Equity and efficiency impacts of rural land rental restrictions: Evidence from India

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Abstract: Recognition of the potentially deleterious implications of high inequality of opportunity due to a biased asset distribution has led to increased interest in land reforms. However, little attention has been devoted to the potential longer-term impacts of the measures used to implement such reforms, despite evidence that, the restrictions on land rental in rural areas they imply can have potentially far-reaching consequences. Use of state level data on rental restrictions, in conjunction with a nationally representative survey from India suggests that, contrary to their original intention, rental restrictions significantly reduce supply of land to the rental market, prevent land access by the landless, and by more productive producers. Ways to counter these effects by liberalizing land rental markets are discussed.

1. Introduction

Researchers and policy-makers alike now realize that unequal access to opportunities arising from a skewed distribution of assets can be harmful for sustained long-term growth and therefore of concern for researchers and policy-makers alike (Aghion *et al.* 1999, World Bank 2005). In India, given the inequality in the distribution of productive assets, in particular land, inherited from colonial times, land reform and land policy have occupied a central stage in the policy debates for a long time. Following successful abolition of intermediaries immediately after independence, award of property rights to sitting tenants through tenancy laws and expropriation with subsequent transfer of 'above-ceiling land' from large land owners to small farmers were the main mechanisms to improve operational and ownership distribution of land. Although initial progress was slow, the country has made significant progress in implementing such policies during the 1970s and 1980s when, under both interventions together, rights to almost 10 mn ha of land were transferred. This is an impressive quantitative achievement; in fact, the area affected amounts to more than three times what was involved in the well-known land reforms of Japan, Korea, and Taiwan together (King 1977). Moreover, even though in most cases beneficiaries did not receive full ownership rights, studies suggest that land reform has helped to reduce poverty while being neutral in terms of efficiency (Besley and Burgess 2000), thus helping to make a contribution towards greater equity.

However, although the historical impact of land reform legislation is undisputed, scholars have increasingly questioned the need to continue maintaining restrictions that were put in place to make redistributive land reform feasible a few decades ago. The most obvious reason for doubts is that a combination of inertia and litigation, together with population pressure and associated land subdivision, has slowed progress in transferring land through land reform legislation to a trickle. In the decade since 1995, the average number of households who, according to official statistics, received land through land reform amounted to less than 3,000 per year. A second reason is that the view of land rental as a backward, exploitative and inefficient institution that tends to benefit the rich the deficiencies of which can easily be rectified by a benevolent bureaucracy may no longer correspond to reality. In fact, with about 15 mn., the number of households participating in rental markets in 1999/2000 alone is larger than the total who benefited from land reforms

since independence. If experience from other Asian countries such as China and Vietnam is any guide for India, increased availability of non-agricultural employment opportunities implies that land rental markets can be expected to positively affect productivity and equity. It also shows that it will often be more appropriate for government to reduce the transaction costs associated with land transfers between private parties rather than intervene directly.

If government's ability to enforce legislation that will help transfer land to the less fortunate is limited and markets are not a priori biased against the poor, many well-intentioned land market interventions of the past may have outlived their period of usefulness. Indeed, there is now evidence from India suggesting that rental restrictions may do more to undermine landlords' willingness to supply to the rental market and reduce the welfare of poor tenants by forcing them to enter informal arrangements in contravention of the rules (Haque 2001). This is consistent with a significant body of international (largely urban) literature that documents and quantifies the undesirable impact of land rental restrictions in India and in other countries in detail. However, while all of this anecdotal evidence is suggestive, more detailed quantitative assessment of the functioning of rental markets, and in particular the impact of land reform policies on these markets, ideally representative at a national level, would be needed to guide the policy debate.

In this paper we use nationally representative household-data from 1982 and 1999 to assess the ability of different groups of producers, in particular the more productive and the landless, to gain access to land through market mechanisms. In addition, we explore the impact of rural rental restrictions as one factor that increases the costs of market participation on land market functioning and outcomes. To do so, we make use of the variation in land reform policies, and the extent to which such policies are implemented, across states that arises from the fact that land policy is responsibility of the states rather than the central government. Joint analysis of these two issues with a large nation-wide sample allows us to answer broader questions concerning the role of land markets in India and derive some interesting conclusions.

The paper is structured as follows. Section two describes the history of land reforms and tenancy regulations in rural India, reviews evidence on the impact of land rental market restrictions and key differences between rural and urban land markets, and uses this to lay out a conceptual model and empirical strategy. Section three presents the data used and reviews descriptive statistics for policy variables and household characteristics. Section four contains econometric results for the production function and different models of land rental market participation and discusses the results and their robustness. Section five concludes by putting results into context and draw out possible policy implications.

2. Background and conceptual framework

Land reform policy, through abolition of intermediaries, imposition of land ceilings, and regulation of tenancy contracts, played a key role in India from the moment it started its existence as an independent state. In this section we review main elements of land rental and ceiling legislation, the way it was implemented,

and discuss the literature that explored links between such legislation and land market outcomes. We use this to develop a conceptual model for households' land market participation and derive hypotheses that can be tested with the data at hand.

2.1 Origins and nature of rural tenancy restrictions in India

Under colonial rule, the main goal of India's land administration system was to obtain government revenue. The *de facto* award of land rights to revenue collectors (*zamindars*) in large parts of the country has consequences that affect development up to this day (Banerjee and Iyer 2004).[1] Given the severity of the burden on individual cultivators, agrarian reform was one of the top demands by the Indian National Congress. Similar to a number of other countries where the state lacked the power to expropriate land owners or the financial means to compensate them, land reform was adopted as part of a redistributive agenda that aimed to increase the property rights enjoyed by tenants.[2] Three elements of agrarian reform were emphasized, namely (i) abolition of intermediary revenue collectors; (ii) tenancy reform including the imposition of rent ceilings and the prohibition of evictions; and (iii) imposition of a ceiling on land holdings that could be owned by any individual or family with a forced transfer of any land beyond this limit to small cultivators (Mearns 1999). Following independence and the transfer of legal competence on land issues to states, significant variation ensued in timing of legislation, its substantive content, and the efforts made to ensure implementation of reform across states (Appu 1997). Abolition of intermediaries was tackled swiftly and successfully while other elements of the agenda, i.e. ceilings and tenancy reform, encountered considerable from landlord interests. In many states, passage of laws was held up to give landlords time to "prepare" - leading to spurious subdivisions, eviction of tenants and resumption of self cultivation, or the transformation of tenants into wage workers.[3] Below we briefly review the context of and sequencing ceiling and tenancy legislation in different states.

The *ceiling* legislation imposed after independence (in most cases only in the early 1960s) is widely judged to have been ineffective due to high ceilings (often defined in terms of individuals rather than a household), exemptions if land was "used productively", and limited implementation effort. National guidelines adopted in 1972 prompted most states to amend their legislation to establish greater consistency and was followed by the only period in Indian history when ceiling legislation led to large-scale land transfers.[4] While modalities of such transfers, in particular whether and how much beneficiaries had to pay, varied across states, one

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[1] The replacement of a system of fixed land rent with revenue collectors, called *zamindars*, who were empowered to collect as much land revenue as they saw fit in 1757, is commonly linked to a deep agrarian crisis that manifested itself in a series of devastating famines, most notably the Bengal famine of 1769/70 in which 10 mn. out of a population of 30 mn. were estimated to have died (Maharatna 1994). To reduce the incentives for short-term overexploitation, the "permanent settlement" of land revenue in 1793 established three types of revenue system, namely (i) the *zamindari* system where revenue administrators were given permanent rights to land and its revenue; (ii) the *ryotwari* system where arrangements were made between individual cultivators and the administration; and (iii) the *mahalwari* system where revenue arrangements were made with the village.

[2] In countries as diverse as Uganda, Thailand, Egypt, Mexico, and India, rent ceilings and/or award of non-transferable occupancy rights have been used to redistribute land resources to occupants in an environment where more far-reaching measures of land reform were politically infeasible.

[3] Using census figures, Appu (1997) estimates that, in order to avoid having to give rights to tenants, landlords evicted about 30 Mn. tenants or about one third of the total agriculturally active population. This is paralleled by evidence in other countries where landlords tried -and often succeeded- to evict tenants in anticipation of legislation to protect tenants against eviction or limit the rents they would have had to pay (Binswanger *et al.* 1995).

[4] Almost 95% of the total 7.34 mn acres that had been declared surplus had been identified by 1980 with coverage increasing to 98% by 1985. Of these, 5.4 mn. acres were actually distributed to beneficiaries.

element common to most of them is that recipients' ability to transfer the land thus received to others remains restricted.[5]

The main differences in *tenancy legislation* across states refer to definition of a tenant,[6] the conditions for permitting tenancy, the amount of rent than can be charged, and the type of property rights awarded to tenants, in particular relating to the circumstances under which landlords can "resume" rented land for 'personal cultivation' and the amount of compensation, if any, which they have to pay. Most states restrict the legality of land leasing.[7] Even where leasing is allowed, the rents that can be received by the landlord are limited[8] and tenants' rights are inheritable but contingent on personal cultivation, i.e. can not be legally transferred to others through sub-lease arrangements by original tenants.

While the variations of legislation across states provides ample scope for analyzing the impact of policies on observed outcomes, capturing the fine differences in timing, applicability, modalities of implementation, and definitions inherent in such legislation, appears difficult if not impossible. Rather than trying to do so, we use the share of households who benefited from key policies as an indicator for policy-induced constraints to the operation of rental markets. Specifically, we construct for each state the share of households who were awarded tenancy rights and the share of ceiling surplus area that was actually transferred to beneficiaries.[9] As none of the Indian states permit sub-leasing of lands to which tenants had received permanent rights and most states also impose restrictions on transfers of land received in the course of implementing ceiling legislation, this is an indicator of direct restrictions on the operation of land rental markets. Both figures also provide a good proxy for a state government's level of implementation effort, a variable that is exogenous to households' decisions but that was shown to be of great importance in earlier studies (Banerjee *et al.* 2002).

