Insecurity of Property Rights and Matching in the Tenancy Market

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Abstract

This paper analyzes the effects of insecure property rights over land on the functioning of the land rental market in the Dominican Republic. It shows that insecurity of property rights not only reduces the level of activity of the land rental market, but also causes market segmentation. A principal-agent framework is used to model the utility maximization of both the tenant and the landlord, where the landlord accounts for the risk of losing the land when it is not traded within a narrow local circle of confidence. Using data collected with a new methodology that enable the entire market to be characterized, we show that insecure property rights lead to matching in the tenancy markets along socio-economic group and hence severely limit access to land for the rural poor. Our results also show the importance of a minimum endowment of assets to obtain access to land in the rental market.

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"Because the rights (to most of the poor's resources) are not adequately documented, these assets cannot readily be turned into capital, cannot be traded outside narrow local circles where people know and trust each other …" (Hernando de Soto, 2000)

1. Introduction

Security of property right has been argued to be a key determinant for economic growth and development (Olson, 2000, de Soto 2000). Empirical results from macro-economic studies do indeed suggest that there is a link between the security of property rights and economic growth (e.g. Knack and Keefer, 1995; Barro, 1996). The empirical results of these studies, however, have been questioned due to a number of methodological problems found in cross-country growth studies in general (Temple, 1999). In this paper, we will address the importance of insecurity of property rights using a micro-level dataset. More specifically, we will analyze how property rights affect the functioning of land rental markets in two regions in the Dominican Republic. Security of property rights for land has been argued to have important effects on incentives for investment, and hence efficient and sustainable land use, on access to credit and on the functioning of the land sales and rental markets (Feder and Feeny, 1991). Deininger and Feder (2001) provide an overview of empirical studies analyzing the investment and credit effects of secure property rights for land. In this paper, we aim at analyzing the effect of insecurity of property rights on the functioning of the land rental market. The results show that insecure property rights not only reduce the level of activity on the land rental market, but also induce market segmentation. This sheds light on a specific mechanism through which lack of property rights might impede efficiency and equity gains, and hence influence growth and development.

In most countries in Latin America, land reallocations through the rental market are limited. In the Dominican Republic, only 14% of the land is traded in the land rental market. This stands in sharp contrast with agricultural land rental markets in many other parts of the world (e.g. 73% in Belgium, 44% in the United States). Different hypotheses can be raised to explain the lack of land rental market activity, but a factor that is likely to be important in the Dominican Republic, as well as in most other countries in Latin America, is the landlord's fear of losing the land. Such fear results from insecure property rights, caused by weak law enforcement, and in many cases, lack of a formal title to the land.

In the Dominican Republic, land ownership and distribution has been severely affected by the different property right systems of the various foreign powers (Spanish, French and American), that got implemented without abolishing the previous system, and by the redistributive land reform, initiated in the 60s. Those policies have resulted in a considerable heterogeneity of property rights and in the strength of these rights. Furthermore, until today, legislation is in place that allows for expropriation of ill-used land, creating incentives for invasions and squatting of land by tenants (Gill, 2000).

Empirical work that analyzes the functioning of the land rental market typically attempts to explain the net demand for land as a function of the asset endowments and household characteristics. For instance, Deininger and Chamorro (2000) estimate the probability of renting in. Their results are consistent with land tenancy markets in Nicaragua enhancing equity and efficiency, as they transfer land to more efficient producers with lower land-labor ratios and higher profit levels. DeSilva (2000) shows that the skill level of a household is an important determinant of renting in Sri Lanka, also indicating an efficiency enhancing rental market. Baland et al. (2000) model the decision to rent in as a function of the characteristics of the tenant and show that land tenancy markets, together with land sale markets, correct for initial inequality in land endowments in Uganda.

In these empirical specifications, the authors only consider either the characteristics of the tenant or the characteristics of the landlord. However, given that land, due to its geographically fixed nature, can only be traded within a certain local rental market, access to land is likely to be determined by the

characteristics of the potential tenants that are desired by the specific landlords in the local market. If all the landlords have the same preferences over the type of tenant, the probability of renting in can indeed be modeled as a function of the characteristics of the tenant. Yet, with heterogeneous landlords and heterogeneous tenants, different landlords might prefer different tenants. In this paper, we argue that these preferences will be significantly influenced by the security of property rights over land. In particular, landlords who have reasons to fear losing their land, will only rent out land within narrowly defined social circles. Belonging to the circle of confidence of particular landlords will be a key determinant for access to land in environments with substantial property rights insecurity.

Hence, access to land for a particular tenant will not only depend on his own characteristics, but also on the characteristics of all available landlords and all other potential tenants, and on the institutional context that might influence the landlords' preferences. Analyzing the matching process on the tenancy market should therefore help to disentangle the micro-foundations of access to land through the land rental market, and hence identify constraints for potential efficiency and equity gains.

The structure of this paper is as follows: First we discuss the data that were collected for the analysis. In section 3, we analyze the determinants of renting in considering the tenants' characteristics in line with the existing literature. We then distinguish between factors affecting the willingness and the opportunity to rent in, to separate factors affecting the demand and the supply side. We also analyze the effect of plot and landlord characteristics on the likelihood of renting out, further shedding light on the supply side. In section 4, we turn to the analysis of the matching between landlords and tenants. We specifically focus on analyzing, first theoretically and then empirically, the effects of insecurity of property rights on trading within local circles of confidence. We also test for several alternative hypotheses of the determinants of matching and for the robustness of our results to alternative specifications. In the last section we conclude and discuss the policy implications of our findings.

2. The Data

2.1. Survey Methodology

To analyze access to land through the tenancy market, we collected data specifically for this purpose, in two regions of the Dominican Republic (DR). An "indirect" survey approach was used to obtain data on communities, each household, and each plot within these communities. The indirect approach relies on the fact that a lot of private information is public at the level of the community. Hence, selected informants from the community can be used to answer questions about individual community members on matters that are locally public.

This approach is advantageous because it allows defining the universe (in our case the complete rental market with all actual and potential tenants and landlords). Data are collected on every household in a geographically closed area, and selectivity bias due to non-response or difficulties of reaching certain households (often the most marginal groups) is eliminated. Furthermore, the indirect approach is an efficient method of collecting data, as information about a large amount of households can be gathered in a short time period, and with relatively minimal effort as compared to direct interviews with each of the concerned household. The accuracy of the indirect approach still needs to be established, which is the aim of ongoing research. However, work by Takasaki, Barham, and Coomes (2000) shows that reliable information on households' asset endowments can be obtained using an indirect survey approach.

In a first step, basic information about all households and all plots in a community was collected in order to (1) define the complete land rental market, (2) match landlords with their respective tenants and hence obtain information about the partners on both sides of the transaction, and (3) obtain a sampling frame for more detailed household and plot level questions. In the second step, a stratified sample of households was drawn in order to oversample the landlords and tenants in the population. This

stratification was used to guarantee sufficient observations on the variables of interest, as rental in some communities is a rare event. All landlords and tenants were selected, complemented by a random sample of all other households in the community. In addition to household-level information, data on all the plots these households owned (either owner-cultivated or rented out) and rented in was obtained. Data on community characteristics were also collected.

Data were collected in the regions of Constanza (1092 households) and San Francisco de Macoris (1431 households). Constanza is located in a fertile valley in the mountainous area in Central DR (La Vega province). It is characterized by a very intensive irrigated horticultural production, which depends to a large extent on hired labor. San Francisco de Macoris is located in the flatlands of the Cibao region (Duarte province) and agricultural production consists mainly of rice, complemented by plantains and pastures.[1] In both regions, agricultural income is an important component of households' budget.[2]

2.2. Descriptive statistics

The land rental market is quite developed in the horticultural region, Constanza, and much more reduced in the rice region, San Francisco de Macoris (Table 1). In the horticultural region, 75% of the plots has a registered public title and 84% a registered public or land reform title. The land rental market involves about half of the households as landlords (25%) or tenants (22%) and 52% of the land. In contrast, in the rice region, where only 33% of the plots has a registered public title and 71% a registered public or land reform title, only 21% of the households and 39% of the land is part of the land rental market. In addition, a larger share of the households are land constrained (i.e., reported as wanting to rent in more land) in the second region (60%) as compared to the first (46%).

