample and coding the firstborn son indicator as zero for these firstborns, and by further restricting the sample to the first two children only. The results do not change qualitatively, and are available from the authors upon request.

coefficients β_1 and β_2 capture respective impacts of the two arms of the programme. The terms d_t and θ_i are year and household fixed effects respectively, and ε_{ijt} is an idiosyncratic error term.

The vector of regressors X_{ijt} includes lagged land owned by the household, an above-ceiling dummy (whether it owned more land than permitted by the land ceiling), and immigrant status indicators (whether the household immigrated after 1967, and year of immigration) which are available for the full time period of 1971-2003.[12] In alternate specifications we include village controls constructed from the farm productivity and infrastructure dataset of Bardhan and Mookherjee (2011), which include logs of annual village rainfall, village land productivity, price of rice, local government expenditures on roads and irrigation, and kilometres of surfaced road and area irrigated by canals in the district. These regressors control for potential confounding effects of other programmes, local infrastructural development, and economic shocks. However they are available for years 1982-96 only, restricting the time coverage of the sample.

As with specification (1), we present separate estimates for Hindu and Non-Hindu households. We further present disaggregated results by the size of household land holdings and whether households immigrated to the village before or after 1977. This is because once the legislation amending the Barga Act was passed in 1977 by the newly elected Left Front, it is plausible that it made landlords unwilling to grant fresh leases after 1977. Indeed, the proportion of land under tenancy declined sharply subsequently (Bardhan et al., 2011). Hence immigrants arriving after 1977 would have been unlikely to obtain any leases, in contrast to those arriving before 1977. So if the observed effects of the Barga reform were driven by effects on tenants, we would expect the effect to be concentrated amongst immigrants arriving before 1977. We similarly expect that programme effects are largest for households with little or no land, as these are the households likeliest to lease in land as tenant sharecroppers.

6. Results

6.1 Firstborn Sons, District Registration Rates, and Mortality

Table 5 reports the estimates from (1). In the full sample of children of birth order two or higher, we find in column (1) that in districts that achieve 50% sharecropper registration, boys born the following year have a 4.6 percentage point decrease in infant mortality risk. The effect

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[12] In some specifications we also include the share of cultivable village land transacted (bought or sold) in the three years preceding year t to examine if income effects from these transactions arising from the programme explain any impacts we find. The results do not change significantly in these specifications, and are available upon request.

is highly significant at the 1% level. There is no differential effect on mortality risk for boys by gender of the firstborn child. Girls with firstborn older sisters experience practically no reduction in infant mortality risk, indicating a degree of parental indifference or neglect. The 50% registration-female interaction term shows a 5.1 percentage point higher estimated infant mortality risk than boys, which is significant at the 5% level. Girls with a firstborn older brother however have a nearly identical reduction in infant mortality risk to boys as indicated by the 50% registration-female-firstborn son interaction term, and show little sign of parental discrimination. These results do not change significantly in column (2) upon adding the district land productivity and infrastructure controls, which if anything strengthen the coefficient on the quadruple interaction term. Column (3) further includes a district-birth year linear trend to control for any such trend in unobservables that may bias the programme impact estimates, and again this serves only to increase coefficient magnitudes.

We examine community-specific results by re-estimating the specifications in columns (1)-(3) for Hindu and Non-Hindu children separately. The results are reported in columns (4)-(6) and (7)-(9) respectively. We find that the gender discrimination faced by girls without a firstborn older brother is almost entirely in Hindu households. Hindu boys have a marginally significant 4.1 percentage point reduction in infant mortality risk in response to high registration, which increases to 5.0 percentage points once district covariates are included, and further to a strongly significant 5.8 percentage points with the district-birth year trend in column (6). Hindu girls with firstborn older sisters appear to actually have an *increase* in infant mortality risk of 1.4-2.6 percentage points in columns (4)-(6), while girls with firstborn older brothers actually have a *greater* reduction in mortality risk than boys in the range of 5.1-9.2 percentage points. In contrast, in Non-Hindu households *all* children experience a statistically significant decline in infant mortality risk of 5.3-8.4 percentage points in columns (7)-(9) regardless of their gender.

Table 6 shows the same specifications in Table 5 estimated with mother fixed effects. As expected, more stringently controlling for mother-specific time invariant unobservables reduces the statistical significance of the estimates. However the qualitative nature of the estimates remains identical. Column (3) with the full set of covariates still shows a statistically significant pattern of gender discrimination against girls with firstborn older sisters compared to those with firstborn older brothers. Columns (4)-(6) again verify that these effects are driven by Hindu households, while columns (7)-(9) show that Non-Hindu households do not appear to discriminate against children by their gender.

6.2 Gender-Differentiated Fertility Stopping

We now examine how registration affected son-biased fertility stopping, which potentially reduced infant mortality for children born after a firstborn son if they grew up in smaller families with less competition for household resources. A firstborn son potentially induces son-preferring parents to have fewer children as their desire for male children is satisfied early in the fertility cycle. If Operation Barga sharpened this behaviour, it could to some extent explain reduced infant mortality among Hindu girls with firstborn older brothers compared to those with firstborn older sisters in response to high district registration. We therefore re-estimate (1) with the new dependent indicator variable for the presence of a younger sibling, without the quadruple interaction terms, and report the results in Table 7.

Column (1) shows that there is a large, statistically significant reduction of 11.4 percentage points in the probability parents have a third child if their firstborn child is a son, and district registration reaches 25% in year previous to the second child's birth. This estimate is robust to the inclusion of the entire set of household and district controls, and a district-birth year trend. This may at least partially explain why girls with firstborn older brothers fare better in Hindu families. There is also a statistically significant decline of 6.1 percentage points in the probability of having a third child in general once registration reaches 50%. There are no visible fertility stopping effects of registration at birth orders three and four in columns (2) and (3). Columns (4) and (7) show that in fact both Hindu and Non-Hindu families increase fertility stopping at two children if they have firstborn sons and registration reaches 25%. There are again no such effects at birth orders 3 or 4 in either group. Hence children with firstborn older brothers do grow up in smaller families in both Hindu and Non-Hindu households as sharecropper registration increases. However in Non-Hindu families there is a large decline in fertility at second parity of 9.5 percentage points regardless of firstborn child gender at 50% registration that may have a larger role in the reduction in mortality risk for both boys and girls at this registration rate found previously.