Table 1 provides summary statistics by state for total agricultural area and 1980 population (columns 1 and 2) as well as our measures of land reform implementation around 1980 (columns 3 and 4).[10] It illustrates that the relative emphasis on different types of intervention, and the extent to which such measures were

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[5] The states of Punjab, Madhya Pradesh, Andhra Prdaesh, Himachal Pradesh, Haryana, Gujarat, Maharashtra and Karnataka stipulate that beneficiaries will gain ownership rights only once they have reimbursed the government for the compensation that had been paid to the original land owner, plus in some cases administrative expenses. In Uttar Pradesh, beneficiaries did not receive ownership rights but were instead made permanent tenants of the government and any transfer, including sub-leasing, was prohibited. Transfer of land received under ceiling legislation is also prohibited in West Bengal, Bihar, Maharashtra and Gujarat, while being subject to a moratorium (of 10, 15, and 20 years after award of full ownership rights) in Orissa, Karnataka, and Himachal Pradesh, respectively.

[6] In a number of states including Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Uttar Pradesh, Haryana, Punjab, Rajasthan and Tamil Nadu, the definition of 'tenant' does not include sharecroppers, implying that the extent to which they will benefit from protection will depend on local discretion.

[7] This includes a complete prohibition of leasing for all except disabled landowners in parts of Andhra Pradesh and in Bihar, Karnataka, Madhya Pradesh, Orissa, Uttar Pradesh, Himachal Pradesh, Kerala and Jammu and Kashmir. Other states (Gujarat, Haryana, Maharashtra, Punjab, Orissa, Rajasthan, West Bengal, and the Andhra Part of Andhra Pradesh) permits leasing but make leases heritable and non-transferable with some (Assam, Gujarat, Haryana, Maharashtra and Punjab) establishing a right for the renter to purchase the property after some time.

[8] The rent ceiling is defined either in terms of multiples of the land revenue or as a share of output, such as a sixth of output in Gujarat (Kutch area) Maharashtra, and Rajasthan (in case the landlord does not provide any inputs), a fifth or fourth of output in AP, Bihar, Rajasthan (if the landlords provides inputs), Orissa, Tamil Nadu, and West Bengal (unless the landlord provides capital, manure, and seed in which case the ceiling is half of the produce), and a third of the crop in Punjab and Haryana.

[9] We use area rather than beneficiaries because in some cases ceiling surplus land was distributed to a collective entity such as a cooperative so that the number of beneficiaries would be misleading. Also, the existence of large discrepancies between the amount of land expropriated and actually distributed -which is due to the fact that in some cases land that had been distributed could not occupied by beneficiaries or was taken back after some time- led us to focus on land actually distributed.

[10] Wherever available, the level of the respective variables in 1980 and 1998, respectively, is used as a right hand side variable in the regressions.

implemented, varies across states. More than 10% of households received tenancy rights in Kerala, Gujarat, West Bengal, and Maharashtra and more than 5% of area was redistributed under ceiling surplus legislation in West Bengal, Andhra, Maharashtra, Rajasthan, and UP. Some states (e.g. West Bengal, Maharashtra) heavily relied on both measures, others (e.g. Andhra, Rajasthan and UP) focused exclusively on ceiling surplus, and some (e.g. Kerala and Gujarat) emphasized tenancy laws. Although the number of tenancy laws enacted is, in the absence of more detailed knowledge on content and implementation effort, at best an imperfect proxy for the number and severity of restrictions on land rental, it can be useful as a point of comparison. We thus include in the mean number of tenancy laws in each state (column 5) from Besley and Burgess (2000). One notes that the mean number of laws at any point amounts to 1.5, from no legislation in Haryana to more than 4 pieces in Tamil Nadu. However, the correlation between the number of laws and the number of tenants who received rights is low ($\rho = 0.28$), supporting the notion that legal provisions alone may have limited impact and that implementation effort makes a perceptible difference.

Although not differentiated in the table, a more detailed look at the time dimension of these measures allows a number of conclusions (Kaushik and Haque 2005): First, land reform has been a major effort; up to 2000, land reform laws resulted in the transfer of almost 10 mn ha, 2.5 mn ha under programs to redistribute of ceiling surplus land, and 7.35 mn ha under tenancy legislation.[11] Second, after a spurt of land transfers in the 1970s and 1980s, progress has slowed down considerably; in fact between 1995/96 and 2003/04, i.e. for almost a decade, progress in awarding land rights to tenants had come to a complete standstill and the increment in ceiling surplus land transferred during the period amounted to only 10,800 ha. The latter represents about one tenth of the land declared ceiling surplus, with the remainder being tied up in litigation. This suggests not only that further progress in achieving redistribution of ceiling land could be slow -it would take almost 90 years to dispose of remaining ceiling surplus cases if the current pace is maintained- but also that, by clogging up the court system and preventing it from quickly dispensing justice in other urgent matters, the ceiling legislation may impose external effects beyond land rental markets (Moog 1997).[12]

2.2 Evidence on incidence and impact of tenancy legislation and rent controls

Even though empirical evidence on the impact of rent ceilings and other forms of tenancy control in rural areas is limited, a number of studies have analyzed this issue in urban contexts. In fact, rent control has served as a textbook example for policies that can be effective to transfer resources in the short term but will be associated with inefficiencies in the medium to long run (Arnott 2003). The key reason, which also formed the basis for analytical approaches, is that, by fixing rents below their equilibrium level, rent controls

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[11] The amount of land involved is much larger than what was redistributed in other Asian land reforms such as Japan (2 mn has), Korea (0.58 mn has) and Taiwan (0.24 mn has). In terms of total area distributed, this puts India on par with Mexico which, in a much more land-abundant setting, and starting in 1917, managed to distribute slightly more than 13 mn ha (Deininger *et al.* 2002).

[12] In addition to cases related to contestation by landlords, there is an unknown number of instances where beneficiaries were allocated land but were either unable to establish effective possession or were subsequently evicted. A field survey to explore this issue in Andhra Pradesh pointed to at least 20% of beneficiaries who were not able to access the property they had received although the number of those who are able to file court cases calling for their (re)instatement is much more limited.

reduce the supply of new housing (or maintenance of existing units) by landlords who face an artificially reduced price (Gyourko and Linneman 1990). Rental restrictions would indeed transfer resources from landlords to sitting tenants when they are imposed but also make access to rental property for those who were not renting when the controls were imposed more difficult (Basu and Emerson 2000). With a constant or decreasing number of beneficiaries and an increasing number of new entrants who need to access to land through now distorted markets, the social cost of keeping land rental restrictions in place is expected to increase over time (Glaeser 2002). As they are generally ill-targeted and also reduce tenant mobility (Munch and Svarer 2002), rather crude first-generation rent controls have been replaced by a more flexible and sophisticated policy mix in many urban areas of the world (Arnott 1995).[13]

While initial studies were focused on developed countries, the adverse impact of rent restrictions may be as significant or even more severe in the developing world. Computing the cost imposed for cities in Ghana, Brazil, India, and Egypt, supports the notion that urban rent controls are generally effective in reducing rents, by between 4% and 64%,[14] However, benefits were generally ill-targeted and, in most cases, reduced significantly by the welfare losses resulting from reduced housing supply. While rent controls or similar restrictions may be useful to deal with emergencies in the short term, other policies such as vouchers or supply-side incentives are generally believed to have greater long-run potential (Malpezzi and Ball 1991).

Even though rigorous quantitative analysis of the impact of rent restrictions in rural areas is more limited than in urban ones, a general equilibrium model of land leasing supports the notion that, in the presence of restrictions on tenancy, landlords will provide less land to tenancy markets, implying less equalization of the farm size structure than without this intervention (Conning and Robinson 2005). In addition, the impact of rental restrictions in rural areas may be more pronounced than in urban ones for four reasons. First, as owners of urban housing stock have less opportunities to revert to self-cultivation (or cultivation with wage labor) than rural land owners, the supply of housing to urban markets will be less elastic, and thus the negative supply response less pronounced, than in the case of rural land. Evidence of widespread tenant evictions as a response to actual or anticipated imposition of tenancy regulations (Appu 1997) supports this argument. Second, to the extent that rural rents are defined in kind -often as a share of output- contract terms in rural areas will be less flexible than in urban ones, limiting the scope for circumventing such restrictions by adjusting rental rates (Basu and Emerson 2000). Third, the rights given to tenants are often non-transferable and heritable but incomplete (i.e. still requiring them to pay rent to the landlord). This would

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[13] Recognition of this fact has led policy-makers to implement a modified set of interventions –most commonly referred to as "tenancy rent controls" that would allow unlimited rent increases between tenancies and may include some other provisions to increase returns to landlords, in the hope of avoiding some of the negative impacts associated with earlier forms of rent control (Arnott 1997). As even such measures would be subject to the deadweight losses associated with rent controls, (Basu and Emerson 2003), the main policy issue boils down to deciding whether potential gains in tenure security that can be achieved through such controls will outweigh the deadweight losses of such a policy instrument as well as the costs of implementing it (Glaeser 2002, Arnott 2003), an issue that needs to be resolved empirically.

[14] In the cases studied, rent to income ratios decreased from about 20% in uncontrolled regimes to about 10% in controlled ones and in the case studies, rent control reduced the price paid by the typical tenant by between 4% and 64%. At the same time, the fact that house price to income ratios increase from about 4 in uncontrolled to between 7 and 8 in controlled regimes suggests that rent control does reduce the supply of housing.

reduce both parties' incentive for making land-related investments.[15] Limits on sub-leasing could also have a pronounced impact if, with generational change, original tenants are no longer able to farm the land they received in the most efficient way while their offspring may have taken up non-agricultural occupations. Finally, in the case of rural (but not urban) land, arrangements for land use or ownership will have a clear impact on productive efficiency due to the disincentive effects associated with wage-labor based cultivation (Binswanger *et al.* 1995) and the fact that, if tenancy laws are combined with land ceiling legislation, landlords have an incentive to artificially subdivide land that is subsequently left idle. All this would imply that the impact of rental restrictions in rural areas will go far beyond the price effects on which the attention of the urban literature has focused. It also suggests that, while tenancy legislation and the associated restrictions on terms under which land can be transferred in rural areas may have been a good way of transferring residual ownership rights, the cost of maintaining such restrictions is likely to increase over time. Empirical analysis of their impact on equity, i.e. land access by landless producers as well as efficiency of land use at the household level over time will thus be of great interest.