The weakness of property rights in the rice region is not only reflected in the lower share of titled land, but also in the much greater occurrence of land conflicts (Table 1). The frequency of land conflicts originates from a long and complex history of land reform in this region. During the Trujillo era, most of the land in this region was owned by one of the close allies of the dictator. Immediately after the fall of the regime, much of the land was expropriated and distributed as part of the newly established land reform. However, within a few years the window of opportunity for large-scale distributions had closed, as the former aid of Trujillo soon became an ally of the new government. Further redistribution of the land, although now officially owned by the Dominican state, was stalled and the former owner and his family maintained possession of most of the property. This invoked squatting and land invasions by the peasant population, who claimed this land is the property of the Dominican people and hence fundamentally theirs. Invasions and squatting have had mixed results. Sometimes the military intervenes in favor of the former owners, other times case law has granted rights to squatting tenants. This might explain why, in all but one community in the rice region, the primary reason for difficult access to land in rental was identified as fear of the landlords to lose their land. In contrast, in the horticultural region, where the land reform had only a very marginal impact, this seemed not to be the major concern (0% of communities). The occurrence of more rental contracts that are in writing in the rice region might be a response to this uncertain environment, although the share of written contracts is still low at only 21%.

Examining household characteristics in our dataset provides further indications on the variables that affect the functioning of the land rental market. Comparing the landlord households (households who rent out land), with tenant households (who rent in land), and autarkic households (land owning households who do not rent out nor in), it appears first of all that the land rental market seems to correct for differences in labor assets between these groups of households (table 2): landlords tend to be older and

[1] In both regions, land is mainly used for annual or seasonal crops, not for perennial crops. Only a limited amount of plots are used as pasture. Hence, the use of the land does not seem to be a limiting factor for renting.

[2] In the rest of this paper, we refer to the first region as the "horticultural region", and to the second region as the "rice region".

are more often female headed compared to autarkic households, while the opposite holds for tenant households. Land reallocation through the land rental market overcompensates tenants for the significantly smaller area of land owned, as the cultivated area per adult member is higher (1.5 ha) for tenant households than for landlord households (1 ha). Apart from a larger area of owned land, landlords also tend to have more cattle and a higher number of household members who live abroad, pointing to an important source of income for those households, which might itself be a source of access to land in ownership.

Interestingly, tenants have on average a higher educational level and than any of the other groups. In particular, differences with the landless households seem to suggest that access to land through the land rental market is only functional for certain groups within society, namely for people who already have certain minimum endowments in physical assets (especially machinery and land), in human capital (education) and in social assets (membership in organizations). Especially in the capital-intensive horticulture region, this is an important factor with 87% of the households reported to be constrained on the land rental market because of lack of the necessary means to cultivate. In fact, lack of capital in this region is also reported as one of the main reasons to rent land out.

Finally, tenants also have a higher living standard than any of the other groups. The living standard variable reflects the ranking of different households by the informant in 4 categories of living standards: very low, low, regular and high.[3] The informant was asked to base these rankings on criteria associated with different measures of living standard, including the characteristics of the house (such as the number of rooms, type and quality of the material), means of transportation, use of education and health institutions, among others. Criteria indicating income-generating potential (such as land or machinery ownership) were specifically excluded. These criteria are consistent across communities.

3. Empirical analysis of the determinants of renting

3.1. Determinants of renting in

The importance of a necessary minimum asset endowment, secure property rights, conflicts, and belonging to the circle of confidence of a landlord when property rights are weak, is confirmed by regression analysis of the determinants of renting in. A weighted regression was used to account for the sample frame.[4]

The regression results in the first column of table 3 show that the rental market is effective in redistributing land for cultivation to the landless as households without land are more likely to rent in. However, access to land through the land rental market is constrained in communities with weak property rights or with lack of enforcement of these rights. The regression results suggest that access to land is facilitated in communities where the majority of the land has strong formal property rights. The presence of land conflicts on the other hand, has a very significant negative effect on land rental.[5] The past occurrence of at least one case of land occupation or squatting decreases the likelihood of renting in by 13%. The positive coefficient of the number of parcels owned by people within your own livingstandard group, can be explained by the fact that landowners might be more likely to trust people that belong to the same socio-economic group.

[3] For the analysis in this paper, the categories “very low” and “low” are considered one category, because the number of households in the “very low” category is rather small.

[4] Given that we have response based sampling, we use a pseudo-maximum likelihood approach, which starts form the likelihood function for a random sample, and then reweights the data to achieve consistency.

[5] The variable for land conflicts is a dummy variable taking the value of 1 if there was at least one case of land occupation or squatting in the community in the last 5 years.

Furthermore, the household's asset endowment is an important determinant of renting in. The results confirm that ownership of machinery significantly increases access to land in rental.[6] A positive but diminishing effect of education indicates that a minimum level of education is desirable to obtain land in rental, but logically people with a high education rent in less as the opportunity cost of their labor in other occupations is higher. Households with female household heads are less likely to rent in. Furthermore, households that are active in one of the community organizations are more likely to rent in. While this is consistent with social capital to be important for access to land, this coefficient need to be interpreted with caution due to possible endogeneity. The coefficients and significance of the other variable are robust to excluding this variable and variable measuring the number of household members, which potentially is also endogenous (see second column of table 3). The regressions further show that the availability of non-agricultural employment and proximity to the local city decreases the likelihood of renting in.

3.2. Determinants of the willingness and the opportunity to rent in

The results in table 3, could reflect the effects of the different variables on the willingness to rent in (determined by the preferences of the tenant) or the opportunity to rent in (determined by the preferences of the landlord). To disentangle these effects, we estimate separately the determinants of the willingness to rent, and the determinants of the likelihood of renting in, for those who want to. Because of a possible selection bias in the second estimation, we estimated a heckit model.

The first column of table 4, reports the results on the determinants of the demand for renting in land, and the second column shows the supply side results. We find that insecurity of property rights mainly affect the supply side. The lack of titles, the presence of conflicts and the number of parcels within your own livingstandard group only affect the opportunity to rent in. Households with male household heads, more household members and households who own no land have a higher demand for land, but do not get more opportunities to do so. Owning machinery only affects the opportunity to rent in, while education on the other hand increases both the willingness and the opportunity for renting. The age of the household heads has opposite effects on demand and supply with younger people more willing to rent in, but landlords preferring older farmers, possibly because of their experience. Interestingly, membership in a community organization increases the willingness to rent, but not the opportunity, suggesting that this is not a measure of social capital, but rather of entrepreneurship. Finally, off-farm labor opportunities affect the demand for land negatively, while distance to the markets affect the supply. Because selection coefficient was found not to be statistically significant from zero, we also did the estimation in 2 separate equations. The results of the 2 separate probit models (not reported) are largely consistent with the heckit estimation.

3.3. Determinants of renting out

To further investigate the supply side of the rental market, we analyze the determinants of renting out on the plot level. The results, reported in table 5, show that older and female-headed households are more likely to rent out, as are households who have household members abroad, and households who own more land and have less labor. These results suggest that the land rental market does help to reallocate land away from those who cannot or do not want to work it efficiently. Table 5 also confirms the effect of the insecurity of property rights on the supply of land on the land rental market. Plots without title and plots in communities with land conflict are less likely to be rented out. Landlords who have a lot of potential tenants within their socio-economic group are also more likely to rent out, suggesting again the role of the circles of confidence. These results are not affected by omitting the number of households, and

[6] The variable 'own machinery' measures the ownership of machinery if the household head is younger than 35. For this category of households, machinery ownership can be considered exogenous, as the period of potential accumulation is relatively short.

the variable measuring membership in a community organization (both potentially endogeneous) from the specification.