6.3 Was Sharecropper Registration Targeted?

Our results are subject to reverse causality bias if sharecroppers were more rapidly registered in districts where families, particularly Hindu families, historically discriminated more against daughters when they did not have firstborn sons than in other districts prior to Operation Barga.

To ensure this is not driving our results, we assign districts as "treated" or "untreated" if they had achieved above or below-median levels of registration in 1985 respectively. This exploits the fact that registration occurred at its fastest pace during 1980-1985. We then regress infant mortality amongst cohorts born before the programme during 1967-77 on a linear time trend covering these years, and the treatment indicator for high or low intensity registration in 1985. This reveals if pre-programme trends in infant mortality risk in a particular district correlate with that district becoming a "treated" district in the future. We then also perform the same test for trends in gender-specific and firstborn son-gender-specific infant mortality trends.

The results from these tests are in Table 8. Across all columns, we find no statistically significant correlations between pre-programme infant mortality during 1967-77 and the intensity of registration in the district in 1985. This holds for mortality in general, gender-specific mortality, and firstborn son-gender-specific mortality. It also holds separately for Hindu and Non-Hindu households, lending further credibility to our results.

6.4 Village Land Registered and Mortality

Table 9 shows the estimated impacts from (2) of Operation Barga on the likelihood of surviving boys being born into households in different landowning classes for the restricted household survey sample. The estimates show a significant positive effect of tenant registration in the past three years on the likelihood of birth of surviving boys in landless households in column (2). This is robust to the inclusion of controls for log land productivity (value -added per acre), proportion of cultivated area leased, log-rainfall, local government expenditures on roads, rice price, irrigation, and the length of surfaced roads in the district. Hence it is unlikely to represent a wealth effect, or an increase in value of male family labour owing to the rise in land productivity. There are no discernible effects of the land distribution arm of the programme, in line with the previous literature. The estimate for landless households is quantitatively large, implying that a standard deviation increase in village land registered in the previous three years resulted in a 22% rise in likelihood of a surviving boy being born.

Table 10 shows the corresponding results for female surviving births. There is a negative and significant effect of land registration on the likelihood of surviving girls being born in marginal and small landowning households in column (4). This bolsters our previous findings from the DHS data, indicating that girls become less desirable than boys once property rights improve. It also eliminates concerns that the increased likelihood of surviving sons being born after registration is driven by a general increase in fertility after exposure to the programme. Again there are no visible effects of land redistribution in any landowning classes. The effect on the landless is zero, suggesting that households in different land classes showed differing degrees of discrimination towards girls versus boys. The positive effect on boys for the landless therefore did not come at the expense of girls.

6.5 Household Religion and Village Land Registered

Tables 11 and 12 further explore the heterogeneity of the effect on male and female surviving births respectively by dividing the sample between Hindu and non-Hindu households (classified using the name of the household head). In Table 11 we observe a positive and significant effect of land registered on male surviving births in Hindu households, and no visible effects for those in non-Hindu households. Again, this is consistent with what we find in the DHS data with Hindu households showing greater son preference in response to the reform. The estimates are robust to the inclusion of village and district-level controls as previously.

The corresponding results for girls in Table 12 show a negative and significant effect of land registration on the likelihood of surviving female births in Hindu households, and no discernible effect for those in non-Hindu households (except for column 2, which shows a positive effect significant at 10%). The increase in male surviving births therefore does appear to occur at the cost of female surviving births in Hindu households in response to sharecropped land registration. There are no statistically significant effects of land distribution in any of the columns in Tables 11 and 12.

6.6 Village Land Registration and Immigrants

Table 13 re-examines the boy regressions across natives and (post–1967) immigrants for both full and restricted samples, for all land classes and landless separately. The positive effect of registration on male surviving births is driven entirely by a positive effect for immigrants, and landless immigrants in particular. This is further evidence in support of our hypotheses, as landless immigrants form the likely pool of sharecropper tenants who would rent from native landowners. Columns 5-8 show that the estimate of the effect is much larger for natives, but it is very imprecisely estimated despite the fact that natives comprise a large majority of the landless, indicating it is not because of a smaller sample size.

As mentioned above, immigrants arriving after 1977 would have been unlikely to obtain any leases, in contrast to those arriving before 1977. So if the observed effects of the Barga reform were driven by effects on tenants, we would expect the effect to be concentrated amongst immigrants arriving before 1977. We test this in Table 14, and find the results showing exactly that — the positive effects for immigrants obtain only in the pre-77 immigrants. Indeed the effect on the post-77 immigrants is negative in all columns excepting column 2. What is particularly striking is that the positive effect estimated for the entire population seems to be driven by a very small subpopulation — landless immigrants arriving before 1977, who comprise only about 4% of the population.

7. Discussion and Conclusions

Our findings show a strong exacerbating effect of increased tenancy security on land on son-bias in parental health investments among Hindu children, indicating that the substitution effects of sharecropper registration outweigh any gender-neutral gains in infant survival. For Non-Hindu children on the other hand, there is a decline in infant mortality for both boys and girls. The gender-neutral income effect therefore seems to dominate in these minority communities where son preference is not as marked. Institutional differences in marital exogamy, female labour force participation, and son preference therefore play a significant role in determining the distribution of benefits by gender.