Although the literature on land reforms in India and beyond is large (Warriner 1969, Thorner 1976, King 1977, Haque and Singh 1986), an often rather limited emphasis on impact constrains the extent to which it can be relied upon to assess the cost-effectiveness of specific interventions and to draw broader policy conclusions.[16] Quantitative studies that use a rigorous analytical framework and aim to construct a counterfactual have made little effort to explore the -direct or indirect- costs of such reforms. For example, analysis of the large-scale registration of sharecroppers in West Bengal after 1978 (Banerjee *et al.* 2002) finds that this policy led to large productivity gains, in line with earlier studies (Lieten 1996, Rawal 2001). Although these gains were contingent on massive tenant mobilization at the grassroots level, the immediate costs of implementation and the possible longer-term effects due to limited transferability of and overlapping property rights over land reform lands are difficult to assess. At an aggregate level, land reforms are found to have had a significant impact on poverty reduction but not on productivity (Besley and Burgess 2000) and a follow-up study based on the same data tentatively concludes that the poverty impact is likely to be worth the cost in terms of productivity (Besley *et al.* 2004).

Obviously, providing an assessment of the direct costs of implementing land reform will be difficult and mainly of historical interest. At the same time, exploring how land rental markets work and to what extent they are affected by tenancy restrictions will allow to put the policy debate on land markets in India on a more robust empirical footing. Doing so will allow us to draw conclusions as to whether the benefits from maintaining restrictions on the functioning of land rental markets are still sufficiently large to outweigh the costs of such measures, something that is of clear policy relevance.

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[15] The tenant will be unlikely to invest as doing so will result in an immediate increase of the rent whereas investment by the landlord is unlikely as part of the benefits will go to the tenant.

[16] Successive generations of IAS officers in the Lal Bahadur Shastri National Academy of Administration in Mussoorie have made a significant contribution to the area by conducting case studies of land reform implementation in almost all of India's states that have thus far resulted in the publication of 10 volumes on the subject that are replete with empirical evidence.

2.3 Conceptual framework

A key rationale for households to engage in land markets is the desire to adjust for differences in their existing endowments of land and family labor. Following similar models in the literature (Carter and Yao 2002), let household i be endowed with fixed amounts of labor ($\overline{L}_i$) and land ($\overline{A}_i$), and a given level of agricultural ability (α_i). Relative land scarcity, together with the cost of supervising labor (Frisvold 1994) makes wage-labor based cultivation undesirable in equilibrium (Binswanger *et al.* 1995), implying that households allocate their labor endowment between farming their own land and off-farm employment at an exogenous wage (w_i).Renting of land incurs three main types of transaction costs (T^{in} or T^{out}), that include three key elements, namely (i) the need to acquire information on market conditions; (ii) the need to negotiate and enforce payments; and (iii) the transaction costs imposed by rental regulations that restrict transferability or completely outlaw certain contract types. While the first is more akin to a fixed cost, the other two elements, which make up the largest share, are likely to be proportional to the amount of land transacted. To keep matters tractable, we assume that households have the possibility of structuring rental contracts in a way that allows those lacking liquidity to enter into sharecropping or other arrangements that would allow them to defer rental payments until the harvest. With this, household i will choose $l^{a}*$, $l^{o}*$ as well as $A*$ by solving the maximization problem:

$$\underset{l^{a},A}{Max}\ pa_i f(l_i^{a},A_i)+wl_i^{o}-I^{in}(A_i-\overline{A}_i)(r+T^{in})+I^{out}(\overline{A}-A_i)(r-T^{out}) \qquad (P)$$

where p is the price of agricultural goods, l^{o} is the amount of time allocated to off-farm labor ($l^{o}=\overline{L}_i-l_i^{a}$), I^{in} is a indicator variable for rent-in (=1 for rent-in, and 0 otherwise), similarly I^{out} is an indicator for rent-out (=1 for rent-out, and 0 otherwise), T^{in} and T^{out} are the transactions costs respectively associated with rent-in and rent-out, all other variables in (a) are as defined above. The optimal choices of l_i^{a*}, l_i^{o*} and A_i^{*} will solve the first order conditions (FOC) of problem (P), i.e.

$$p\alpha_i f_{l_i^{a}}(l_i^{a},A_i)=w \qquad (1)$$

or for households who rent in, $\qquad p\alpha_i f_{A_i}(l_i^{a},A_i)=r+T^{in} \qquad (2a)$

or for households who rent out, $\qquad p\alpha_i f_{A_i}(l_i^{a},A_i)=r-T^{out} \qquad (2b)$

and for autarkic households, $\qquad r-T^{out}<p\alpha_i f_{A_i}(l_i^{a},A_i)<r+T^{in} \qquad (2c)$

The first order conditions allow derivation of three empirically testable propositions (see Deininger and Jin (2005) for a more detailed derivation) as follows:

Proposition 1. The amount of land rented in is strictly increasing in ability, α, and strictly decreasing in the original land endowment $\overline{A}$. Other things constant, rental markets will thus transfer land to "land-poor but efficient" producers, causing large land owners and those with low agricultural ability to rent out to smaller ones while still enjoying the credit-market and potential non-monetary (status) advantages associated with land ownership. This is indeed consistent with what is observed in the literature (Sadoulet *et al.* 2001).

Proposition 2. Rental restrictions as well as other types of transaction costs drive a wedge between those renting in and those renting out with any increase in *T* decreasing α_l and increasing α_u,[17] thereby expanding the range of producers who remain in autarky, reducing the number of households who are able to gain access to land by participating in rental markets, and decreasing the amount of land transacted through rental markets. Reduction in transaction cost will therefore increase social welfare.

Proposition 3. Increases of the wage for off-farm employment will increase the supply of land to the rental market and thus the amount of land transacted in rental markets. This will result in a reduction of the rental rate and, in a risk-free environment this will make everybody better off.

2.4 Estimation strategy

According to equations 2a-2c, a household's decision to enter land rental markets depends on their marginal productivity in autarky compared to the effective land rental, either the rental payment inclusive of state-specific transaction costs $r^{in}(T)$ for those renting in or the rental net of transaction costs $r^{out}(T)$ for those renting out. In addition to agricultural ability (α), the productivity impact of rental market participation will depend on the household's endowment of land (*A*), family labor (*L*), assets (*K*), and the opportunity cost of labor which will be affected by the level of education (*E*) and the presence of opportunities in the local off-farm labor market (*O*). Defining a well-behaved net earning function $g(\overline{A}, L, K, O)$ with first derivative $g'()$ allows us to express the market participation regimes as:

$$
\left.
\begin{array}{ll}
\text{I. Rent-in regime} (A_i^* > \overline{A}_i): & g'(\alpha,\overline{A},L,K,O) + \varepsilon_i > r^{in}(T) \\
\text{II. Autarky regime} (A_i^* = \overline{A}_i): & r^{out}(T) < g'(\alpha,\overline{A},L,K,O) + \varepsilon_i < r^{in}(T) \\
\text{III. Rent-out regime} (A_i^* < \overline{A}_i): & g'(\alpha,\overline{A},L,K,O) + \varepsilon_i < r^{out}(T)
\end{array}
\right\} (3)
$$

This switching regime model is estimated using ordered probit with upper and lower thresholds being a function of tenure security and market development variables (Sadoulet *et al.* 1998). Transforming (8) into ordered probit model notation, we have:

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[17] We denote by α_l ()and α_u() the level of ability where households with given other characteristics switch from rent out land to autarky or from autarky to renting in land, respectively. In other words, households with $\alpha_i < \alpha_l$ will rent out land, those with $\alpha_i > \alpha_u$ rent in, and those with $\alpha_u > \alpha_i < \alpha_l$ stay autarky. We can solve for α_u, and α_l jointly with $\overline{l}_i^a$ from the FOCs : $\alpha_l = \dfrac{r-T}{pf_A(\overline{l}_i^a, \overline{A}_i)}$, $\alpha_u = \dfrac{r+T}{pf_A(\overline{l}_i^a, \overline{A}_i)}$.

$$pr(A_i^* > \overline{A}_i) = pr\{\varepsilon_i > r^{in}(T)\text{-}g'(\alpha,\overline{A},L,K,O)\}$$
$$pr(A_i^* = \overline{A}_i) = pr\{\varepsilon_i > r^{out}(T)\text{-}g'(\alpha,\overline{A},L,K,O) \cap \varepsilon_i < r^{in}(T)\text{-}f'(\alpha,\overline{A},L,K,O)\} \qquad (4)$$
$$pr(A_i^* < \overline{A}_i) = pr\{\varepsilon_i < r^{out}(T)-g'(\alpha,\overline{A},L,K,O)\}$$

We assume that the functions $g'(\alpha,A,L,K,O)$, $r^{in}(T)$ and $r^{out}(T)$ are linear, allowing us to express them as:

$$g'(\alpha,A,L,K,O)= \beta_0 + \beta_1\alpha + \beta_2 A + \beta_3 L + \beta_4 K + \beta_5 O$$

$$r^{in}(T) = \delta_0 + \delta_1 S \qquad (5)$$

$$r^{out}(T) = \eta_0 + \eta_1 S$$

respectively. The ordered probit model is then estimated by maximum likelihood.

A key element of the regression is households' agricultural ability α. As the data available are a panel of households and their offspring who were observed in 1982 and again in 1999, one way of recovering this parameter would be to estimate a panel production function and then use household (dynasty) fixed effects as a proxy for ability (Deininger and Jin 2003). For a variety of reasons, including intergenerational transfers, the fact that a significant portion of cultivators had moved out of agriculture, and the expansion of the sample from about 4,000 to more than 7,000 households[18], such an approach would have involved the loss of a large number of observations. We therefore chose to estimate a stochastic frontier production function to determine producers' level of technical efficiency in each of the periods. The stochastic frontier model assumes that the disturbance term is composed of two additive components, one that is pure white noise (v_i), and a one-sided term ($u_i \sim N^+(0, \delta_u^2)$) that follows a truncated normal with zero mean 0 that captures producers' level of technical inefficiency, t (Coelli 1995). Assuming a Cobb-Douglas functional form allows to write the model as

$$q_i = \phi_o + \phi x_i + u_i - v_i \qquad (6)$$

where q_i is the logarithm of crop output obtained by household i, x_i is a input vector including sown area, land, material inputs (i.e., fertilizer, seed, etc), fixed assets (all in logs), and household characteristics that may affect crop output, and ϕ are the parameters to be estimated. The technical efficiency variable TE_i, defined as $TE_i = \exp(-u_i)$, can be predicted after estimating equation (6).