Exploring the relationship between landlords and tenants in more detail, table 6 shows the correspondence between the living standard of the landlords an their tenants, distinguishing between communities with and without recent land occupations. Table 6a shows that in communities with more land conflicts, there is a very strong positive assortative matching along livingstandard. For each livingstandard class, more than half of the transactions are between members of the same class. The assortative matching is the strongest for the richest class. On the other hand, less than 7 % of the land transacted by the rich is rented out to the poor, and vice versa. Comparing this pattern to the pattern in the communities without land conflicts (table 6b), we see that transactions are much more equally distributed across livingstandard classes there, with 41% of the plots rented out by the rich, going to the poor. Table 6c shows the distribution of area transacted over all communities. A pattern of reverse renting is apparent with more land being rented out to tenants of a higher livingstandard than the landlords. Comparing this pattern with table 6a and 6b, suggests that it is mainly the larger plots that are rented out to people with a higher livingstandard.

The estimations of the determinants of renting only capture the matching between landlords and tenants in an indirect way. We now turn to analyzing the matching between landlords and tenants directly. In analyzing the determinants of matching, we focus in particular on the role of the circles of confidence in environments with insecure property rights.

4. Matching in the tenancy markets

4.1. Theoretical foundations of matching in the tenancy market

We assume that landlords and tenants have perfect information about all the players in the market and about their preferences. Hence we do not rely on a search mechanism to explain the matching patterns as is often done in the literature (Mortensen, 1982; Pissarides, 1990; Burdett and Coles, 1999). Search will occur if the employers do not have perfect information on the traits of the potential employees, but can obtain this information by engaging in a costly search process. The assumption of perfect information on the variables that matter seems warranted for the village communities in the DR, as information sharing (gossiping) is an inherent part of social life. Furthermore, different studies in other parts of the world find that information on attributes of farmers is widely available in village communities (Bardhan, 1984; Bell, 1988; and Lanjouw, 1999). In future research, we will formally test this assumption for the regions studied.

In the context of the rural Dominican Republic the threat of losing the land because of squatting by the tenant, once the plot is rented, is not only likely to decrease the total amount of land offered for renting, but might also influence the access to land for different groups in society differently. In deciding who to rent out to, landlords will account for the probability of losing their land. We hypothesize that conflicts and insecurity of property rights will lead to positive assortative matching along group or class-membership.[7] Such positive matching is likely to occur because enforcement against squatting is easier for members of the same group. People from the same group depend on each other for various other interactions, apart from the ones in the land market (e.g. mutual insurance or access to credit). If squatting leads to exclusion from the group, and hence loss of all the benefits from these interactions, within-group enforcement is going to be stronger.

To model this formally we set up as a principal-agent model, in which the landlord makes the offers to the tenant, and the tenant accepts or rejects. This modeling approach is justified by the field

[7] Membership of different groups might be relevant, going from belonging to a same living standard class or landownership class, to, in the limit, belonging to the same family.

observations, as in reality it is indeed the landlord who takes the first step and determines the terms of the contract. Furthermore, we assume that all players know the best possible pay-offs of each of the other players. Hence, we will model the matching process as a decision process of the landlord, who takes the reservation utility of the potential tenants into account. The reservation utility of a potential tenant is the utility he would derive without access to that particular landlord-plot. It will be determined both by the characteristics of the tenant, and by his access to other plots in the market. We assume that the profit the tenant receives from working plot i for one time period equals this reservation utility, i.e. the landlord has all the bargaining power and drives the tenant to his reservation utility.

The tenant (agent) decides at time t=1 whether to squat or not, with the decision variable s_j being either 0 (no squatting) or 1 (squatting). The decision is determined by the trade-off between the value of all the future benefits of the plots, in case he becomes the new owner, and the value of the benefits of all future social interactions, which depends on the social distance between the tenant and the landlord. If the tenant and the landlord belong to the same group, there exist social interactions between them, leading to benefits R. If they belong to a different group there are no such benefits (R=0). We also allow for some unobserved - from the point of view of the econometrician- preference of tenant j to squat on landlord-plot i, ε_{ij}.

The tenant's maximization problem becomes

$$\underset{s_{ij}}{Max}\ U = \overline{U_{-ij}} + s_{ij}\left[s\ (P_i) * \left(\sum_{t=1}^{\infty} d^{\,t-1} p_{\,i} \right) - \sum_{t=1}^{\infty} d^{\,t-1} R(\Delta_{ij}) \right] + e_{ij} \qquad (1)$$

with

$\overline{U_{-ij}}$ the reservation utility of tenant j, given all plots except i, measured in monetary terms

π_i the profit in one time period on plot i[8]

$\sigma(P_i)$ the probability of success of squatting on plot i, which is a function of the plot characteristics P_i determining the tenure security of that plot.

δ the discount factor

And $R(\Delta_{ij})$ the one period benefits (in monetary terms) of all other social interactions, which is a function of the social distance between tenant j and the landlord of plot i, (Δ_{ij}).

The outcome of this maximization process will be the equilibrium value

$$s_{ij}^{*} = s_{ij}^{*}(\Delta_{ij}, P_i, p_{\,i})$$

These equilibrium values are common knowledge to all tenants and all landlords in the market (perfect information).

The landlord, on the other hand, chooses which tenant to offer the plot to, based on the trade-off between the profit he gets from renting out the plot of land for 1 period versus the potential loss of future profit of the land, in case of a successful squat.[9] We assume that the landlord decides each period whom to rent his plot of land out to (or whether to rent it out at all). The relevant trade-off is the profit from renting out one

[8] The profit of plot i is not modeled as function of the tenant characteristics. Although the tenants' productive assets are likely to affect the profit from the plot, these assets are endogeneous to the tenant's maximization problem as the tenant can adjust his asset endowment (machinery ownership, labor) over time.

[9] Note that we only consider here the choice of tenant, taken the choice of renting as given. Hence we only consider the landowners who have decided to rent a plot i.

period, versus the value of the potential loss of future profit. Landlords for who the later effect dominates for all potential tenants, will decide not to rent out at all, and are not considered here.

The probability that the landlord offers the plot i to a tenant j, $\delta_{ij} = 1$ if

$$E(U_{ij}) \geq E(U_{ik})$$

or

$$\left(p_{ij} - \overline{U_{-ij}}\right) - s_{ij}^{*}\left[s(P_i) * \sum_{t=1}^{\infty} d^{t-1} p_i\right] \geq \left(p_{ik} - \overline{U_{-ik}}\right) - s_{ik}^{*}\left[s(P_i) * \sum_{t=1}^{\infty} d^{t-1} p_i\right] \quad \forall k \in I, k \neq j \quad (2)$$

where I is the set of choices (tenants) available to the landlord and π_{ij} the profit of plot i with tenant j. We allow the profit of plot i, to differ between tenants as the productive assets of the tenant are likely to affect this profit. The productive assets of the tenant are exogenous to the landlord. The productive assets of the tenant will affect both the profit of the plot and the reservation utility of the tenant, which will affect the landlord's choice in opposite directions. Given that ε_{ij} is unobservable for the econometrician, we define the probability

$$\tilde{s}_{ij}^{*} = \tilde{s}_{ij}^{*}(\Delta_{ij}, P_i, p_i) = \Pr ob(s_{ij}^{*} = 1)$$

and the model becomes: $\delta_{ij} = 1$ if

$$p_{ij} - \overline{U_{-ij}} - \tilde{s}_{ij}^{*}\left[s(P_i) * \sum_{t=1}^{\infty} d^{t-1} p_i\right] \geq p_{ik} - \overline{U_{-ik}} - \tilde{s}_{ik}^{*}\left[s(P_i) * \sum_{t=1}^{\infty} d^{t-1} p_i\right] \quad \forall k \in I, k \neq j \quad (3)$$

4.2. Empirical specification

The importance of endogenous partner choice for explaining economic outcomes has been incorporated in recent studies in different areas of economic activity, such as fertility (Rosenzweig, 1999), children's education (Foster, 1998; Liu and Zhang, 1999), intergenerational transmission of religious traits (Bisin, Topa and Verdier, 2000) and choice of the rental contract (Ackerberg and Boticelli, 2000). These studies all focus on assortative matching along a certain trait and hence do not allow testing for different variables that might influence the 2-sided utility maximization matching process.