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Figure 1: Total Rice Yield and Sharecropper Registration by District

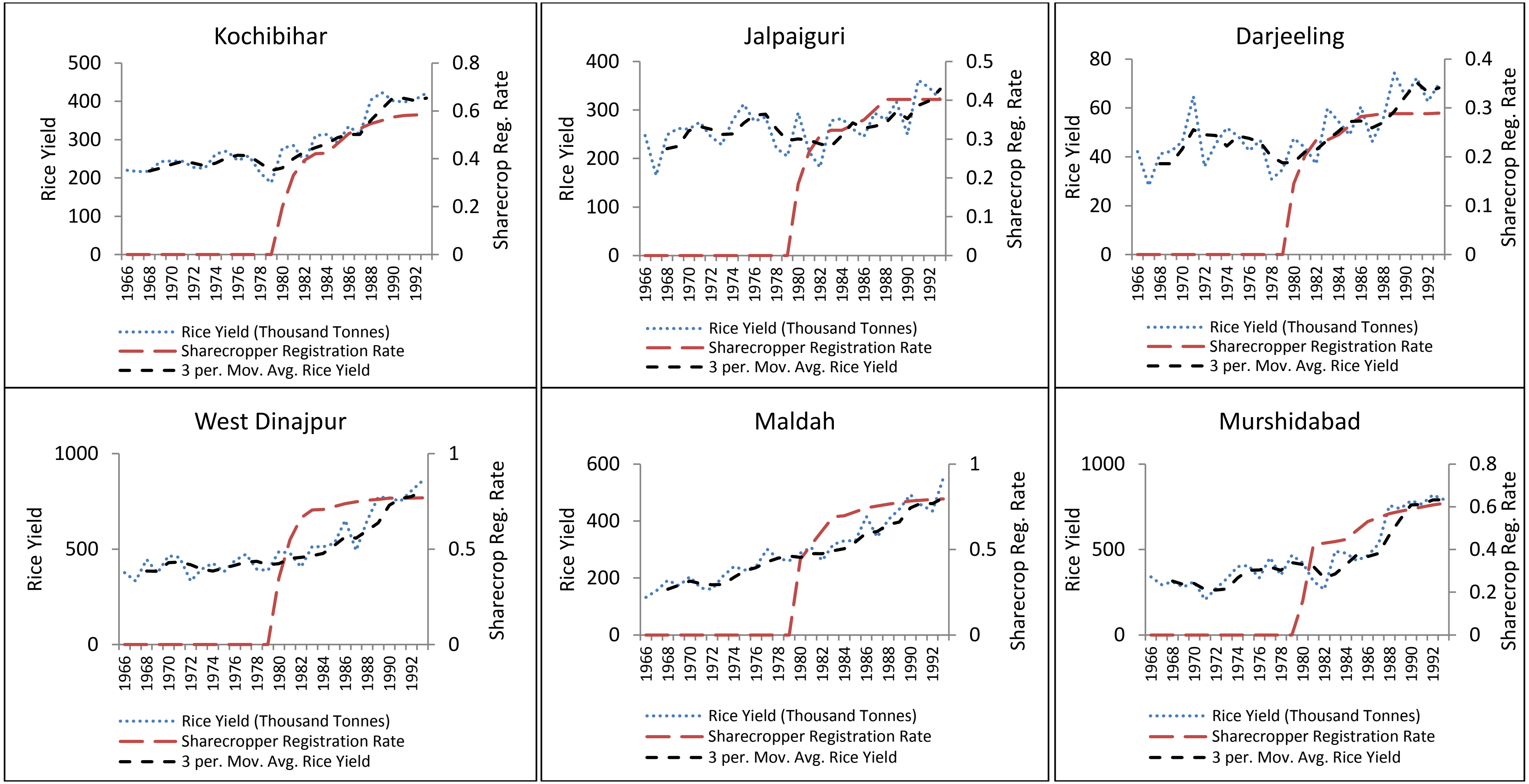


Figure 1 (continued)