Other household-level variables included in the ordered probit model (5) include a dummy for households who were landless at the time of the survey and the logarithm of the total land endowment to represent A, the number of members in the 14-60 and below 14-year age group to represent L, the total value of assets and the share of agricultural assets, defined to include livestock, implements, and structures directly useful for agricultural production to represent K, a dummy for whether the head has primary or above education

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[18] Of 4981 households who were included in the 1982 sample, 3880 could be retrieved in the 1999 round; 2697 who continued under the same head and 1183 who had split up. Replacements for households who had dropped out together with multiple ones who had emerged from the plit ones resulted in a total sample size of 7474 households in 1999.

and the head's age as a proxy of experience to represent human capital E, and the mean level of village income to represent wage labor opportunities in the local off-farm labor market O.

According to proposition 1, land rental markets would transfer land to more productive producers with lower land endowments and high levels of labor leading us to expect $\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 > 0$. A positive sign on the element of β_4 that correspond to assets would point towards wealth bias in rental markets, possibly caused by credit market imperfections. Based on proposition three, we expect households whose past experience in off-farm labor markets reflects greater opportunities for such employment to be less likely to rent in and more likely to rent out and the level of rental market activity in general to increase with development of the off-farm economy, a variable that is represented empirically by the share of income derived from non-agricultural sources. We thus expect β_5 to be negative and the coefficient on the share of village income from agriculture to be positive ***.

In addition to the above variables, a key focus of our analysis is on assessing the impact of exogenous restrictions on land market performance and households' land market participation (proposition 2). We do so by having policy variables that will have an impact on T -which are represented by implementation of restrictions and number of tenancy laws as explained earlier- affect the lower and upper thresholds δ and η in (5). Beyond these, we allow thresholds to vary over time to allow that overall economic development will systematically shift supply or demand of land in the rental market, and the household's caste status as a proxy for the ability to find out about land on offer in the local market and to enforce contracts.

3. Data sources and descriptive evidence

Before discussing econometric results, we highlight some salient features of India's rural economy by presenting evidence on socio-economic characteristics as well as land market participation and changes in these variables over time. This allows us to explore changes of the economic structure, growth, and asset accumulation by individuals and at the village level. Concerning rental markets, our interest is to find out whether our hypotheses are supported by descriptive evidence, or whether, possibly as a result of "reverse tenancy" rental markets lead to transfers from small to larger producers rather than to land-poor ones.

3.1 Household characteristics

The data used in the analysis come from two rounds of NCAER's ARIS/REDS survey that were conducted in 1982 and 1999, respectively. This survey, the first rounds of which were implemented in 1968-71 to evaluate the impact of an agricultural development program, covers all of India's major states. Even though the first round sample, which is stratified by farm size and wealth class, was limited to project areas, the survey was significantly expanded in 1982 to make it more representative at the national level, covering slightly less than 5,000 households (Foster and Rosenzweig 1996). The 1999 sample contains all of the households included in 1982 as well as replacements for those who were no longer present. If the original

household had split, all of the households belonging to the same dynasty in the original village plus a sub-sample of successor households outside the village were interviewed, bringing the total to about 7,500 households (Foster and Rosenzweig 2004).

Table 2 reports descriptive statistics for the whole country and its four main regions in both periods.[19] We note that there has been a marked increase in educational attainment, as illustrated by the fact that the share of household heads who had at least primary schooling completed increased from about 26% in 1982 to 50% in 1999. Also the gap that had earlier separated Northern and Southern states has narrowed considerably. At the same time, population growth has led to a decline in the average land endowment, from 3.3 ha in 1982 to 2.1 ha in 1999, and a small increase in landlessness, from 22% to 24%. The size of the average household decreased, from 6.9 to 6.0, with about 4 in the 14 to 60 age category, 0.4 aged above 60, and 2.4 as compared to 1.8 below the age of 14. The share of female headed households is, with 6.8%, almost the same in both periods, although female headship is more pronounced in the South than in other regions.

Survey results also point towards an annual increase of per capita income of 3.08% during the period under concern. This aggregate masks pronounced differences across regions with the South having caught up and even replaced the North as the region with the highest income in the second period. Use of the information from the listing exercise allows us to compute the Gini coefficient for self-assessed income in a way that includes all households in the sampled villages. Doing so highlights that, with a Gini coefficient of 0.32 in the first and 0.31 in the second period, inequalities in income remain modest and have not appreciably increased between the two periods. The overall improvement in living standards as illustrated by increased income is mirrored by a significant rise in asset values of approximately 6% per year.[20] It is worth noting that, with a Gini coefficient of 0.60 in 1982, inequality in assets is higher than income inequality as is found in other parts in the world. However, this coefficient has actually decreased to 0.56 in the second period. While overall asset endowments have increased, the broad composition of households' asset portfolio shows greater stability; the house and consumption durables make up the largest share in both periods (57.5% and 56.9%, respectively in 1982 and 1999), followed by financial and off-farm assets (26.7% and 23.2%), and farm assets including livestock (15.8% and 19.9%).

The bottom panel illustrates the diversification of livelihood sources achieved during the period by highlighting the share of households who participated in various activities, noting that households generally rely on more than just one income source. Three observations are of particular interest. First, despite a drop by about 7 and 15 points in the share of households engaging in crop and livestock production, respectively (from 70% to 63% for crop and from 78% to 63% for livestock), self employment in agriculture continues to constitute the single most important source of employment in India's rural economy. The fact that this is

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[19] We group states into four regions as follows: The North includes the states of Haryana, Himachal Pradesh, Punjab, and Uttar Pradesh; the West includes Gujarat, Maharashtra, Madhya Pradesh, and Rajasthan; the East includes Assam, Bihar, Orissa, and West Bengal; and the South includes Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu.

[20] While part of this increase may be due to improvements in the survey instrument that resulted in better measurement of assets in the second period, it is impossible to test this hypothesis as disaggregated data for 1982 were not available.

followed by agricultural wage employment, the share of which has actually increased over the period (from 37.6% to 43.3%) illustrates the continued importance of agriculture. As wage employment is one of the few sources of livelihood open to the landless, agriculture is particularly relevant for the poor. A second finding of interest is that the share of households engaging in self-employment in rural India has been more or less constant, implying that growth of the rural non-farm sector has been just large enough to absorb population growth. This contrasts with other countries where the rural non-farm economy develops largely as a result of households taking up non-farm self employment (Lanjouw and Lanjouw 2001). In fact, according to our data, the main source of income diversification was the growth of non-farm wage employment, participation in which increased from 8.6% in 1982 to 20% in 1999. This can be explained as a result of the government's emphasis on creating rural employment through a plethora of mechanisms that range from direct subsidies for firms setting up in remote areas to industrial and labor market regulation such as small scale reservation acts, as described and analyzed in recent contributions to the literature (Besley and Burgess 2004).

3.2 Operation of land markets

To provide evidence on the extent to which our hypotheses on land markets are borne out descriptively, table 3 presents the above variables for households disaggregated by their land rental market participation (rent in, rent out, or autarky). The table points towards a large increase in the level of land market activity over the period; from 5.3% and 2% for renting out and renting in in 1982, the share of market participants has increased to 10.7% and 4.1%, respectively, in 1999. While this is a large change, the level of rental market activity increased more rapidly, and in a shorter period, in other Asian countries such as China or Vietnam, despite the fact that the more egalitarian land ownership distribution in these countries would put greater limits on the potential of land markets to equalize operational holdings than in India.[21] Exploring econometrically the extent to which the impact of factors such as lower non-farm growth, landlessness, and land reform policies, affected the scope for land markets to improve land access and allocative efficiency will be of interest.

Descriptive figures support the propositions from our model and point towards improved rental market functioning in the second, as compared to the first period. The first panel illustrates that in both periods rental provided an opportunity for relatively land-scarce and labor-abundant households to gain access to land as evident from comparing the per capita land endowment for land owners who are autarkic (0.51 ha and 0.36 ha in 1982 and 1999), rent-in (0.28 ha and 0.20 ha), or rent-out (0.68 ha and 0.64 ha) in the two periods. Land markets can be seen to have transferred land from households whose head is more educated and female headed to male headed ones with educational lower attainment. We also note that the share of landless who had gained access to land through rental markets increased from 12% in the first to 37% in the second period, suggesting a marked increase of outreach towards this group over time. Noting that our

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sample represents a total rural population in India of about 130 mn, this suggests that in 1999 about 15 mn households -a quarter of them landless- were able to use markets as a means to get access to land. It is worth noting not only that this figure is much larger than the number of households who got access to land through land reform but also that, given the magnitudes involved, even policies that have only a "modest" impact on the functioning of land rental markets, could have implications for a large number of households.

Comparing levels of consumption and assets for households who differ in the nature of their land market participation reinforces the notion that rental provided opportunities for poor segments of the population to access productive resources and thereby improve their well-being, especially in the second period. The value of all assets owned by rent-in households in 1999 is, with Rs. 33,839, more than 25% below the average, compared to asset ownership that is similar to the mean for autarkic households and about 33% higher than the mean for those renting out, supporting the notion that it is the asset-poor who benefit from the access to land which rental markets provide. The narrowing of the gap between rent-in and average households with respect to per capita expenditure supports the hypothesis of land markets making a positive contribution to the livelihood of participants. Finding significant differences in the composition of the asset portfolio between rent-in and rent-out households, with the former having relatively more of their wealth in farming and livestock and the latter in off-farm and financial assets is not too surprising.

While higher rates of participation in crop and livestock production by rent-in households should not come as a surprise, the high share of rent-in households engaging in (agricultural) wage employment suggests that land rental provides opportunities for earning additional income to wage laborers, consistent with earlier evidence. At the same time, the fact that, contrary to what was found in 1982, non-farm self employment is significantly higher among rent-in households than the mean (or autarkic ones) suggests that land rental is not an obstacle to participation in the rural non-farm economy. To the contrary, renting may provide an opportunity to accumulate experience and capital to replace the "agricultural ladder" (Spillman 1919) with a general increase in occupational mobility including the non-farm sector (Alston and Ferrie 2005).