Little empirical work on matching has been done that considers matching along more than one trait at once at the individual level. However, two recent papers empirically estimate the determinants of matching in the marriage market, to test for Becker's hypothesis of assortative mating. Jepsen and Jepsen (1999) estimate a conditional logit model, modeling the matching process as a choice by one of the partners, determined by the absolute value of the differences in traits to compare the relationship of the traits of the choices to the traits of the choser. They model the matching process as a one-directional decision process, and do not account for utility maximization of the other side, nor for the competition in the market. In large markets the effect of such competition (i.e. the probability that your preferred match is all ready matched with somebody else that he/she prefers) is likely to be negligible. Yet, in thinner markets this might not be the case. Furthermore, partner selection differs from a discrete choice problem because the choice of a spouse is mutual and because different individuals can not chose the same alternative. Suen and Li (1999) explore a method that does not build on such an assumption, but is instead

directly derived from the Becker model of efficient competitive matching in the marriage market. Specifically, Becker's result that the marriage market maximizes marital output provides a framework for estimating a model of spouse selection. This model has the advantage that it takes the reservation utility of the potential partners into account. However, it draws on the assumption of efficiency in the market and does not allow including the non-chosen alternatives in the estimation.

Based on our theoretical model, we model the tenant choice made by the landlord for each plot, based on utility maximization, in a conditional logit framework, but allowing for the utility maximization by the tenants. The conditional logit allows estimating how the characteristics of the alternative (i.e. the tenant), as relevant for the landlord, affect the choice of the landlord. We define the probability that a landlord chooses tenant j for his plot i as

$$P(d_{ij}=1)=\frac{e^{E(U_{ij})}}{\sum_{k\in I} e^{E(U_{ik})}}=\frac{e^{X_{ij}b}}{\sum_{k\in I} e^{X_{ik}b}} \qquad (4)$$

where $E(U_{ij})$ is the expected utility the landlord derives from renting out plot i to tenant j, X_{ij} is the vector of characteristics of the partnership created by matching the landlord of plot i with tenant j, β is the vector of coefficients to estimate and *I* the set of all potential partners for i. The set of potential partners are all households from the community who are renting in land, and all the households in the community that are willing to rent in land (at the most common contract in the community). Note that by modeling the probability of a certain match as a function of all possible matches, we account for the distribution of the relevant traits in the population. All possible matches are obtained by matching the landlord-plot i with all potential tenants in the community.[10] The expectation of the utility of the landlord depends on the probability of losing the land through squatting.

We specify X_{ij} based on equation (3) and accounting for the fact that terms containing only landlord-plot characteristics will cancel out, due to the conditional logit framework. We use a linear approximation for the term in between the square brackets in (3). As a measure of social distance between the landlord and the tenant the absolute value of the difference in living standard group ($DCLASS_{ij}$) or land ownership ($DLAND_{ij}$) is used.[11] As measures of insecurity of property rights we define the dummy variables $TITLE_i$, $LOTFAM_i$ and $CONFLICTS_i$. $TITLE_i$ takes the value of 1 if the plot has a title and measures the formal strength property right of the plot. $LOTFAM_i$ takes the value of one if the landlord has a lot of family in the community, and is a proxy for the informal strength of the property right. $CONFLICTS_i$ takes the value of one if there were cases of squatting or landoccupations in the last 5 years in the community. These terms enter as interaction terms, in keep with our hypothesis that social distance matters more the higher the insecurity of property rights. Furthermore, the model predicts that social distance should also matter more the higher the profit associated with the plot, so we include interaction terms SUP_i, the surface of the plot, and IRR_i, a dummy for whether the plot has the potential of being

[10] Given that the communities are located at small distances from each other, one could also consider all potential tenants in the region (or in neighboring communities). This approach was not followed because the number of across-community matches is rather small (37) and as this would increase the number of non-realized matches considerably. Furthermore, it would rely on the arbitrary definition of the geographically closed area of the survey as being the relevant region for matching of landlords and tenants.

[11] Unfortunately, we do not have information on kinship relationships with households other than the actual tenants, and hence we cannot account for positive assortative matching along kinship. The difference in living standard class is defined as 1 for matches between people with a regular and high livingstandard, or with a low and regular livingstandard, and is defined as 2 for matches between high and low livingstandards.

irrigated.[12] Finally, to allow for regional differences in the effects of social distance, an interaction term with the regional dummy, RR_i (which equals1 for the rice region) was added

To account for the tenants characteristics that determine the expected profit for the landlord and the reservation utility of the tenant, variables measuring the tenants productive assets, education level ($EDUC_j$), age of the household head (AGE_j), number of adult household members, ($LABOR_j$), machinery ownership ($MACH_j$), female household head ($FEMALE_j$) and a variable measuring the number of other plots the tenant is cultivating, $OPLOT_{ij}$, are added. The empirical specification of the model to estimate becomes (4) with

$$
\begin{aligned}
X_{ij}B = \\
& b_1 + b_2(1 + g_0^o TITLE_i + g_1^o LOTFAM_i + g_2^0 CONFLICT_i + g_3^o SUP_i + g_3^o IRR_i + g_4^o RR_i) * DLAND_{ij} \\
& + b_3(1 + g_0^l TITLE_i + g_1^l LOTFAM_i + g_2^l CONFLICT_i + g_3^l SUP_i + g_3^l IRR_i + g_4^l RR_i) * DCLASS_{ij} \\
& + b_4 OPLOT_{ij} + d_1 EDUC_j + d_2 AGE_j + d_3 MACH_j + d_4 LABOR_j + d_5 FEMALE_j
\end{aligned}
$$

In order to test for other reasons for matching of tenants and landlords, we define an alternative specification. Specifically, we allow for matching of landowners and tenants along productive assets. Given that productive assets are substitutable inputs in the agricultural production function (e.g. machinery of the landlord can substitute for machinery of the tenant), Becker's theorem of assortative mating (1973) would lead to negative assortative matching along productive assets in the tenancy market. The intuition behind such negative assortative matching comes from the fact that tenants who own a lot of assets (e.g. machinery or skill) will have a higher reservation utility, because there is competition among landlords for these tenants. Those tenants will still be preferred by landlords with little assets, since the marginal value of the tenant's assets to production is high. However, landlords who themselves own such assets, will prefer tenants with less productive assets, as the marginal value of the tenant's assets for production will be lower, and the reservation utility of these tenants is lower. Therefore π_{ij} is expected to be a function of the absolute difference between the landlords and the tenant's assets. We allow for such matching along productive assets in an alternative specification, with X_{ij} also containing variables capturing the difference in productive assets. Specifically it will contain the absolute value of the difference in labor endowment, $DLABOR_{ij}$, machinery ownership, $DMACH_{ij}$, and human capital endowment, $DEDUC_{ij}$ (level of education of the household head) and $DAGE_{ij}$.(as a proxy for experience with farming). A positive coefficient for these variables would be consistent with negative matching along productive asset.