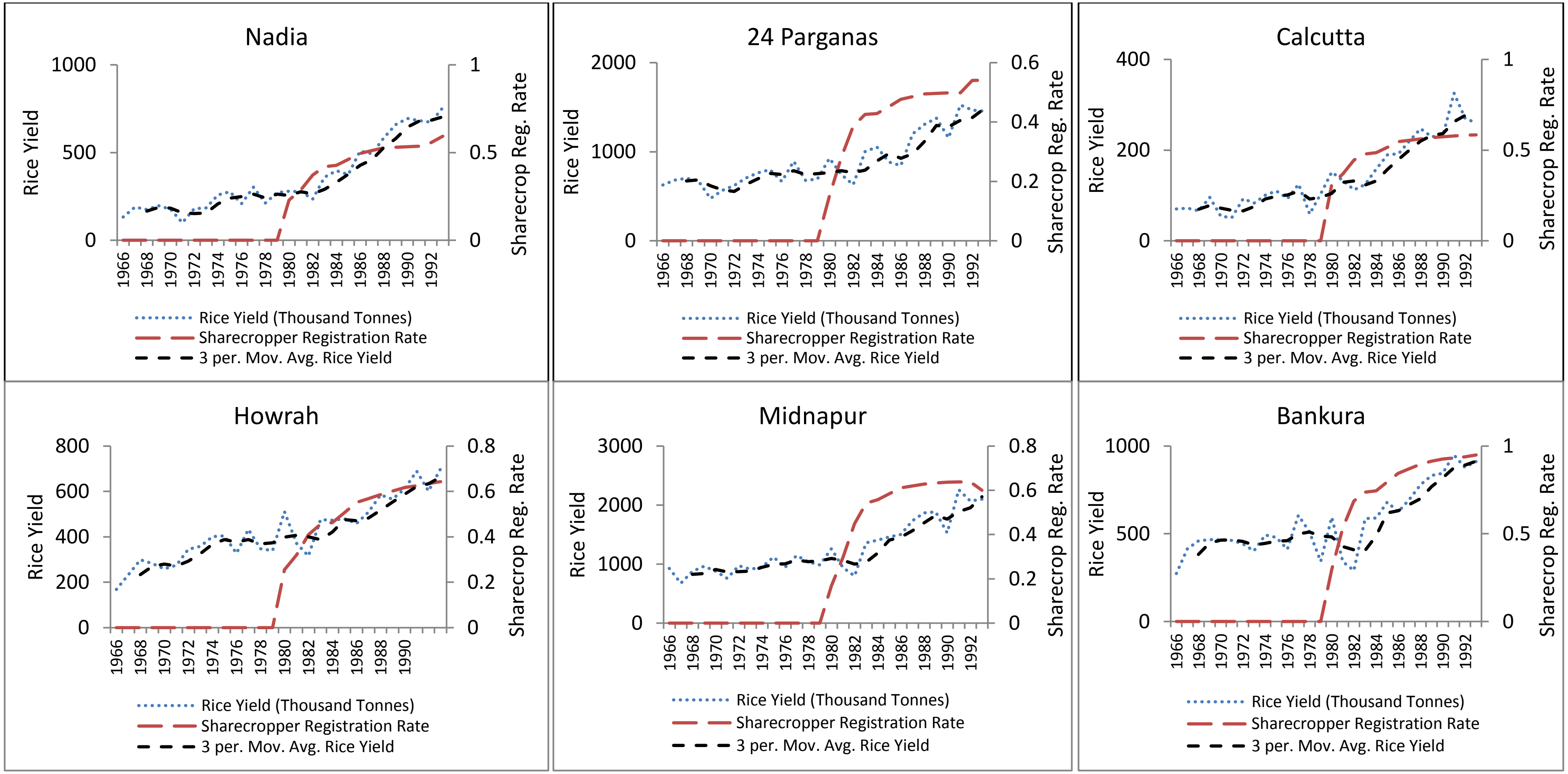
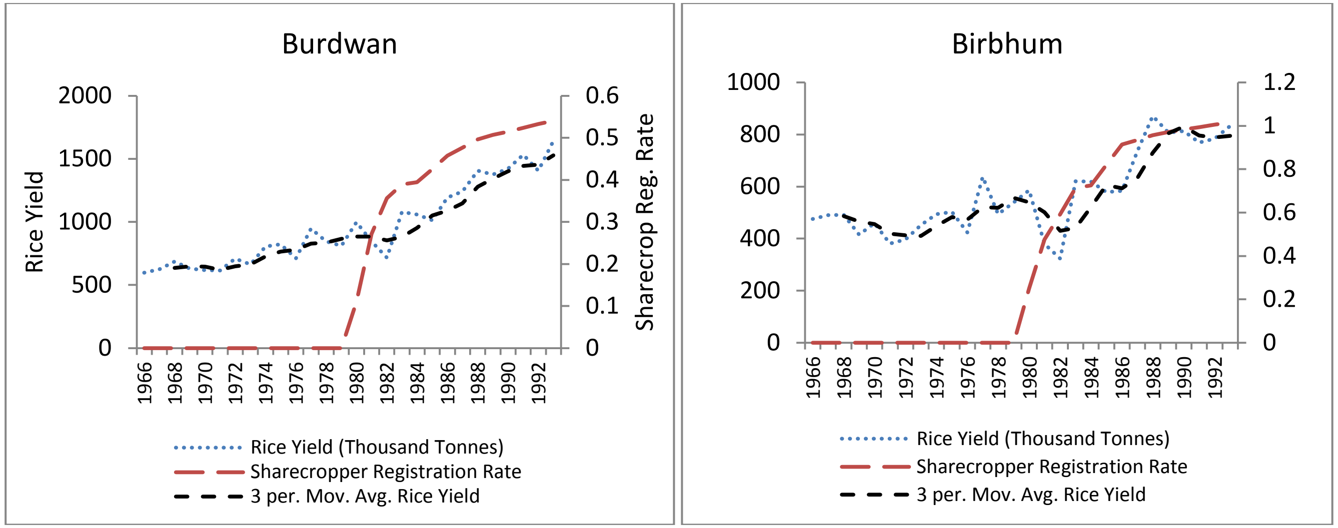
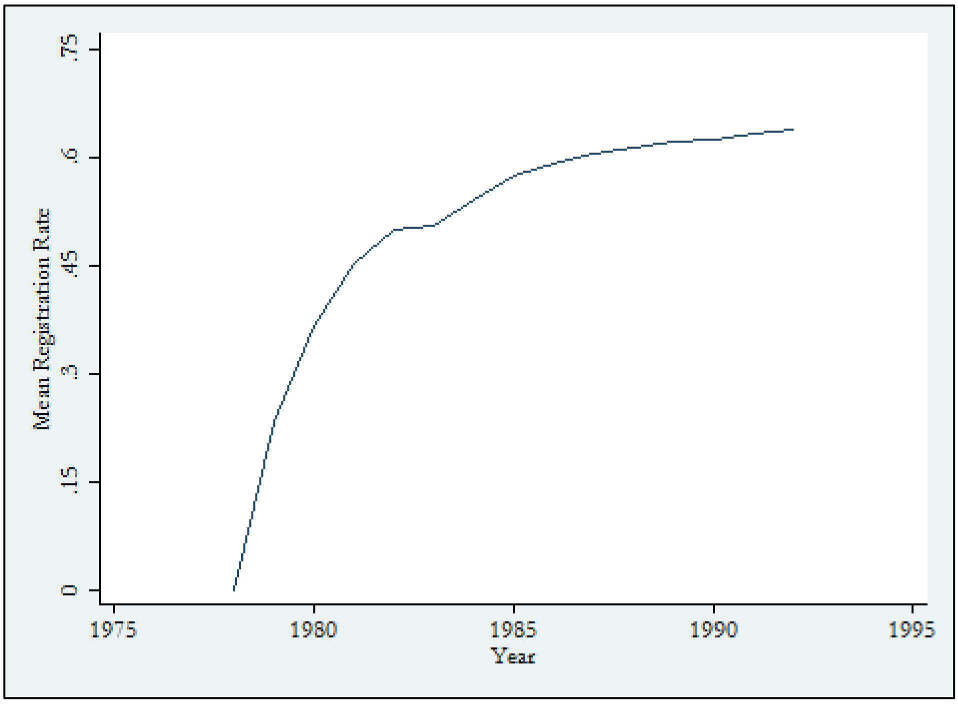


Figure 1 (continued)



Notes: The figure shows annual rice yield in thousand tonnes and sharecropper registration rate for each of our sample districts in West Bengal over the period 1966-1993. The 3-month moving average of total rice yield is also plotted for each district over this period. The data on rice yields is from the ICRISAT-VDSA dataset, and the data on sharecropper registration is that used in Banerjee, Gertler, and Ghatak (2002).

Figure 2: Average Sharecropper Registration Rate by Year



Notes: The figure shows the average rate of completed sharecropper registration across the 14 West Bengal districts in the Banerjee at al. (2002) data in each year.