4. Econometric evidence

Consistent with descriptive evidence, results from production function and rental participation equations point towards the importance of land as a factor of production, suggesting that households with larger family labor endowments and less non-farm involvement will use rental markets as an avenue to access land. We also find that measures to effect land reform, whether proxied by the number of laws passed, the area transferred under ceiling legislation, or the number of beneficiaries from tenancy acts, constrain rental market activity, thereby reducing both equity and efficiency. They make it more difficult for producers with high ability, including the landless, to gain access to land while at the same time constituting an obstacle for giving up farming by those with low ability who want to get out of agriculture.

4.1 Production function

As discussed earlier, a panel approach to recovering to recover a measure of households' (or dynasties') agricultural ability would have required dropping households or dynasties for whom production is observed only in one of the periods, either because they entered the sample in 1999 as a replacement for an earlier household or because they moved out of agriculture during the 20-year period that separates the two surveys.[22] To avoid this, we rely on a frontier production function in both periods and, in cases where a household's production is observed only in one period, assume that the level of ability is time-invariant.[23]

Appendix table 1 contains descriptive statistics for the variables included in the production function in both periods while table 2 reports results from estimating the Cobb-Douglass production functions for output, based on value of production from the 40 most important commodities,[24] using OLS and a frontier approach. re presented in appendix table 2. production function estimation for a each of the two time periods. High values of the R^2 for the OLS regressions points towards a very good fit. Coefficient estimates from the maximum likelihood estimation of the Cobb-Douglas stochastic production frontier are similar to those obtained by OLS. Concerning the individual variables, land is estimated to be by far the most important input to crop production; doubling cultivated land area alone would lead to an almost 50% increase in total crop production. This is followed by labor with an estimated elasticity between 18.8% and 20.8.%.. Compared to these two variables, returns to labor are estimated to be more moderate with elasticities of about 5%, 4%, 2.5%, and 2.3% for fertilizer, assets, other, and pesticide expenditures. While neither education nor the gender of the household head are significant, having all of the farm area under irrigation is estimated to increase output by between 31.5% and 34.2%. Figure 1 presents predicted technical efficiency, $TE_i=exp(-u_i)$, the measure we use to represent production ability, in histogram form. The fact that ability varies considerably between households could imply that, even without a strong pull from non-agricultural employment opportunities as in the case of China, the scope for market-mediated transfers to bring about efficiency gains could be large.

4.2 Determinants of land market participation

Results from ordered probit estimation of the rental market participation equation on the pooled sample for 1982 and 1999 as reported in table 4 provide insights on the factors affecting rental market participation as well as the impact of rental market restrictions. For the latter, we use three measures and, for each of them, present equations with and without producers' estimated ability to ensure that results do not dependent on inclusion of this measure. While regressions without ability (columns 1, 3 and 5) include the whole sample,

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[22] In fact, our sample suggests that it was households with higher productivity who left the agricultural sector and that the difference in the level of productivity between this group and those who remained in agriculture is statistically significant. .

[23] For the subset of households that were observed in both periods, we estimated 1999 ability from estimating production frontier using 1999 data and 1982 ability using 1982 data. The pairwise correlation between the 1999 and 1982 abilities is 0.70, significant at 1% level., which supports the assumption that dynasties'a agricultural ability is indeed quite time-invariant.

[24] These commodities include paddy, wheat, barley, maize, jowar, bajra, ragi, pulses, small millets, groundnut and other oilseeds, cotton, jute and other fibre crops, sugarcane and other sugar and starch crops.

the fact that ability is defined only for households or dynasties who engaged in agricultural production in either of the periods reduces the sample by about 2,500 observations while not altering substantive results.[25]

Factor affecting participation on either the supply- or demand-side of the rental market as indicated from the main equation are consistent with our hypothesis (recall the coding convention of 1 for renting out, 2 for autarky, and 3 for renting in). In particular, as proposition 1 and descriptive statistics led us to expect, land rental provides an important opportunity for landless households to gain access to land. One indication for this is the significance and magnitude of the coefficient on the landless dummy. Furthermore, higher land endowments are estimated to increase households' propensity to supply land to the rental market while higher endowments with family labor, especially of members in the 14-60 year age group, increase the propensity to rent in land. This supports the notion that, by transferring land to those with higher endowments of family labor, markets will improve the scope for gainful employment of labor in rural areas. To interpret the regression coefficients, note that the probability for a landless household to gain access to land through rental is 4.1 to 7.4 percentage points higher than of those who are endowed with land. At the same time, the propensity to supply land of the largest land owners in our sample is between 26.8 and 40.3 points higher than that of a landless household.

Contrary to widespread belief which assumes that markets will favor those with higher levels of wealth, the lack of significance of households' total asset ownership suggests that, consistent with descriptive statistics, land rental markets are not biased against the poor. However, the composition of households' asset portfolio does matter; the significant coefficient on the share of non-farm assets highlights that those with a higher share of their assets in agriculture will be more likely to rent in land. Compared to those with no off-farm assets at all, those who initially had all the assets related to off-farm activities is more than 25% more likely to rent out their land.

The results also suggest that higher levels of education, measured by whether the head has completed at least primary education, significantly increase the propensity to supply land to rental market due to higher opportunity cost of labor for more educated individuals (proposition 2 and 3). The probability to rent out (rent in) land for a household whose head attained primary education or above is 2.3% higher (1% lower) than one without such education. Mean village income similarly increases the tendency to rent out, implying that as, with overall development, the level of income increases, households will be more likely to move out of agriculture and supply their land to the rental market, thereby allowing those with higher levels of agricultural ability to increase their holdings and income levels, as also observed in China (Deininger *et al.* 2005). Compared to villages in the lowest income decile, those in the highest are 4-5 percentage points more likely to supply land to the rental market. This would imply that the importance of land rental markets will increase with overall economic development and that imposing exogenous restrictions on the operation of

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[25] There are 4,346 observations in the 1982 and 7,476 in the 1999 survey, 491 of which lack information on village income, yielding 11,331 ones that can be used in the regression. Columns 2, 4 and 6 include 2,889 producer households from 1982 who split into 4,605 in 1999, in addition to 1419 ones who were added in the second period, excluding 93 for whom no village level income was available.

such markets could have far-reaching implications and may inflict efficiency losses the magnitude of which increases over time.

The highly significant coefficient on ability also supports our hypothesis of rental markets transferring land from less to more efficient producers. To illustrate, the probability of the most efficient household in the sample to receive land is about 4 percentage points higher than that for the least efficient producer while the least efficient producer is about 7 percentage points more likely to rent out than the most efficient one. This points towards the potential for land transfers through rental markets to significantly enhances efficiency.

Regarding the lower bound equation, the regressions suggest that the three different measures used to represent land market restrictions (labeled as "policy variable") are associated with a significant and quantitatively important reduction of supply of land to the rental market.[26] This is in line with our discussion suggesting that landlords will be less ready to rent out their land if regulations either imply that part or all of their property rights to land that is rented out may be lost or limit their ability to freely negotiate the amount of rent to be paid. This result is obtained irrespectively of the variable chosen to empirically represent policy although comparing the coefficients on policy measures across specifications suggests that the number of laws passed had the least impact, followed by the implementation of ceiling laws and the implementation of tenancy legislation. This is consistent with the notion that ceiling laws pose less of a threat than tenancy regulation, both because the latter apply to all market participants irrespectively of the size of their holding - in contrast to ceiling legislation which is applicable only to large owners- and because enforcement of tenancy regulation is less politically controversial and administratively complex than that of land ceilings.

Coefficients on other variables in the lower bound equation suggest that, even after adjusting for the factors discussed earlier, scheduled castes and tribes as well as other backward castes are less likely to rent out land than the remainder of the population, a finding that may be related to lower levels of social capital and thus either less opportunity to find partners in rental markets or to enforce protection of property rights for land that had been rented out. At the same time, the highly significant coefficient on 1999 dummy illustrates that, over and above the activation of land rental markets that comes about as a result of increases in village income, the supply of land to rental markets has increased significantly over time.

Turning to the (upper) bound between autarky and renting in, the fact that estimates for all of the policy variables are positive suggests that such measures not only reduced supply (as indicated by the lower bound equation) but also depressed demand and made it more difficult for households to obtain land through rental markets. Across specifications, the level of significance is much higher for variables relating to the intensity of enforcement; in fact the number of laws, while of the expected sign, is not significantly different from zero at conventional levels, suggesting that such legislation affects market outcomes only if measures are taken to implement it, consistent with what has been observed in the literature (Banerjee *et al.* 2002). The

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[26] To interpret the coefficients in the lower bound equation marking the transition form renting out to autarky, note that a positive coefficient implies expansion of the rent-out regime and better functioning of rental markets while a negative coefficient suggests the opposite.

magnitude of the coefficients which can be interpreted as a rough measure of the difference in impact between tenancy and ceiling legislation is similar to what had been observed for the lower bound, suggesting that these variables have contributed to a roughly equal expansion of supply and demand in the rental market. Parallel to what emerged for the lower bound, we find that backward and scheduled castes and tribes are more likely to remain in autarky. Over time the size of the autarky area has decreased, i.e. land rental markets have become more active, partly offsetting the negative impact of rental regulation. While this is an encouraging sign, one should note that, given the magnitude of the coefficients, almost a century will be required for the time trend to fully offset the impact of tenancy legislation. This, together with evidence that circumventing such legislation is normally easier for the rich than the poor (Thangaraj 1995, Yugandhar 1996) would imply that expecting the passage of time alone to eliminate the negative effect of tenancy regulation is unlikely to be a realistic policy option.

4.3 Equity and efficiency impact of land reform policy

The above provides strong support for the hypothesis that different forms of land rental legislation have reduced activity in land rental markets and constrained the ability of the poor and landless to acquire land that would help them to improve their income and social status. At the same time, many scholars argue that tenancy regulations can still be socially desirable because of an underlying trade-off between equity and efficiency. Under this interpretation, the equity and social gains they bring about would, at least for some welfare weights, more than outweigh the associated efficiency losses (Besley *et al.* 2004). More importantly, the equity and efficiency-impact of land reform legislation can be obtained from the signs of appropriate coefficients in an expanded version of the ordered probit regression (6) where the policy coefficient *T* is interacted with a dummy for landlessness or the level of productive efficiency as obtained from the frontier production function discussed earlier.[27] Inclusion of producers' initial level of productivity requires little justification and the focus on landless households is motivated by equity concerns, in particular the apparent high production elasticity of land and the presumption that gaining access to land will be associated with a qualitative and discrete increase in economic opportunities and social status (Finan *et al.* 2005).