Hence, the "Becker" specification becomes

$$
\begin{aligned}
X_{ij}B = \\
& b_1 + b_2(1 + g_0^o TITLE_i + g_1^o LOTFAM_i + g_2^0 CONFLICT_i + g_3^o SUP_i + g_3^o IRR_i + g_4^o RR_i) * DLAND_{ij} \\
& + b_3(1 + g_0^l TITLE_i + g_1^l LOTFAM_i + g_2^l CONFLICT_i + g_3^l SUP_i + g_3^l IRR_i + g_4^l RR_i) * DCLASS_{ij} \\
& + b_4 OPLOT_{ij} + d_1 EDUC_j + d_2 AGE_j + d_3 MACH_j + d_4 LABOR_j + d_5 FEMALE_j \\
& + c_1 DEDUC_{ij} + c_2 DLABOR_{ij} + c_3 DAGE_{ij} + c_4 DMACH_{ij}
\end{aligned}
$$

[12] In our sample, given that ownership of a title is largely determined by different historical events that were beyond the control of the current possessors, title can be treated as an exogenous variable. Conflicts are a community level variable and therefore also exogenous to the household. The irrigation variable reflects the proximity to a irrigation canal or natural stream, and is hence also exogenous.

In the above specifications, a possible endogeneity bias might result if there is an unobservable that is correlated both with the probability of the match, and with one of the unobserved tenant characteristics. Therefore, in an alternative specification, tenant fixed effects are included instead of the tenant characteristics to account for the reservation utility of the tenant. In this specification, however, another potential problem arises with the conditional logit estimation due to the fact that in the tenancy market the choices of different landlords are likely to be correlated. If one landlord chooses a certain tenant, this reduces the probability of other landlords choosing the same tenant and hence errors across choosers are negatively correlated and not independent.[13] The estimates with the tenant fixed effects therefore are quasi-maximum likelihood estimations, giving consistent, but not efficient, results.

4.3. Estimation results

The first column in table 7 reports the results for the first specification.[14] In line with our hypothesis, we find that the presence of conflicts reduces the likelihood of renting out to people whose livingstandard is different, and that the presence of a lot of family within the community increases the likelihood of renting out to people from a different landownership class or livingstandard class. The presence of a lot of family in the community is likely to increase the possibilities of contract enforcement, both, directly, because it increases the likelihood of renting out to a family member, and indirectly, because the presence of a lot of family members in the community can help landlords enforce contracts with third parties, as it increases the costs (loss of social benefits) for tenants of squatting.

As expected, landlords are less likely to rent out to tenants who all ready cultivate other plots, while they are more likely to rent out to higher educated male household heads who own machinery. This suggests that the positive effect of the productive assets on the expected profit of the landlord compensates the negative effect through the reservation utility. Finally, we find that large plots are less likely to be traded across living standard groups, which is consistent with our model. However, the results also show a positive effect of plotsize on trading across landownership class.

In table 7, we do not find a significant effect for the interaction terms with title. However, if we estimate the model for the rice region separately, a significant effect of title is found (table 8). This can be explained by the fact that the results for the 2 regions together are largely driven by the results of the horticultural region, as there are many more land rental contracts there. On the other hand, we do not find a significant effect of the presence of a lot of family in the rice region. A possible explanation for this difference between regions is that in the rice region, where there is a long history of land conflicts, the role of traditional informal mechanisms to enforce property rights, has eroded. In such an environment, the ownership of titles, and hence legally enforceable property rights, becomes more important. Also, in the horticultural region, almost all the plots that are rented out (90%) have a title, which might further explain why we do not find an effect of titles in this region (see table 9). Further comparison of the results in table 8 and 9, shows that the productive assets of the tenant have a much more important effect in the horticultural region. This is probably due to the fact that in this region with a very intensive production system, the productive assets of the tenant play a larger role in determining profits.

Testing for alternative reasons for matching in the tenancy market

In the second column of table 7, 8 and 9, we report the results of the second specification, to test for assortative matching along productive assets. There is some evidence of landowners with machinery favoring tenants without, and vice versa, but only at the 10% level. For the other productive assets we do not find any significant result. The results in the second column of table 9 also show that landlords are more likely to match with tenants who have a similar number of household members. This result contradicts the Becker hypothesis, and might indicate again the role of informal contract enforcement,

[13] This negative correlation does not occur in the first specification, due to the inclusion of the variable OPLOTij. This variable can however not be included together with the fixed effects, due to collinearity.

[14] In the interpretation of the results, it is important to point out, that while measurement error is likely to be higher in data collected using the indirect survey approach, random measurement error will cause our estimates to be attenuated towards zero.

which might be more difficult if the tenant has much more household members than the landlord. The coefficients of the other variables are robust to the changes in specification.

By measuring the social distance as an absolute value of the difference between the landlord and the tenant characteristics, we have assumed the effect of social distance to be independent from the direction of the difference. To test for possible asymmetries, we estimated the model allowing the coefficient of each difference to differ depending on the direction. Only the coefficients of the interaction terms with the plot size were significantly different from each other. In table 10, we report the estimations for the horticultural region, allowing the coefficient for these interaction terms to differ. We first note that this does not alter the effects of the insecurity of property rights. Moreover, these estimations show that the positive effect of the plotsize on difference in landownership is due to smaller landowners giving their larger plots to larger landowners. This pattern of reverse rental can also be seen from poor landowners to richer tenants, and is likely to be driven by the need for large asset endowments to work those larger plots. The negative effect of plotsize on matching between richer landlords and poorer tenants is consistent with rich landlords preferring to trade within their circle of confidence for plots with higher values.

We also tested whether there is an asymmetric effect of differences in assets between tenants and landlords. The coefficients of the difference in education and the difference in machinery ownership vary significantly depending on the direction of the difference. The signs in the 2nd column of table 10 however mainly confirm earlier findings, i.e. that all landlords prefer renting out their land to tenants with higher education and machinery ownership. In this specification, we also allowed the coefficients of the difference in the number of household members to differ. Although we can not reject the hypothesis that the 2 coefficients are equal, the result does show that the negative sign of the difference in the number of household members in table 9 is driven by the fact that landlords with small households prefer not to rent out to tenants with large households. This is consistent with the interpretation of this variable as capturing another informal enforcement mechanism.

Robustness checks

Table 11 and 12 report the results of the estimates with the tenant fixed effects. In these estimations, the set of potential matches for each landlord is restricted to the actual tenants in the community since the fixed effects cannot be identified for the households that don't rent in from any landlord. In addition, we cannot estimate the effect of land conflicts on the matching across group, because of within-group collinearity with the fixed effects. Focussing hence on the plot specific tenure security measures, the estimations show that the effect of title on matching across landownership class in the rice region, and the effects of family protection on matching across landownership and livingstandard class in the horticultural reason, are robust to including the fixed effects. Also the significance of the other variables remains.

To further test the robustness of our findings we estimated the model with alternative measures of the distance in land ownership (not reported). We re-estimate the model taking the logarithm of the difference in landownership or the square root of the difference, because taking the absolute value of land ownership might lead the results to be driven by a few very large distances, The results are robust to these different specifications. Estimating the model excluding the 5% largest differences in landownership also does not alter the findings, further showing that the results are not driven by a few large outliers. The results are also robust to replacing the conflict dummy, with an index of conflicts, which accounts for the presence of different types of conflicts in the community.

5. Conclusions

This paper has been motivated by the observation that land rental markets in Latin America are small and segmented. In other regions, land rental markets have fulfilled important efficiency and equity functions. The observed atrophy and segmentation in Latin America suggests that there exists an

important missed opportunity to improve the performance of agriculture and to combat rural poverty through rentals. As opposed to other parts of the world where access to land has been promoted through the regulation of land rental contracts, the issue of access to land in Latin America has focused on a long history of state-led expropriative land reforms and, more recently, on land market-assisted land reforms (Deininger, 1997), focusing in all cases on access to land in ownership and suppressing access to land through rental arrangements. The observation of relatively inactive and distorted land rental markets suggests that the policy focus on access to land needs to go beyond land reform and land ownership toward enhancing contractual forms of access to land that are less politically demanding than expropriative land reform, cheaper than land market-assisted land reform, and more progressive than the free operation of land sales markets.