Table 1: Hindu Mother and Child Characteristics by District Sharecropper Registration Rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A	*0 ≤ R < 0.25*	*0.25 ≤ R < 0.50*	*0.5 ≤ R ≤ 1*	*(2)-(1)*	*(3)-(2)*	*N(1)*	*N(2)*	*N(3)*
Mother's Education (years)	2.420	2.747	2.626	0.327***	-0.121	5,454	3,095	3,956
Mother's Height (cm)	148.690	149.324	149.339	0.635***	0.014	1,492	1,269	1,908
Mother's Age at Birth (years)	21.269	23.210	23.153	1.941***	-0.057	5,466	3,103	3,973
Birth Order	2.474	2.803	2.699	0.329***	-0.104**	5,466	3,103	3,973
Mother's Total Fertility	5.048	4.052	3.549	-0.996***	-0.502***	5,466	3,103	3,973
Panel B	*0 ≤ R < 0.25*	*0.25 ≤ R < 0.50*	*0.5 ≤ R ≤ 1*	*(2)-(1)*	*(3)-(2)*	*N(1)*	*N(2)*	*N(3)*
Infant Death	0.121	0.088	0.076	-0.033***	-0.012*	5,466	3,103	3,973
Scheduled Caste/Tribe	0.248	0.292	0.349	0.044***	0.057***	5,466	3,103	3,973
Other Backward Caste	0.016	0.026	0.026	0.010***	-0.000	5,466	3,103	3,973
Rural	0.731	0.728	0.766	-0.003	0.038***	5,466	3,103	3,973

Notes: *R* denotes the district sharecropper registration rate in the year preceding that of the child's birth. Panel A shows results from t-tests of continuous variables, and Panel B shows results from proportions tests of binary variables. The sample of children is from cohorts of birth 1956-1993. *** p<0.01, ** p<0.05, * p<0.1

Table 2: Non-Hindu Mother and Child Characteristics by District Sharecropper Registration Rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A	*0 ≤ R < 0.25*	*0.25 ≤ R < 0.50*	*0.5 ≤ R ≤ 1*	*(2)-(1)*	*(3)-(2)*	*N(1)*	*N(2)*	*N(3)*
Mother's Education (years)	1.165	1.395	1.594	0.230***	0.199**	2,058	1,574	2,131
Mother's Height (cm)	150.128	150.763	151.020	0.635	0.257	481	583	841
Mother's Age at Birth (years)	21.107	23.306	23.874	2.199***	0.569***	2,074	1,583	2,142
Birth Order	2.709	3.354	3.484	0.645***	0.130*	2,074	1,583	2,142
Mother's Total Fertility	6.503	5.311	4.721	-1.192***	-0.590***	2,074	1,583	2,142
Panel B	*0 ≤ R < 0.25*	*0.25 ≤ R < 0.50*	*0.5 ≤ R ≤ 1*	*(2)-(1)*	*(3)-(2)*	*N(1)*	*N(2)*	*N(3)*
Infant Death	0.125	0.090	0.079	-0.035***	-0.011	2,074	1,583	2,142
Scheduled Caste/Tribe	0.052	0.035	0.060	-0.016**	0.024***	2,074	1,583	2,142
Other Backward Caste	0.004	0.006	0.001	0.002	0.004**	2,074	1,583	2,142
Rural	0.899	0.880	0.932	-0.019*	0.052***	2,074	1,583	2,142

Notes: *R* denotes the district sharecropper registration rate in the year preceding that of the child's birth. Panel A shows results from t-tests of continuous variables, and Panel B shows results from proportions tests of binary variables. The sample of children is from cohorts of birth 1956-1993. *** p<0.01, ** p<0.05, * p<0.1

Table 3 – Mother Characteristics by Sex of First Child

	(1)	(2)	(3)	(4)	(5)
	First Daughter	*First Son*	*(2)-(1)*	*N(1)*	*N(2)*
Education (years)	3.067	3.023	0.044	2,608	2,805
Height (cm)	149.997	149.732	0.265	1,037	1,153
Hindu	0.730	0.731	-0.001	2,619	2,815
Non-Hindu	0.270	0.269	0.001	2,619	2,815
Scheduled Caste/Tribe	0.208	0.212	-0.004	2,619	2,815
Other Backward Caste	0.019	0.020	0.000	2,619	2,815
Rural	0.752	0.766	-0.014	2,619	2,815

Notes: Columns (1) and (2) show means and proportions of mothers' characteristics by the sex of their first child. Column (3) shows differences between columns (1) and (2), which are all statistically insignificant. Columns (4) and (5) report frequencies in columns (1) and (2) respectively.

Table 4 – District Sharecropper Registration Rates by Year

	1979	*1981*	*1983*	*1985*	*1987*	*1989*	*1991*
Kochibihar	19.96	39.42	42.34	50.54	54.65	57.46	58.31
Jalpaiguri	18.44	30.88	32.30	34.95	40.25	40.25	40.25
Darjeeling	14.49	23.40	24.52	28.22	28.84	28.84	28.84
West Dinajpur	34.88	66.41	70.77	73.86	75.63	76.74	76.77
Maldah	44.15	60.93	69.75	74.40	76.57	78.32	79.24
Murshidabad	15.82	43.01	44.69	53.09	56.80	58.89	60.79
Nadia	22.99	37.20	42.79	49.52	52.74	53.35	55.71
24-Parganas	15.22	38.54	42.84	47.67	49.51	49.84	54.05
Howrah	31.05	44.56	48.67	54.63	56.12	57.32	58.22
Hooghly	25.50	40.94	46.26	55.11	58.60	61.62	63.45
Midnapur	16.79	44.89	55.70	61.09	62.84	63.64	63.82
Bankura	29.69	68.67	74.48	84.46	89.66	92.56	93.83
Burdwan	11.00	35.64	39.45	45.74	49.60	51.42	53.31
Birbhum	25.01	59.26	72.49	91.37	95.67	98.30	100.00

Notes: The table shows district sharecropper registration rates by year as reported in Banerjee et. al. (2002).