Results from three specifications of the ordered probit equation that interact the level of tenancy restrictions with landlessness, efficiency, and both (in columns 1, 2, and 3, respectively), are reported in table 5. While it is not surprising to find that the coefficients in the main equation are broadly consistent with those in table 4, a number of additional insights are of interest. As to possible equity impacts, inspection of the upper bound equation suggests that the main impact of tenancy regulation on the demand side is to prevent access to land by the landless (column 1) and more efficient producers (column 2); in fact after accounting for both these effects, the coefficient on the policy variable by itself is negative and highly significant. One explanation consistent with this finding is that sitting tenants who already own land but are not necessarily the most

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[27] As landless households will obviously not be able to supply land to the rental market, the interaction between landlessness and the policy variable is included only in the upper bound equation.

efficient producers[28] benefit from tenancy regulation at the cost of landless and more productive producers are constrained by the transaction costs imposed through tenancy restrictions and unable to effectively express their demand in the market.

Concerning the impact of tenancy restrictions on efficiency, the upper bound equation suggests that, in addition to rationing out efficient producers on the demand side, and contrary to what is intended, tenancy regulations encourage more efficient producers to supply their land to the rental market, possibly because they are in a better position to sidestep the transaction costs imposed by this intervention. Instead, possibly because tenancy restrictions make it more difficult for them to gain access to additional land that would allow to make best use of their skills, producers with high levels of ability are estimated to supply land to the rental market. This suggests that tenancy restrictions can make the economy worse off and that the gains associated with their removal should be more than sufficient to compensate possible losers and ensure that reforms are Pareto-improving. Comparing the coefficient for the policy variable and its interaction with ability between columns 1 and 2 or 3, respectively, suggests that, in states where tenancy restrictions are prevalent, producers with low levels of ability are less likely to rent out their land. This would imply that, where such restrictions exist, possible efficiency gains from low-ability producers moving out of agriculture and making their land available to those with higher levels of ability will are less likely to materialize.

4.4 Exploring variation over time

A key argument to justify adoption of rental regulations when they were first introduced was that presence of multiple market imperfections in rural areas, exacerbated by immobility of land, would allow landlords to extract large rents from tenants who lack alternative opportunities. Comparing tenants' returns from cultivating rented land per day of family labor spent, net of any cash or kind outlays for inputs and the rental payment, for tenants with the prevailing agricultural wage rate provides a simple way of assessing the extent to which participation in rental markets can help to improve overall welfare. Doing so with the data at hand highlights the potentially far-reaching and positive impact of rental markets; even after deducting the rental fee (in cash or kind) from the net return per day of R 150 which is very close to the value marginal product of family labor from a Cobb-Douglas production function {jin nagarajan}, the average tenant earns more than double the wage rate for agricultural labor (46.4 for men and 33.7 for women) for every day spent on rented-in land. Although unobserved differences in ability could play a role, anecdotal evidence these are unlikely to be sufficient to explain such large differences. In view of the fact that wages for women are significantly lower than those for men, the potential for rental markets to contribute economically empower women is particularly noteworthy and in line with anecdotal evidence suggesting that women are among the most avid users of programs aiming to make land available for rental, either on an individual or on a group basis, {sc/st evaluation}.

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[28] Especially when they become old and their children do not want to continue in farming as was found to be the case in the Philippines (Deininger *et al.* 2002).

An explanation that is consistent with the above evidence is that, with economic development and greater availability of non-agricultural employment options, the impact of other markets imperfections (e.g. barriers to credit market access) may have become less pronounced over time, a possibility that has indeed been discussed at a theoretical level in the literature (Mookherjee 1997). While lack of wage rates in 1982 prevents us from directly examining how this gap has evolved over time, we use an econometric approach to empirically test for this. In particular, probit regressions for renting in and renting out where most of the coefficients included earlier are interacted with a time dummy allows us to test for the extent to which the structure of land access through rental markets has changed over time, and whether this would reduce or even obviate the need for tight regulation of such markets that may have been justified earlier.

Results from doing so (table 6) suggest that there have indeed been structural changes in the almost 20 years separating our two surveys. Results from tests for the hypothesis that the value of one of the time-varying coefficients equaled zero in 1999 are reported in the bottom panel. Most importantly, a significant wealth-bias in the ability to access land -which may have been the result of capital market imperfections- that was present in the first period is no longer discernible in 1999. While in 1982 households with higher levels of assets were more likely to access land through rental markets (see the positive sign of γ_1 in table 6), this had been reversed in the second period as we can no longer reject the hypothesis of no wealth effect, i.e. $\gamma_1 + \gamma_2 = 0$ as indicated in the bottom of table 6 and consistent with the findings from earlier regressions. While more detailed investigation of the factors underlying this results transcends the scope of this paper, one explanation consistent with this finding would be that supply of land as well a the ability of potential renters to access (formal or informal) credit markets have increased in the course of economic development. This interpretation is consistent with the elimination of a similar, albeit slightly less significant bias of land rental markets in favor of more educated individuals between the first and the second period (δ_1 and δ_2 in table 6). It is also of interest to observe that, while the propensity of large land owners to rent in, which was already negative in the initial period (β_1) has further decreased and that in villages with higher levels of income, the demand for land rental is now significantly lower than it was earlier, both factors presumably due to better availability of non-agricultural opportunities. This suggests that, at least in the areas represented by our sample, concerns about a trend towards reverse tenancy that could undermine livelihood options for the poorest are not justified. At the same time, we note that the strong advantage which landless had enjoyed in the land rental market has decreased slightly, an issue that would be worth to be further explored. On the supply side, we note that the propensity of large land owners to supply land to the rental market also has increased significantly between the two periods, implying that, instead of encountering transactions between small land owners that have little impact on the agrarian structure, one will be more likely to find exchanges of land that modify the structure of operational land holdings.

5. Conclusion and policy implications

In rural India, there is an increasing recognition of the importance of land rental markets to bring land to more productive uses while at the same time providing a basis for development of the rural non-farm economy. Even though the presence of numerous restrictions on the operation of land rental markets in the case of India makes this of even greater interest, cross-state evidence on this issue has thus far been limited. By using a national sample, we are able to provide such evidence.

We find that, contrary to what is often assumed, land rental markets help to improve not only productivity but also equity. They do so by allowing landless and land-poor households to access land and improve their livelihood. More importantly, the pro-poor nature of land markets has significantly improved over time as wealth bias that had characterized such markets earlier has been eliminated. The fact that land markets are more active in locations with higher levels of non-farm activity supports the notion that such markets make an increasingly important contribution to diversification of livelihoods in rural areas. In fact, higher incidence of opportunities and options open through such diversification could be a key factor underlying the elimination of wealth-related barriers to land rental market participation. At the same time, the finding that presence of tenancy laws and ceiling legislation, as well as high levels of implementation of these, reduce rather than increase land access by the landless and possibly very efficient producers is cause for concern. It suggests that, while such laws may have led to significant social gains in the past, their maintenance does no longer have a positive impact on equity but instead is developing into an increasingly potent obstacle to land access and greater productivity. Our findings provide an empirical underpinning to support the desirability of eliminating land rental market restrictions that is articulated in the Government's most recent 5-year plan (Government of India 2002).[29] In fact, by demonstrating the significance and magnitude of these impacts quantitatively, our results reinforce the importance of moving from policy principles towards action on this issue.

While our sample is too small (and the survey too general) to provide specific guidance on how to move the debate from the "whether" to the "how" of reform, our results, together with the literature, provide two pointers. The literature suggests that sitting tenants are the main beneficiaries from tenancy regulation or other rental restrictions -and thus stand to lose most from reform. In fact, elimination of rent controls on rural lands without protection of sitting tenants in Egypt seems to have been associated with undesirable consequences (Bush 2000). Ways to compensate tenants who have been on the same plot for a long time will increase the likelihood that reforms be feasible politically. This could include innovative mechanisms to clarify overlapping property rights to land reform land as experimented with in some Indian states (Hanstad and Nielsen 2004). On the other hand, many Indian scholars contend that liberalization of rental markets should be complemented by strong further regulation that would, for example, limit the amount of land that can be rented in by a producer (Saxena 2002). The evidence that land rental markets increasingly transfer

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[29] "…freedom in leasing of land, both 'leasing in' and 'leasing out' will help generate income for both lessee and lessor/contractor. A legislation needs to be enacted to facilitate the land utilisation by making land transactions easier and facilitating leasing and contract farming." (Government of India 2002, p. 528).

land towards the land-poor that emerges from our analysis suggests that there may be no need for such regulation. To the contrary, experience in other countries suggests that such regulation is difficult to enforce and, by creating incentives for discretionary interference by bureaucrats, impose considerable transaction costs (Zepeda 2000) and the need for it should be evaluated very carefully. Opening up of land leasing markets in India has the potential to generate significant benefits for the rural poor and it would be a pity if these gains were jeopardized by a tendency of low-level bureaucrats to use well-intended regulation a pretext for discretionary use of their power.

Table 1: Land reform implementation in various Indian states

State	Total agric. area (mn.ac)	1980 Population (mn)	Share of households receiving tenancy rights	Share of area redistributed under ceiling legislation	Mean level of land tenancy laws
Andra Pradesh	17.11	75.73	0.75%	8.34%	0.53
Bihar [a]	22.22	82.88	0.00%	4.42%	2.64
Gujarat	8.44	50.60	11.20%	1.95%	1.47
Haryana	10.60	21.08	0.01%	1.26%	0.00
Himachal Pradesh	2.08	6.08	3.19%	0.06%	n.a.
Karnataka	18.79	52.73	5.29%	1.71%	1.42
Kerala	0.94	31.84	12.49%	1.30%	2.42
Madhya Pradesh	43.75	60.39	0.61%	2.69%	0.94
Maharashtra	33.54	96.75	10.68%	7.74%	0.97
Orissa	13.54	36.71	1.43%	2.24%	1.94
Punjab [b]	15.45	24.29	0.04%	1.50%	0.58
Rajasthan	27.04	56.47	0.16%	6.63%	0.00
Tamil Nadu	10.12	62.11	3.23%	2.47%	4.03
Uttar Pradesh	51.17	166.05	0.00%	5.81%	1.42
West Bengal	16.98	80.22	10.80%	14.91%	3.83
All India	298.77	930.57	5.35%	4.41%	1.49

Source: Kaushik and Haque (2005), based on annual reports by the Ministry of Rural Development for columns 1-4; Besley and Burgess (2000) for coloumn 5.