To understand the determinants of access to land through the land rental market in a Latin American context, this paper uses new survey data from the Dominican Republic. Results from these surveys show that while the land rental markets play an equalizing function between the distribution of land in ownership and use, the likelihood of renting is increased by the security of property rights in the community and a lower incidence of conflicts over access to land. Moreover, insecurity of property rights constrains the equalizing potential of the land rental market as it induces positive assortative matching along socio-economic group. Hence, in the absence of secure property rights, a segmented rental market results, limiting access to land for the landless and the land-poor. Our results also show that those who rent in are not the poorest since they need working capital (especially machinery) and some education. Land rental markets thus concentrate land among a middle class of endowed tenants.

These findings point to specific policy recommendations to enhance the scope of land rental markets and make these markets more effective for efficiency gains and poverty reduction stress three elements. The first is the importance of strengthening property rights through both formal and informal mechanisms. In many cases, weakness of property rights affecting rental is due to lingering land reform legislation that has in general fallen into disuse from its initial purpose of land redistribution in ownership. However it remains a threat in letting land to be used by tenants, as it opens the possibility of rewarding squatting or land occupations. It is urgent to revise this legislation which is creating a loss-loss situation: it no longer helps the poor gain access to land through ownership, and it blocks them from accessing land in rental. In other cases, weakness of property rights is due to incomplete land titling programs. Our results suggest that the establishment of secure formal titles is particularly important in regions where a history of land conflicts might have eroded the role of informal enforcement mechanisms. Furthermore, it is important to explore and enhance reliable, low-cost conflict resolution mechanisms. Our results show that the existence of conflicts over land in a community is a major deterrent to rentals. Contracting cannot occur without anticipating the emergence of conflicts and the mechanisms through which they may be resolved.

Finally, if the land rental market is to serve as an effective instrument for poverty reduction, the performance of this market needs to be "assisted" on behalf of poor participants, in the same perspective as land market-assisted land reform for access to land in ownership. This would include helping poor candidates secure the threshold asset endowments needed to enter this market. It would also include the development of innovative institutional arrangements such as group rentals, rental with option to buy, and community supervision of rental transactions to both secure the rights of the landlord and enhance the bargaining position of the tenant.

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Table 1: Descriptive statistics for two survey regions

	Horticultural region Constanza	Rice region SF de Macoris
HOUSEHOLDS		
Total number of households	1092	1431
% landlord households	20	10
% tenant households	25	11
% autarkic households	11	21
% landless households	43	58
% land constrained households	45	63
LAND		
Total number of plots	667	658
% plots owner-operated	36	64
% plots rented out	64	36
% plots rented out to family	32	53
% plots rented out to non-family	68	47
% plots in land reform	9	68
% plots with registered public title	75	33
% plots with registered public or land reform title	84	71
COMMUNITIES		
Total number of communities	8	10
% communities with "fear" as main reason for non rental	0	90
% communities with few invasions/occupations	25	30
% communities with a lot of invasions/occupations	0	20
% communities with a few cases of squatting	50	50
% communities with a lot of cases of squatting	0	10
% communities with few other conflicts	50	20
% communities with a lot of other conflicts	0	20

Table 2: Descriptive statistics for all households

	landlord	autarkic[o]	tenants	landless[o]
No. observations	365	207	463	703
DEMOGRAPHICS				
Average age of head	58	53	43	43
% female headed households	29	17	6	30
HUMAN CAPITAL				
Average education of head*	1.61	1.52	1.89	1.61
Average number of adults in household	2.34	2.57	2.39	2.05
Average number of international migrants	0.32	0.19	0.07	0.08
LAND AND PHYSICAL CAPITAL				
Average land owned/adult member (ha/pers)	2.27	1.09	0.31	0
Average land cultivated/adult member (ha/pers)	0.97	1.09	1.48	0
Average number of cattle	3.17	0.95	1.19	0.02
% of households with machinery	15	16	18	3
SOCIAL CAPITAL				
Average number of years lived in community	46	43	35	36
% of households that are member of a community organization	39	56	41	32
% of households that are leader of a community organization	16	19	16	9
LIVING STANDARD				
% of households with good living standard	22	11	20	3
% of households with regular living standard	40	46	48	25
% of households with bad living standard	30	38	27	55
% of households with very bad living standard	7	5	6	13
Average "Living standard index"**	2.79	2.63	2.82	2.19
LAND RENTAL MARKET CONSTRAINT				
% of households that want to rent in (more) land	-	52	76	67
% of households that want to rent out (more) land	4	9	-	-

º Data are weighted to account for sampling probabilities

* Education is ranked from 1 to 4 (1 =less than primary school, 2 = primary school; 3 = secondary school, 4 = higher education)

** Living standard is ranked from 1 to 4 (1 = very bad; 2 = bad; 3 = regular; 4 = good)

Table 3: Determinants of renting in land: weighted probit estimation

	Mean Var.	Marginal Effect	Marginal Effect
Tenant's assets			
Amount of land owned (ha)	1.16	-0.003	-0.003
		(1.36)	(1.29)
No land owned	0.65	0.090***	0.094***
		(4.75)	(5.00)
Education household head	1.65	0.193***	0.183***
		(4.04)	(3.80)
Square education household head	3.18	-0.032***	-0.030***
		(2.89)	(2.69)
Household members living in other countries	0.13	-0.019	-0.014
		(0.92)	(0.70)
Own machinery of younger than 35	0.03	0.181***	0.170***
		(3.14)	(3.00)
# of household members	2.24		0.009
			(1.14)
Member of a community organization	0.54		0.053***
			(3.21)
Age household head	46.81	0.000	0.000
		(0.63)	(0.09)
Female household head	0.23	-0.140***	-0.136***
		(7.25)	(6.92)
Insecurity of property rights			
Share of parcels without title in community	0.24	-0.096**	-0.094*
		(1.98)	(1.94)
Land conflicts in community	0.72	-0.128***	-0.127***
		(5.73)	(5.68)
Many familymembers in community	0.60	0.016	0.013
		(0.95)	(0.75)
Number of parcels owned by the same livingstandard	39.42	0.002***	0.002***
		(5.67)	(5.55)
Control variables			
Total of non-agricultural employment	33.63	-0.001***	-0.001***
		(3.01)	(2.98)
Distance to market (minutes)	23.41	0.003***	0.002***
		(3.18)	(2.89)
Rice region	0.57	-0.101***	-0.112***
		(3.62)	(3.89)
Observations		1688	1688
LR chi^2		279.85	297.73
Pseudo R^2		0.16	0.17
Average predicted probability if prob=0		0.16	0.17
Average predicted probability if prob=1		0.32	0.33

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Determinants of renting in land: supply and demand (weighted heckit estimation)

	Mean Var.	Prob. of wanting to rent in Marg. Effects	Prob. of renting in, if want to Marg. Effects
Tenant's assets			
Amount of land owned (ha)	1.16	-0.009	-0.005
		(1.15)	(0.54)
No land owned	0.65	0.325***	-0.053
		(8.15)	(0.59)
Education household head	1.65	0.321***	0.113***
		(2.98)	(3.91)
Square education household head	3.18	-0.081***	
		(2.98)	
Household members living in other countries	0.13	0.018	-0.064
		(0.56)	(1.3)
Own machinery of younger than 35	0.03	-0.118	0.295***
		(1.17)	(2.88)
# of household members	2.24	0.061***	-0.019
		(3.39)	(0.81)
Member of a community organization	0.54	0.114***	0.001
		(3.36)	(0.03)
Age household head	46.81	-0.010***	0.005*
		(7.48)	(1.93)
Female household head	0.23	-0.362***	-0.079
		(8.43)	(0.71)
Insecurity of property rights			
Share of parcels without title in community	0.24	0.159	-0.329***
		(1.53)	(3.1)
Land conflicts in community	0.72	-0.007	-0.157***
		(0.16)	(3.3)
Many familymembers in community	0.60	-0.043	0.030
		(1.26)	(0.82)
Number of parcels owned by the same livingstandard	39.42	0.000	0.002***
		(0.24)	(3.75)
Control variables			
Total of non-agricultural employment	33.63	-0.002**	-0.001
		(2.39)	(1.24)
Distance to market (minutes)	23.41	0.000	0.005***
		(0.05)	(2.9)
Rice region	0.57	0.312***	-0.327***
		(5.76)	(4.63)
Observations		1688	889
Selection coefficient			-0.606
Wald chi^2			224.09
Wald test of indep. eqns. Prob > chi^2 =			0.1458
Average predicted probability if prob=0		0.38	0.31
Average predicted probability if prob=1		0.69	0.50