Table 5 – Infant Mortality, Firstborn Sons, and Registration

	Infant Death								
	All Children			Hindu Children			Non-Hindu Children		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
*$SCROP50_{t-1}$ * FIRSTSON * FEMALE*	-0.057*	-0.080*	-0.080*	-0.077**	-0.106**	-0.106**	-0.022	-0.033	-0.039
	(0.074)	(0.056)	(0.054)	(0.032)	(0.020)	(0.020)	(0.665)	(0.615)	(0.549)
*$SCROP25_{t-1}$ * FIRSTSON * FEMALE*	0.036	0.030	0.031	0.024	0.017	0.019	0.065	0.061	0.046
	(0.396)	(0.480)	(0.493)	(0.659)	(0.803)	(0.763)	(0.268)	(0.292)	(0.392)
*$SCROP50_{t-1}$ * FEMALE*	0.051**	0.048**	0.048**	0.067**	0.071**	0.072***	0.024	0.002	0.005
	(0.026)	(0.026)	(0.028)	(0.030)	(0.012)	(0.006)	(0.569)	(0.979)	(0.933)
*$SCROP25_{t-1}$ * FEMALE*	-0.022	-0.029	-0.029	-0.023	-0.026	-0.028	-0.032	-0.045	-0.040
	(0.557)	(0.406)	(0.390)	(0.589)	(0.454)	(0.396)	(0.504)	(0.370)	(0.454)
*$SCROP50_{t-1}$ * FIRSTSON*	0.027	0.041	0.040	0.019	0.044	0.044	0.040	0.031	0.032
	(0.256)	(0.156)	(0.169)	(0.446)	(0.174)	(0.186)	(0.118)	(0.344)	(0.378)
*$SCROP25_{t-1}$ * FIRSTSON*	-0.038	-0.035	-0.034	-0.043	-0.034	-0.035	-0.026	-0.029	-0.014
	(0.188)	(0.204)	(0.236)	(0.374)	(0.406)	(0.354)	(0.450)	(0.463)	(0.699)
$SCROP50_{t-1}$	-0.049***	-0.050***	-0.064***	-0.041*	-0.050*	-0.058**	-0.075**	-0.053*	-0.084**
	(0.008)	(0.010)	(0.006)	(0.086)	(0.084)	(0.050)	(0.050)	(0.098)	(0.014)
$SCROP25_{t-1}$	0.019	0.011	-0.001	0.008	0.000	0.000	0.047	0.031	-0.012
	(0.504)	(0.639)	(0.909)	(0.869)	(0.959)	(0.983)	(0.236)	(0.432)	(0.743)
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Covariates		x	x		x	x		x	x
District-Birth Year Trend			x			x			x
Observations	8,367	8,367	8,367	5,448	5,448	5,448	2,919	2,919	2,919
Cohorts	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91
Districts	14	14	14	14	14	14	14	14	14

Notes: Wild cluster bootstrapped p-values in parentheses. All specifications also include the female child and firstborn son indicators and their interaction, birth year fixed effects, indicators for household religion and caste, whether the household is rural, mother's educational attainment, and linear and quadratic terms of the mother's age at which the child is born. The district covariates include logs of for rice and cereal productivity, *patta* land area distributed, number of medical institutions, and kilometres of surfaced road per capita and their full set of interactions with the female child and the firstborn son indicators.. *** p<0.01, ** p<0.05, * p<0.1

Table 6 – Infant Mortality, Firstborn Sons, and Registration: Mother Fixed Effects

	Infant Death								
	All Children			Hindu Children			Non-Hindu Children		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$SCROP50_{t-1}$ * *FIRSTSON* * *FEMALE*	-0.069**	-0.086**	-0.086**	-0.065	-0.089*	-0.091*	-0.069	-0.067	-0.062
	(0.050)	(0.022)	(0.014)	(0.146)	(0.068)	(0.080)	(0.210)	(0.234)	(0.266)
$SCROP25_{t-1}$ * *FIRSTSON* * *FEMALE*	0.021	0.020	0.020	0.009	0.007	0.009	0.058	0.060	0.047
	(0.504)	(0.539)	(0.535)	(0.877)	(0.877)	(0.849)	(0.336)	(0.260)	(0.468)
$SCROP50_{t-1}$ * *FEMALE*	0.042*	0.039**	0.039**	0.049	0.053**	0.054**	0.029	0.003	-0.003
	(0.090)	(0.032)	(0.018)	(0.110)	(0.040)	(0.030)	(0.458)	(0.907)	(0.905)
$SCROP25_{t-1}$ * *FEMALE*	-0.017	-0.022	-0.023	-0.033	-0.036	-0.038	-0.006	-0.016	-0.011
	(0.533)	(0.402)	(0.375)	(0.414)	(0.346)	(0.304)	(0.865)	(0.721)	(0.855)
$SCROP50_{t-1}$ * *FIRSTSON*	0.036	0.046	0.046	0.028	0.051	0.052	0.040	0.018	0.011
	(0.102)	(0.124)	(0.130)	(0.282)	(0.194)	(0.182)	(0.186)	(0.663)	(0.789)
$SCROP25_{t-1}$ * *FIRSTSON*	-0.018	-0.008	-0.008	-0.026	-0.004	-0.006	-0.016	-0.027	-0.020
	(0.444)	(0.685)	(0.761)	(0.430)	(0.911)	(0.879)	(0.793)	(0.500)	(0.543)
$SCROP50_{t-1}$	-0.041**	-0.044**	-0.048***	-0.039	-0.053*	-0.055*	-0.046*	-0.019	-0.022
	(0.030)	(0.012)	(0.004)	(0.152)	(0.010)	(0.058)	(0.084)	(0.474)	(0.509)
$SCROP25_{t-1}$	0.020	0.005	0.000	0.031	0.009	0.007	0.015	0.009	-0.005
	(0.392)	(0.845)	(0.997)	(0.336)	(0.825)	(0.853)	(0.567)	(0.749)	(0.839)
Mother FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Covariates		x	x		x	x		x	x
District-Birth Year Trend			x			x			x
Observations	8,367	8,367	8,367	5,448	5,448	5,448	2,919	2,919	2,919
Cohorts	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91
Districts	14	14	14	14	14	14	14	14	14

Notes: Wild cluster bootstrapped p-values in parentheses. All specifications also include the female child and firstborn son indicators and their interaction, birth year fixed effects, indicators for household religion and caste, whether the household is rural, mother's educational attainment, and linear and quadratic terms of the mother's age at which the child is born. The district covariates include logs of for rice and cereal productivity, *patta* land area distributed, number of medical institutions, and kilometres of surfaced road per capita and their full set of interactions with the female child and the firstborn son indicators.. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 7 – Younger Siblings and Sharecropper Registration