Table 2: Key household characteristics by region and time.

	1982					1999				
	All	**North**	**West**	**East**	**South**	**All**	**North**	**West**	**East**	**South**
Basic characteristics										
Household size	6.86	7.20	7.28	6.97	6.01	6.02	6.64	6.10	6.30	5.21
Members aged below 14	2.36	2.58	2.61	2.36	1.87	1.86	2.15	2.02	1.93	1.36
Members aged 14 – 60	4.16	4.22	4.35	4.28	3.83	3.75	4.01	3.68	4.02	3.44
Members older than 60	0.34	0.41	0.32	0.33	0.32	0.41	0.48	0.40	0.36	0.41
Head's age	50.10	51.52	49.59	48.89	49.96	49.20	49.45	48.55	48.43	50.30
Female head dummy (%)	6.86	4.14	4.39	4.63	13.29	6.66	4.28	5.14	4.65	11.89
Head with primary or above.	0.26	0.22	0.17	0.26	0.40	0.50	0.56	0.42	0.54	0.51
Land endowment (ha)	3.29	2.65	4.78	2.31	2.52	2.12	1.99	2.82	1.29	1.86
Land endowment p.c.	0.52	0.42	0.72	0.36	0.42	0.39	0.35	0.52	0.24	0.37
Landless dummy (%)	22.28	22.43	18.78	20.30	27.02	23.93	27.16	21.10	23.41	25.03
Consumption and asset ownership										
Per capita income	1538.62	1915.45	1470.32	1226.49	1424.24	2595.59	2994.16	2125.07	1979.44	3246.56
Per capita consumption exp.	1305	1506	1200	1058	1362	1561	1803	1526	1287	1579
Gini (per capita cons. exp.)	0.32	0.30	0.29	0.31	0.36	0.31	0.31	0.30	0.36	0.28
Value of all assets (Rs.)	17710	24654	17947	10170	14743	47749	66529	43810	29298	48688
Financial and off-farm (%)	26.69	25.73	29.56	28.30	23.62	23.21	18.56	19.87	25.14	31.66
Farming and livestock (%)	15.81	16.69	20.67	7.16	10.58	19.86	23.53	26.27	8.08	13.01
House & cons. durables (%)	57.50	57.58	49.79	64.54	65.79	56.93	57.91	53.86	66.78	55.33
Gini (all assets per capita)	0.60	0.54	0.56	0.55	0.64	0.56	0.55	0.53	0.59	0.54
Participation in economic activities (%)										
Crop production	70.24	68.57	75.64	71.49	65.07	62.89	67.45	68.41	61.29	53.15
Livestock production	78.11	81.31	87.35	66.27	70.36	62.85	72.90	66.88	55.16	54.26
Non-farm self-employment	11.33	10.63	11.16	13.13	11.22	10.96	7.86	10.77	20.73	7.41
Salaried employment	17.47	24.71	12.65	22.24	14.18	17.27	27.33	13.59	16.22	13.90
Off-farm wage employment	8.59	5.63	11.10	10.15	7.62	19.96	17.01	18.48	32.36	16.17
Wage employment	37.59	21.27	39.49	42.69	47.71	43.29	28.27	44.98	53.94	47.05
No. of observation	4980	1279	1613	670	1417	7476	1705	2479	1307	1985

Source: Own computation from 1982 and 1999 ARIS/REDS surveys

All values are in 1982 Rs with 1999 values having been deflated by state level deflators.

Table 3: Key household characteristics by rental market participation status (1982 and 1999)

	1982			1999		
	Autarkic	**Rent-in**	**Rent-out**	**Autarkic**	**Rent-in**	**Rent-out**
Basic Characteristics						
Household size	6.92**	8.15**	5.34**	6.04	6.91**	5.54**
Members aged below 14	2.38**	2.75	1.83**	1.87	2.38**	1.53**
Members aged 14 – 60	4.20**	4.90**	3.10**	3.77	4.17**	3.45**
Members older than 60	0.34**	0.49*	0.41	0.40**	0.36	0.56**
Land endowment (ha)	3.34*	2.31*	2.93	2.02**	1.27**	2.87**
Land endowment p.c.	0.51	0.28**	0.68**	0.36**	0.20**	0.64**
Landless dummy (%)	23.76**	11.83*	0.00**	26.29**	37.34**	0.00**
Head's age	49.97*	51.85	51.71	48.98**	47.41*	51.65**
Female head dummy (%)	6.67*	2.15	12.03**	6.54	3.30*	8.90**
Head with primary or above (%)	25.34**	29.03	35.71**	48.51**	49.50	61.53**
Consumption and asset ownership						
Per capita consumption exp. (Rs.)	1280.42**	1426.98	1697.84**	1549.19**	1346.19**	2213.63**
Value of all assets (Rs)	17215**	34783**	20333	46568**	33839**	62466**
Financial and off-farm (%)	26.47	19.48	34.20**	22.69*	19.23**	27.160**
Farming and livestock (%)	15.70**	32.12**	7.69**	20.91**	21.67	13.26**
House & cons. durables (%)	57.83	48.40	58.10	56.41	59.10*	59.58
Participation in activities (%)						
Crop production	72.60**	100.00**	19.17**	66.12**	100.00**	23.07**
Livestock production	78.66*	97.85**	61.65**	63.57**	81.82**	49.88**
Non-farm self-employment	11.30	5.38	13.91	9.9**	14.61*	17.96**
Salaried employment	16.84**	18.28	28.2**	15.98**	10.71**	30.05**
Wage employment	38.82**	26.88*	19.92**	44.93**	59.74**	23.94**
Number of observations	4621	93	266	6366	308	802

Source: Own computation from 1982 and 1999 ARIS/REDS surveys

  All values are in 1982 Rs with 1999 values having been deflated by state level deflators.

Table 4: Determinants of participation in land rental markets (ordered probit regression)

	Tenants recognized		Ceiling land redistributed		No. of tenancy laws	
		Policy measure in the upper/lower bound equations				
Main equation						
Cultivation ability		0.248***		0.252***		0.247***
		(2.63)		(2.63)		(2.61)
Landless dummy	0.623***	0.746***	0.626***	0.786***	0.622***	0.762***
	(18.09)	(15.16)	(17.81)	(15.43)	(17.91)	(15.24)
Land endowment (ac)	-0.012***	-0.029***	-0.013***	-0.029***	-0.011***	-0.029***
	(4.63)	(8.56)	(5.14)	(8.63)	(4.61)	(8.35)
Members below 14 years	0.054***	0.054***	0.055***	0.056***	0.056***	0.058***
	(6.22)	(5.65)	(6.18)	(5.80)	(6.38)	(5.96)
Members aged 14-60 years	0.063***	0.056***	0.062***	0.057***	0.060***	0.055***
	(7.97)	(6.42)	(7.74)	(6.53)	(7.55)	(6.29)
Head's age	0.021***	0.026***	0.022***	0.026***	0.021***	0.026***
	(3.44)	(3.56)	(3.62)	(3.51)	(3.45)	(3.59)
Head's age squared/100	-0.025***	-0.028***	-0.025***	-0.028***	-0.025***	-0.029***
	(4.34)	(4.14)	(4.36)	(4.08)	(4.34)	(4.24)
Head has primary or above	-0.148***	-0.117***	-0.153***	-0.119***	-0.161***	-0.135***
	(4.59)	(3.23)	(4.77)	(3.30)	(4.99)	(3.67)
Mean village income (log)	-0.090***	-0.106***	-0.077***	-0.100***	-0.072***	-0.078***
	(3.42)	(3.56)	(2.91)	(3.32)	(2.77)	(2.64)
Total assets (log)	0.010	0.009	0.008	0.002	0.011	0.007
	(0.59)	(0.44)	(0.50)	(0.11)	(0.65)	(0.32)
Off-farm share in total assets	-1.194***	-1.617***	-1.180***	-1.588***	-1.216***	-1.685***
	(5.43)	(4.63)	(5.24)	(4.53)	(5.42)	(4.65)
Lower bound (rent out to autarky)						
Policy variable	-12.300***	-4.294*	-1.502**	-2.154***	-0.110***	-0.121***
	(6.50)	(1.90)	(2.53)	(2.97)	(6.07)	(5.38)
ST/SC dummy	-0.200***	-0.138**	-0.178***	-0.127**	-0.187***	-0.136**
	(3.85)	(2.16)	(3.38)	(1.98)	(3.54)	(2.10)
OBC dummy	-0.105**	-0.040	-0.104**	-0.024	-0.093**	-0.030
	(2.49)	(0.81)	(2.42)	(0.48)	(2.23)	(0.60)
1999 dummy	0.527***	1.426***	0.454***	1.391***	0.451***	1.359***
	(8.73)	(13.09)	(7.49)	(12.79)	(7.53)	(12.51)
Upper bound (autarky to rent in)						
Policy variable	12.697***	8.816***	2.551***	4.256***	0.018	-0.023
	(4.18)	(2.64)	(2.71)	(4.06)	(0.90)	(1.00)
ST/SC dummy	0.166**	0.101	0.148**	0.090	0.165**	0.110
	(2.52)	(1.44)	(2.24)	(1.28)	(2.52)	(1.57)
OBC dummy	0.148**	0.166***	0.116*	0.139**	0.147**	0.170***
	(2.42)	(2.64)	(1.87)	(2.20)	(2.42)	(2.72)
1999 dummy	-0.239***	0.143*	-0.245***	0.156*	-0.258***	0.097
	(3.41)	(1.75)	(3.43)	(1.89)	(3.69)	(1.19)
Observations	11331	8820	11147	8820	11221	8711
Log likelihood	-4564.94	-3513.55	-4450.96	-3501.93	-4514.77	-3436.48

Robust z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Constants and regional dummies included throughout but not reported.