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Determinants of renting out land: weighted probit estimation

	Means var.	Marginal Effects	Marginal Effects
Landlord's assets			
Amount of land owned (ha)	5.44	0.006*	0.005*
		[1.88]	[1.84]
Education household head	1.63	-0.055	-0.067
		[0.51]	[0.62]
Square education household head	3.06	0.018	0.020
		[0.74]	[0.81]
Household members living in other countries	0.30	0.039*	0.041*
		[1.71]	[1.80]
Age household head	56.63	0.008***	0.008***
		[5.46]	[5.40]
Female household head	0.21	0.292***	0.300***
		[6.13]	[6.41]
# household members	2.55	-0.05***	
		[2.95]	
Member of a community organization	0.60	-0.106**	
		[2.57]	
Plot characteristics			
Plot size (ha)	2.58	-0.024***	-0.021***
		[3.65]	[3.34]
Irrigated plot	0.45	0.062	0.053
		[1.47]	[1.27]
Insecurity of property rights			
Plot with title	0.77	0.09*	0.106**
		[1.81]	[2.11]
Land conflicts	0.75	-0.129***	-0.115**
		[2.65]	[2.43]
Many family members in the community	0.54	-0.036	-0.051
		[0.91]	[1.29]
# potential tenants with the same livingstandard	50.91	0.003***	0.002***
		[3.80]	[3.64]
Control variables			
Total of non-agricultural employment	31.51	-0.001	-0.002
		[1.36]	[1.42]
Distance to market (minutes)	22.75	-0.002	-0.002
		[0.94]	[1.29]
Rice region	0.52	-0.285***	-0.300***
		[4.04]	[4.46]
Observations		860	860
LR chi^2		206.44	205.86
Pseudo R^2		0.21	0.19
Average predicted probability if prob=0		0.31	0.32
Average predicted probability if prob=1		0.57	0.56

Robust z statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6a. Distribution of transactions by living standard of tenant and landlord in communities with recent land occupations

		Living standard tenant			
		Low	Regular	High	Total
Living standard landlord	Low	52%	41%	7%	100%(46)
	Regular	21%	52%	27%	100% (70)
	High	7%	33%	60%	100% (45)
Total		26%	43%	30%	100%(161)

Table 6b. Distribution of transactions by living standard of tenant and landlord in communities without recent land occupations

		Living standard tenant			
		Low	Regular	High	Total
Living standard landlord	Low	33%	48%	19%	100% (54)
	Regular	25%	45%	30%	100% (47)
	High	41%	36%	23%	100%(39)
Total		33%	43%	24%	100%(140)

Table 6c. Distribution of area transacted by living standard of tenant and landlord (all communities)

		Living standard tenant			
		Low	Regular	High	Total
Living standard landlord	Low	24%	42%	24%	100%
	Regular	18%	46%	36%	100%
	High	11%	27%	61%	100%
Total		19%	37%	43%	100%

Table 7: Determinants of matching in the tenancy market in 2 regions in the DR

	Cond. prob. match between landlord-plot i and tenant j	Cond. prob. match between landlord-plot i and tenant j
Social distance (and interaction terms)		
|Δ land owned|	-0.085	-0.093
	(0.69)	(0.76)
| Δ land owned|*title	0.028	0.033
	(0.31)	(0.35)
| Δ land owned|*family protection	0.097*	0.102*
	(1.81)	(1.89)
| Δ land owned|*land conflict	-0.031	-0.037
	(0.39)	(0.47)
| Δ land owned|*plotsize	0.032**	0.032**
	(2.04)	(2.02)
| Δ land owned|*irrigated plot	-0.033	-0.032
	(0.56)	(0.53)
| Δ land owned|*rice region	-0.013	-0.013
	(0.20)	(0.20)
| Δ livingstandard|	0.353	0.324
	(1.11)	(1.02)
| Δ livingstandard|*title	-0.244	-0.218
	(0.80)	(0.71)
| Δ livingstandard|*family protection	0.510**	0.488**
	(2.47)	(2.35)
| Δ livingstandard|*land conflict	-0.583***	-0.559***
	(2.75)	(2.62)
| Δ livingstandard|*plotsize	-0.079	-0.094*
	(1.46)	(1.71)
| Δ livingstandard|*irrigated plot	-0.070	-0.048
	(0.28)	(0.19)
| Δ livingstandard|*rice region	-0.097	-0.084
	(0.37)	(0.32)
Tenant's assets		
# other parcels cultivated	-0.099*	-0.086
	(1.71)	(1.47)
Age household head	-0.009	-0.005
	(1.58)	(0.64)
Female household head	-0.577**	-0.559**
	(2.11)	(2.04)
Education household head	0.491***	0.540***
	(4.95)	(3.92)
Machinery ownership	1.024***	0.829***
	(6.24)	(4.31)
# of adults in household	0.004	0.042
	(0.05)	(0.52)
Difference in productive assets		
| Δ education household head|		-0.097
		(0.70)
| Δ # household members|		-0.102
		(1.19)
| Δ age household head|		0.008
		(0.94)
| Δ machinery ownership|		0.320*
		(1.84)
Observations	23182	23088
# of landlord-plots	290	289
Average # of potential tenants per plot	80	80
LR chi^2	126.96	130.07
Pseudo R^2	0.05	0.05

Absolute value of z statistics in parentheses ; * significant at 10%; ** significant at 5%; *** significant at 1%
All potential tenants in same community included

Table 8: Determinants of matching in the tenancy market in the rice region

	Cond.prob. match between landlord-plot i and tenant j	Cond.prob. match between landlord-plot i and tenant j
Social distance (and interaction terms)		
| Δ land owned|	-0.873*	-0.868*
	(1.81)	(1.79)
| Δ land owned|*title	0.943**	0.938**
	(2.41)	(2.40)
| Δ land owned|*family protection	-0.108	-0.112
	(0.50)	(0.51)
| Δ land owned|*land conflict	0.021	0.025
	(0.08)	(0.10)
| Δ land owned|*plotsize	0.048	0.045
	(0.46)	(0.44)
| Δ land owned|*irrigated plot	0.128	0.132
	(0.49)	(0.51)
| Δ livingstandard|	0.246	0.260
	(0.34)	(0.36)
| Δ livingstandard|*title	-0.273	-0.261
	(0.48)	(0.46)
| Δ livingstandard|*family protection	0.366	0.368
	(0.90)	(0.90)
| Δ livingstandard|*land conflict	-0.842*	-0.851*
	(1.86)	(1.87)
| Δ livingstandard|*plotsize	-0.000	-0.007
	(0.00)	(0.05)
| Δ livingstandard|*irrigated plot	0.062	0.063
	(0.13)	(0.13)
Tenant's assets		
# other parcels cultivated	0.066	0.062
	(0.58)	(0.54)
Age household head	-0.018	-0.018
	(1.59)	(0.87)
Female household head	-0.194	-0.180
	(0.57)	(0.53)
Education household head	0.419***	0.516*
	(2.63)	(1.95)
Machinery ownership	0.727*	0.733*
	(1.88)	(1.88)
# of adults in household	0.282**	0.224
	(2.01)	(1.35)
Difference in productive assets		
| Δ education household head|		-0.116
		(0.43)
| Δ # household members|		0.115
		(0.65)
| Δ age household head|		0.000
		(0.00)
Observations	4962	4962
# of landlord-plots	86	86
Average # of potential tenants per plot	58	58
LR chi^2	39.53	40.11
Pseudo R^2	0.06	0.06