	Has a Younger Sibling								
	All Children			Hindu Children			Non-Hindu		
	B. Order 2	*B. Order 3*	*B. Order 4*	*B. Order 2*	*B. Order 3*	*B. Order 4*	*B. Order 2*	*B. Order 3*	*B. Order 4*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
*$SCROP50_{t-1}$ * FIRSTSON*	-0.004	0.013	0.058	-0.012	0.002	0.031	0.013	0.025	0.118
	(0.933)	(0.821)	(0.410)	(0.893)	(0.999)	(0.763)	(0.871)	(0.769)	(0.330)
*$SCROP25_{t-1}$ * FIRSTSON*	-0.114***	-0.035	-0.012	-0.104***	-0.010	-0.005	-0.177***	-0.046	-0.077
	(0.002)	(0.505)	(0.913)	(0.002)	(0.873)	(0.979)	(0.002)	(0.611)	(0.470)
*$SCROP50_{t-1}$ * FEMALE*	0.056	-0.033	-0.001	0.053	-0.019	-0.017	0.046	0.011	-0.038
	(0.172)	(0.533)	(0.927)	(0.268)	(0.835)	(0.905)	(0.523)	(0.893)	(0.655)
*$SCROP25_{t-1}$ * FEMALE*	-0.036	0.084	-0.042	-0.011	0.083	-0.046	-0.063	0.095*	0.018
	(0.509)	(0.294)	(0.502)	(0.865)	(0.278)	(0.621)	(0.322)	(0.084)	(0.873)
$SCROP50_{t-1}$	-0.061**	0.003	-0.073	-0.053	-0.011	-0.059	-0.095*	-0.032	-0.082
	(0.046)	(0.961)	(0.316)	(0.160)	(0.803)	(0.569)	(0.078)	(0.771)	(0.631)
$SCROP25_{t-1}$	-0.011	0.013	-0.055	-0.074	0.013	-0.077	0.082	-0.094	0.069
	(0.823)	(0.831)	(0.478)	(0.390)	(0.837)	(0.557)	(0.390)	(0.505)	(0.505)
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District Covariates	x	x	x	x	x	x	x	x	x
District-Birth Year Trend	x	x	x	x	x	x	x	x	x
Observations	2,686	2,012	1,378	1,919	1,381	891	767	631	487
Cohorts	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91	1978-91
Districts	14	14	14	14	14	14	14	14	14

Notes: Wild cluster bootstrapped p-values in parentheses. All specifications also include the female child and firstborn son indicators and their interaction, birth year fixed effects, indicators for household religion and caste, whether the household is rural, mother's educational attainment, and linear and quadratic terms of the mother's age at which the child is born. The district covariates include logs of for rice and cereal productivity, *patta* land area distributed, number of medical institutions, and kilometres of surfaced road per capita and their corresponding interactions with the female child and the firstborn son indicators.. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 8 – Test of Targeted Registration

	Infant Death								
	All Children			Hindu Children			Non-Hindu Children		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
*TRT * TREND*	-0.001	-0.004	0.001	-0.001	-0.003	0.017	-0.002	-0.006	0.147
	(0.673)	(0.420)	(0.871)	(0.737)	(0.563)	(0.931)	(0.539)	(0.418)	(0.442)
*TRT * TREND * FEMALE*	-	0.006	0.002	-	0.004	0.001	-	0.007	0.007
		(0.262)	(0.817)		(0.484)	(0.925)		(0.468)	(0.418)
*TRT * TREND * FIRSTSON * FEMALE*	-	-	0.004	-	-	0.008	-	-	-0.008
			(0.530)			(0.284)			(0.380)
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,294	5,294	5,294	3,854	3,854	3,854	1,440	1,440	1,440
Cohorts	1967-77	1967-77	1967-77	1967-77	1967-77	1967-77	1967-77	1967-77	1967-77
Districts	14	14	14	14	14	14	14	14	14

Notes: Wild cluster bootstrapped p-values in parentheses. All specifications also include the female child and firstborn son indicators and their interaction, birth year fixed effects, indicators for household religion and caste, whether the household is rural, mother's educational attainment, and linear and quadratic terms of the mother's age at which the child is born. *** p<0.01, ** p<0.05, * p<0.1

Table 9 - Probability of Male Surviving Birth by Land Holdings

	Male Surviving Birth							
Land Category:	Landless		(0, 1.5]		(1.5, 5]		(5,1]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged land	-	-	-0.009	0.032	-0.006	0.031	0.002	-0.030
			(0.011)	(0.082)	(0.006)	(0.044)	(0.002)	(0.024)
PATTA_LAND	0.100	-0.084	0.042	-0.034	-0.060*	-0.008	0.039	-0.146
	(0.102)	(0.315)	(0.065)	(0.129)	(0.031)	(0.050)	(0.149)	(0.185)
BARGA_LAND	0.047***	0.105***	0.006***	0.000	-0.003*	0.006	0.232***	-1.242
	(0.015)	(0.004)	(0.001)	(0.005)	(0.002)	(0.004)	(0.057)	(1.083)
Household FE	x	x	x	x	x	x	x	x
Controls		x		x		x		x
Observations	18,531	2,702	10,357	1,234	7,043	803	3,924	397
Households	988	666	606	325	410	218	208	110
Villages	89	89	89	89	89	89	89	89

Notes: Linear probability model. Robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects. The variables % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village, using official land records. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 10 - Probability of Female Surviving Birth by Land Holdings

	Female Surviving Birth							
Land Category:	Landless		(0, 1.5]		(1.5, 5]		(5,1]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged land	-	-	-0.015*	0.012	0.011*	0.029	0.000	-0.003
			(0.009)	(0.097)	(0.006)	(0.041)	(0.002)	(0.025)
PATTA_LAND	0.000	-0.180	-0.004	-0.009	0.074	-0.004	-0.015	-0.263
	(0.054)	(0.147)	(0.053)	(0.206)	(0.079)	(0.134)	(0.088)	(0.609)
BARGA_LAND	0.000	0.000	-0.007***	-0.008*	-0.007***	-0.009	-0.087**	3.240
	(0.003)	(0.004)	(0.001)	(0.005)	(0.001)	(0.006)	(0.043)	(2.807)
Household FE	x	x	x	x	x	x	x	x
Controls		x		x		x		x
Observations	18,531	2,702	10,357	1,234	7,043	803	3,924	397
Households	988	666	606	325	410	218	208	110
Villages	89	89	89	89	89	89	89	89