Table 5: Ordered probit regression interacting policy with efficiency and landlessness

	Interaction considered	
	Landlessness	**Landlessness & Productivity**
Main equation		
Ability		0.384***
		(3.35)
Landless in 1982 dummy	0.768***	0.850***
	(20.07)	(15.35)
Land endowment	-0.012***	-0.029***
	(4.68)	(8.50)
Members below 14 years	0.053***	0.054***
	(6.16)	(5.63)
Members aged 14-60 years	0.063***	0.056***
	(8.01)	(6.40)
Head's age	0.020***	0.025***
	(3.34)	(3.52)
Head's age squared/100	-0.025***	-0.028***
	(4.26)	(4.11)
Head has primary or above	-0.148***	-0.122***
	(4.59)	(3.36)
Mean village income (log)	-0.096***	-0.106***
	(3.62)	(3.58)
Total assets (log)	0.010	0.011
	(0.59)	(0.50)
Share of off-farm in total assets	-1.254***	-1.632***
	(5.69)	(4.70)
Lower bound (rent out to autarky)		
Share receiving tenancy rights	-13.250***	-26.524***
	(7.08)	(3.09)
Tenancy rights*ability		32.764***
		(2.60)
ST/SC dummy	-0.187***	-0.134**
	(3.56)	(2.09)
OBC dummy	-0.105**	-0.042
	(2.50)	(0.85)
1999 dummy	0.528***	1.427***
	(8.62)	(13.07)
Upper bound (autarky to rent in)		
Share receiving tenancy rights	2.884	-0.109
	(1.07)	(0.01)
Tenancy rights*landlessness	55.098***	35.528***
	(4.56)	(2.82)
Tenancy rights*ability		7.689
		(0.51)
ST/SC dummy	0.147**	0.092
	(2.23)	(1.31)
OBC dummy	0.143**	0.170***
	(2.35)	(2.71)
1999 dummy	-0.180**	0.144*
	(2.54)	(1.75)
Observations	11331	8820
Log likelihood	-4528.49	-3502.61

Robust z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%
Constants and regional dummies included throughout but not reported.

Table 6: Determinants of rental market participation (probit results)

	Type of participation				
	Renting in			Renting out	
Cultivation ability		0.016*	0.017**		-0.022*
		(1.88)	(2.05)		(1.74)
Log area owned (α_1)	-0.002***	-0.003***	-0.003***	-0.001	0.001
	(4.49)	(4.74)	(4.70)	(1.37)	(1.49)
Area owned * 1999 (α_2)	0.008	0.012*	0.013*	0.069***	0.053***
	(1.46)	(1.78)	(1.86)	(5.56)	(3.41)
Head has primary or above (β_1)	-0.004	-0.008	-0.008	-0.026*	-0.023
	(0.74)	(1.03)	(1.08)	(1.95)	(1.63)
Head primary or more * 1999 (β_2)	-0.003**	-0.004**	-0.004**	0.009***	0.004***
	(2.28)	(2.10)	(2.07)	(5.25)	(3.49)
Log total assets (γ_1)	0.009**	0.013**	0.012**	0.006	0.016**
	(2.39)	(2.33)	(2.25)	(1.07)	(2.01)
Total assets * 1999 (γ_2)	-0.009**	-0.011**	-0.011*	-0.012*	-0.017*
	(2.13)	(1.99)	(1.86)	(1.80)	(1.92)
Share of off-farm in total assets (δ_1)	-0.090*	-0.095*	-0.096*	0.111	0.047
	(1.81)	(1.87)	(1.92)	(1.60)	(0.79)
Share of off-farm assets * 1999 (δ_2)	0.036	0.017	0.020	0.265**	0.166**
	(0.58)	(0.25)	(0.28)	(2.55)	(2.07)
Log village income (ζ_1)	0.008	0.010	0.010	0.006	0.011
	(1.64)	(1.54)	(1.52)	(0.56)	(0.71)
Village income level * 1999 (ζ_2)	-0.019***	-0.021***	-0.021***	0.007	-0.002
	(3.43)	(2.99)	(3.05)	(0.51)	(0.14)
Landless dummy (η_1)	-0.012*	0.570***	0.573***		
	(1.92)	(5.83)	(5.83)		
Landless * 1999 (η_2)	0.019*	-0.042***	-0.041***		
	(1.80)	(4.88)	(4.88)		
Members below 14 years	0.002***	0.002***	0.002***	-0.011***	-0.008***
	(2.86)	(2.83)	(2.70)	(5.55)	(5.15)
Members aged 14-60 years	0.002***	0.002***	0.002***	-0.015***	-0.008***
	(3.26)	(3.17)	(3.12)	(7.79)	(6.21)
Head's age	0.000	0.001	0.001	-0.004***	-0.003***
	(0.91)	(0.91)	(0.91)	(3.31)	(3.81)
Head's age squared	-0.000	-0.000	-0.000	0.000***	0.000***
	(0.97)	(0.86)	(0.85)	(4.26)	(4.49)
Share receiving tenancy rights	-0.712***	-0.649***	-0.434**	-1.865***	-0.339
	(4.60)	(3.25)	(2.11)	(5.67)	(1.28)
Share receiving tenancy rights * landless		-1.652**	-1.626**		
		(2.39)	(2.45)		
Share receiving tenancy rights * ability			-1.051**		-1.379**
			(2.41)		(2.52)
1999 dummy	0.309***	0.250***	0.242***	0.106	0.260**
	(4.52)	(3.90)	(3.83)	(1.28)	(2.54)
Observations	11331	8820	8820	8660	7816
Log likelihood	-1542.80	-1363.31	-1360.98	-2695.67	-1956.37
Tests:					
$\alpha_1 + \alpha_2 = 0$	16.70***	17.75***	17.83***	27.32***	23.05***
$\beta_1 + \beta_2 = 0$	1.35	1.40	1.55	26.38***	23.45***
$\gamma_1 + \gamma_2 = 0$	0.08	0.42	0.71	2.06	0.01
$\delta_1 + \delta_2 = 0$	2.07	2.37	2.39	23.42***	16.17***
$\zeta_1 + \zeta_2 = 0$	20.25***	15.06***	16.09***	4.51**	4.22**
$\eta_1 + \eta_2 = 0$	0.11	12.39***	12.67***	n.a.	n.a.

Robust z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Regional dummies included throughout but not reported. The reported test statistics for the joint tests in the bottom panel are χ^2 statistics.

Appendix Table 1: Characteristics of crop production of rural India in 1982.

	All India	Regions			
		Northern	Western	Eastern	Southern
1982					
Value of crop production	22820.86	30739.11	21492.66	16301.58	20407.80
Crop area (ha)	2.12	2.41	2.74	1.35	1.41
Share of crop area irrigated	0.27	0.43	0.19	0.18	0.26
Total labor in crop production (days)	472.19	419.40	449.48	437.17	571.43
Seed expenditure (Rs.)	749.88	865.04	821.73	346.59	752.32
Fertilizer expenditure (Rs.)	2161.45	3501.84	1506.81	1058.67	2330.39
Pesticide expenditure (Rs.)	268.09	266.27	184.24	84.65	477.77
Other expenditure (Rs.)	626.32	1163.98	462.11	258.02	523.41
Total farming assets (Rs.)	3504.22	5404.92	4520.87	649.34	1798.99
Head's age	50.91	52.77	50.12	49.87	50.71
Head attained primary education or higher	0.26	0.21	0.16	0.28	0.43
Share of household with female head	0.05	0.02	0.03	0.03	0.10
No. of observations	3,328	834	1,171	452	871
1999					
Value of crop production	44434.29	61075.79	40082.64	25425.60	47803.93
Crop area (ha)	2.54	2.78	3.11	1.61	1.99
Share of crop area irrigated	0.63	0.92	0.55	0.56	0.51
Total labor in crop production (days)	166.62	136.57	170.34	143.97	213.16
Seed expenditure (Rs.)	2171.38	2086.84	2621.99	958.04	2455.94
Fertilizer expenditure (Rs.)	3589.31	5359.63	3403.45	1806.13	3276.48
Pesticide expenditure (Rs.)	730.25	1027.46	863.09	174.33	597.83
Other expenditure (Rs.)	2335.45	3341.76	2751.46	950.65	1548.77
Total farming assets (Rs.)	45240.54	69732.29	50568.00	8318.05	36984.85
Head's age	50.04	50.71	49.59	49.33	50.60
Head attained primary education or higher	0.51	0.56	0.41	0.57	0.56
Share of household with female head	0.05	0.04	0.04	0.04	0.08
No. of observations	4,208	1,037	1,557	713	901

Appendix Table 2: Estimation of Cobb-Douglass crop production function (1982 data)

	1982		1999	
	OLS	**Frontier**	**OLS**	**Frontier**
Total crop area sown (log)	0.488***	0.494***	0.584***	0.607***
	(22.95)	(31.74)	(35.13)	(37.54)
All labor in crop production (log)	0.208***	0.188***	0.154***	0.138***
	(11.15)	(14.15)	(14.47)	(13.56)
Seed expenditure (log)	0.093***	0.078***	0.290***	0.283***
	(8.49)	(10.02)	(32.43)	(33.47)
Fertilizer expenditure (log)	0.054***	0.045***	0.058***	0.051***
	(10.73)	(10.91)	(12.02)	(11.24)
Pesticide expenditure (log)	0.023***	0.023***	0.029***	0.028***
	(5.11)	(5.36)	(10.17)	(10.18)
Other expenditures (log)	0.025***	0.026***	0.014***	0.011***
	(4.11)	(5.26)	(4.27)	(3.67)
Value of farming assets (log)	0.040***	0.039***	0.009**	0.011***
	(6.25)	(8.28)	(2.30)	(2.89)
Share of crop area irrigated	0.342***	0.315***	0.110***	0.109***
	(5.03)	(5.51)	(6.07)	(6.15)
Head's age	0.001	0.002**	-0.001	-0.001
	(1.63)	(2.24)	(1.18)	(1.12)
Head attained primary or above education	0.009	0.034	-0.037***	-0.029**
	(0.33)	(1.48)	(2.60)	(2.05)
Female headed	-0.032	-0.024	-0.017	-0.016
	(0.67)	(0.54)	(0.53)	(0.52)
Constant	5.847***	6.595***	5.818***	6.302***
	(61.98)	(88.92)	(86.64)	(90.60)
Observations	3328	3328	4208	4208
R^2 or log-likelihood	0.77	-2721.08	0.87	-2284.66

Absolute value of t statistics in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%

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