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All potential tenants in same community included

Table 9: Determinants of matching in the tenancy market in the horticulture region

	Cond.prob. match between landlord-plot i and tenant j	Cond.prob. match between landlord-plot i and tenant j
Social distance (and interaction terms)		
| Δ land owned|	-0.085	-0.084
	(0.71)	(0.71)
| Δ land owned|*title	0.006	0.010
	(0.07)	(0.12)
| Δ land owned|*family protection	0.106*	0.109*
	(1.91)	(1.96)
| Δ land owned|*land conflict	-0.004	-0.016
	(0.04)	(0.19)
| Δ land owned|*plotsize	0.028*	0.028*
	(1.74)	(1.70)
| Δ land owned|*irrigated plot	-0.044	-0.043
	(0.72)	(0.69)
| Δ livingstandard|	0.339	0.304
	(0.91)	(0.82)
| Δ livingstandard|*title	-0.270	-0.238
	(0.72)	(0.63)
| Δ livingstandard|*family protection	0.593**	0.559**
	(2.48)	(2.32)
| Δ livingstandard|*land conflict	-0.476**	-0.434*
	(1.97)	(1.78)
| Δ livingstandard|*plotsize	-0.091	-0.106*
	(1.54)	(1.74)
| Δ livingstandard|*irrigated plot	-0.204	-0.186
	(0.68)	(0.62)
Tenant's assets		
# other parcels cultivated	-0.198***	-0.189***
	(2.84)	(2.69)
Age household head	-0.005	-0.001
	(0.74)	(0.14)
Female household head	-1.117**	-1.105**
	(2.19)	(2.16)
Education household head	0.547***	0.584***
	(4.25)	(3.52)
Machinery ownership	1.159***	1.001***
	(6.28)	(4.85)
# of adults in household	-0.116	-0.066
	(1.30)	(0.68)
Difference in productive assets		
| Δ education household head|		-0.077
		(0.46)
| Δ # household members|		-0.227**
		(2.18)
| Δ age household head|		0.008
		(0.88)
| Δ machinery ownership|		0.279
		(1.53)
Observations	18220	18126
# of landlord-plots	204	203
Average # of potential tenants per plot	89	89
LR chi^2	110.91	115.19
Pseudo R^2	0.06	0.07

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All potential tenants in same community included

Table 10: Determinants of matching in the horticulture region-specification allowing for asymmetries

	Cond.prob. match between landlord-plot i and tenant j	
Social distance (and interaction terms)		
| Δ land owned|	-0.073	-0.066
	(0.64)	(0.59)
| Δ land owned|*title	0.009	0.007
	(0.11)	(0.09)
| Δ land owned|*family protection	0.096*	0.101**
	(1.92)	(1.98)
| Δ land owned|*land conflict	-0.005	-0.018
	(0.06)	(0.22)
| Δ land owned|*plotsize if from big to small	0.001	0.001
	(0.99)	(0.91)
| Δ land owned|*plotsize if from small to big	0.002**	0.002**
	(2.13)	(2.12)
| Δ land owned|*irrigated plot	-0.025	-0.027
	(0.48)	(0.50)
| Δ livingstandard|	0.049	-0.001
	(0.13)	(0.00)
| Δ livingstandard|*title	-0.209	-0.175
	(0.55)	(0.46)
| Δ livingstandard|*family protection	0.519**	0.489*
	(2.10)	(1.96)
| Δ livingstandard|*land conflict	-0.567**	-0.514**
	(2.26)	(2.03)
| Δ livingstandard|*plotsize if from rich to poor	-0.009**	-0.011**
	(2.07)	(2.31)
| Δ livingstandard|*plotsize if from poor to rich	0.051***	0.050***
	(4.19)	(4.16)
| Δ livingstandard|*irrigated plot	-0.260	-0.220
	(0.83)	(0.70)
Tenant's assets		
# other parcels cultivated	-0.267***	-0.259***
	(3.66)	(3.52)
Age household head	-0.006	-0.005
	(0.78)	(0.75)
Female household head	-1.015**	-0.991*
	(1.98)	(1.93)
Education household head	0.471***	
	(3.63)	
Machinery ownership	0.843***	
	(4.39)	
# of adults in household	-0.134	
	(1.47)	
Difference in productive assets		
| Δ education household head| if from high to low		-0.559*
		(1.87)
| Δ education household head| if from low to high		0.421***
		(2.83)
| Δ machinery ownership| if from with to without		-0.297
		(0.87)
| Δ machinery ownership| if from without to with		1.003***
		(4.67)
| Δ # household members| if from many to few		-0.114
		(0.76)
| Δ # household members| if from few to many		-0.312**
		(2.26)
Observations	18220	18126
# of landlord-plots	204	203
Average # of potential tenants per plot	89	89
LR chi^2	151.59	156.46
Pseudo R^2	0.09	0.09

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

Table 11: Determinants of matching in the tenancy market in the rice region: Estimation with tenant fixed effects

	Cond.prob. match between landlord-plot i and tenant j	Cond.prob. match between landlord-plot i and tenant j
Social distance (and interaction terms)		
| Δ land owned|	-1.732	-1.126
	(1.36)	(0.61)
| Δ land owned|*title	1.949**	4.214**
	(2.13)	(2.06)
| Δ land owned|*family protection	0.466	2.266
	(0.77)	(1.27)
| Δ land owned|*plotsize	-0.042	-0.504
	(0.21)	(1.22)
| Δ land owned|*irrigated plot	0.866	0.669
	(0.89)	(0.47)
| Δ livingstandard|	0.967	0.753
	(1.09)	(0.83)
| Δ livingstandard|*title	-1.192	-1.146
	(1.44)	(1.34)
| Δ livingstandard|*family protection	0.067	-0.007
	(0.12)	(0.01)
| Δ livingstandard|*plotsize	-0.165	-0.138
	(0.78)	(0.64)
| Δ livingstandard|*irrigated plot	-0.833	-0.770
	(1.17)	(1.07)
Difference in productive assets		
| Δ education household head|		0.246
		(0.80)
| Δ # household members|		0.552
		(1.63)
| Δ age household head|		0.022
		(0.70)
Observations	842	842
# of landlord-plots	86	86
Average # of potential tenants per plot	10	10
LR chi^2	39.67	48.41
Pseudo R^2	0.11	0.13

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Only actual tenants in same community included; fixed effects are not reported

Table 12: Determinants of matching in the tenancy market in the horticulture region
Estimation with tenant fixed effects

	Cond.prob. match between landlord-plot i and tenant j	Cond.prob. match between landlord-plot i and tenant j
Social distance (and interaction terms)		
| Δ land owned|	-0.124**	-0.132**
	(2.00)	(2.07)
| Δ land owned|*family protection	0.121*	0.122*
	(1.75)	(1.71)
| Δ land owned|*plotsize	0.051**	0.050**
	(2.43)	(2.42)
| Δ land owned|*irrigated plot	-0.081	-0.071
	(1.06)	(0.96)
| Δ livingstandard|	-0.264	-0.229
	(1.20)	(1.02)
| Δ livingstandard|*family protection	0.459*	0.454*
	(1.75)	(1.71)
| Δ livingstandard|*plotsize	-0.091	-0.105
	(1.38)	(1.57)
| Δ livingstandard|*irrigated plot	-0.006	-0.022
	(0.02)	(0.07)
Difference in productive assets		
| Δ education household head|		-0.258
		(1.38)
| Δ # household members|		-0.244**
		(2.06)
| Δ age household head|		0.019*
		(1.64)
| Δ machinery ownership|		0.230
		(1.05)
Observations	6086	6066
# of landlord-plots	204	203
Average # of potential tenants per plot	30	30
LR chi^2	70.19	83.82
Pseudo R^2	0.0526	0.0633

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Only actual tenants in same community included; fixed effects are not reported