Notes: Linear probability model. Robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects. The variables % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village, using official land records. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 11 - Probability of Male Surviving Birth by Religion of Household

	Male Surviving Birth							
Sample:	Full				Restricted			
Religion:	Hindu	Non-Hindu	Hindu	Non-Hindu	Hindu	Non-Hindu	Hindu	Non-Hindu
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged land	0.001	-0.003	0.007	0.002	0.001	-0.002	0.001	-0.067*
	(0.001)	(0.002)	(0.006)	(0.009)	(0.001)	(0.005)	(0.004)	(0.037)
PATTA_LAND	-0.020	-0.068	-0.014	-0.053	0.013	-0.069	-0.007	0.658
	(0.019)	(0.049)	(0.030)	(0.169)	(0.042)	(0.136)	(0.056)	(0.599)
BARGA_LAND	0.005**	0.170	0.008***	2.099	0.007**	0.341	0.010***	3.093
	(0.002)	(0.203)	(0.002)	(2.194)	(0.003)	(0.355)	(0.002)	(3.477)
Household FE	x	x	x	x	x	x	x	x
Controls			x	x			x	x
Observations	44,178	12,283	5,952	1,426	31,854	8,001	4,298	838
Households	1,822	464	1,448	324	1,357	308	1,057	191
Villages	89	89	89	89	89	89	89	89

Notes: Linear probability model. Robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects. The variables % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village, using official land records. Religion is the religion of the household head. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 12 - Probability of Female Surviving Birth by Religion of Household

	Female Surviving Birth							
Sample:	Full				Restricted			
Religion:	Hindu	Non-Hindu	Hindu	Non-Hindu	Hindu	Non-Hindu	Hindu	Non-Hindu
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged land	0.002***	-0.003***	-0.003	-0.011**	0.001	-0.002	-0.010	-0.044
	(0.001)	(0.001)	(0.005)	(0.005)	(0.001)	(0.002)	(0.011)	(0.044)
PATTA_LAND	0.034	-0.004	-0.115***	0.078	0.047	-0.127	-0.034	-0.343
	(0.035)	(0.028)	(0.040)	(0.077)	(0.056)	(0.133)	(0.117)	(0.296)
BARGA_LAND	-0.006***	0.169*	-0.011***	0.656	-0.005***	0.047	-0.007***	0.661
	(0.001)	(0.094)	(0.002)	(1.443)	(0.001)	(0.093)	(0.002)	(2.465)
Household FE	x	x	x	x	x	x	x	x
Controls			x	x			x	x
Observations	44,178	12,283	5,952	1,426	31,854	8,001	4,298	838
Households	1,822	464	1,448	324	1,357	308	1,057	191
Villages	89	89	89	89	89	89	89	89

Notes: Conditional logit in (1) and (5), Linear probability model in (2)-(4) and (6)-(8). Robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects. The variables % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village, using official land records. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 13 - Probability of Male Surviving Birth by Immigrant Status

	Male Surviving Birth							
Land owned:	All				Landless			
Sample:	Full		Restricted		Full		Restricted	
Group:	Natives	Immigrants	Natives	Immigrants	Natives	Immigrants	Natives	Immigrants
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged land	0.000	-0.008	0.004	0.023	-	-	-	-
	(0.001)	(0.009)	(0.005)	(0.046)				
PATTA_LAND	-0.026	-0.077*	-0.020	-0.081	-0.020	-0.052	0.066	-0.653
	(0.019)	(0.044)	(0.033)	(0.113)	(0.044)	(0.185)	(0.102)	(1.418)
BARGA_LAND	0.002	0.039***	-0.004*	0.106***	0.090	0.035***	0.392	0.104***
	(0.002)	(0.007)	(0.002)	(0.004)	(0.069)	(0.004)	(0.669)	(0.006)
Household FE	x	x	x	x	x	x	x	x
Controls			x	x			x	x
Observations	49,117	7,344	6,121	1,257	17,992	5,162	2,478	917
Households	1,730	556	1,444	328	808	422	586	241
Villages	89	89	89	89	89	89	89	89

Notes: Linear probability model. Robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects. The variables % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village, using official land records. Share land transacted is the proportion of land transactions (sales and purchases, in acres) of total land cultivated. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.

Table 14 - Probability of Male Surviving Birth by Pre and Post-1977 Migration

	Male Surviving Birth							
Land owned:	All				Landless			
Sample:	Full		Restricted		Full		Restricted	
Group:	Pre-77	Post-77	Pre-77	Post-77	Pre-77	Post-77	Pre-77	Post-77
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged land	-0.004	-0.020	-0.097**	0.081	-	-	-	-
	(0.009)	(0.020)	(0.041)	(0.059)				
PATTA_LAND	-0.073*	-0.078	-0.084	-0.352	-0.249**	0.193	-1.817***	3.141**
	(0.041)	(0.131)	(0.116)	(0.288)	(0.119)	(0.402)	(0.381)	(1.347)
BARGA_LAND	0.039***	0.020	0.113***	-1.223*	0.037***	-0.548***	0.113***	-0.669
	(0.007)	(0.213)	(0.006)	(0.655)	(0.005)	(0.191)	(0.009)	(1.065)
Household FE	x	x	x	x	x	x	x	x
Controls			x	x			x	x
Observations	3,358	3,986	524	733	2,168	2,994	339	578
Households	137	419	128	200	97	325	83	158
Villages	89	89	89	89	89	89	89	89

Notes: Linear probability model. Robust standard errors in parentheses, adjusted for clustering on villages. All regressions include year dummies and household fixed effects. The variables % land registered and % land distributed are computed as the sum over the previous three years of the share of land affected by each program over the total cultivable land in each village, using official land records. Share land transacted is the proportion of land transactions (sales and purchases, in acres) of total land cultivated. ***, ** and * indicate statistical significance at the 99%, 95% and 90%, respectively.