Insecurity of Property Rights and Social Matching
in the Tenancy Market

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Abstract

This paper shows how property rights insecurity can result in the reproduction of local inequalities because of social matching in assets markets. A principal-agent framework is used to model the landlord's decision to rent when he takes into account the risk of losing the land and contract enforcement is decreasing in social distance with his tenant. These effects are quantified for the case of local land rental markets in the Dominican Republic. Results show that insecure property rights lead to matching in the tenancy market along socio-economic lines, severely limiting access to land for the rural poor. Simulations suggest that improving tenure security would increase the total area rented to the poor by 63%. Property rights insecurity hence not only affects asset owners, but also those with whom they might interact in the market.

1. Introduction

Much attention has recently been given to the economic and social costs of high inequality in developing countries. It has been argued that the impact of growth on poverty reduction is smaller when inequality is larger (Ravallion, 2001), and various theoretical arguments also suggest that high inequality might hamper growth and investments (World Bank, 2005).[1] One of the most striking features about inequality is its resilience (De Ferranti et al., 2004). An important question to be addressed is therefore how inequality gets to be reproduced.

This paper provides evidence on one mechanism through which inequality is reproduced at the local level: the insecurity of property rights over agricultural land. It shows how such insecurity induces land rental market segmentation by social class, and as such reproduces inequality in access to land. This question is particularly relevant for Latin America, a region where income inequality is among the highest in the world (Bourguignon and Morrison, 2002) and, in rural areas, is closely related to inequality in access to land (De Ferranti et al., 2004).

We quantify this effect for local land rental markets in two regions of the Dominican Republic. For each local market, exhaustive records were collected on all land transactions with information on households on the two sides of the market, a large sample of non-participating households, and identification of potential tenants that were constrained out of the market. By simulating the effect of strengthening property rights on land rental market decisions, we show that large efficiency and equity gains can be achieved when formal titles are granted, land conflicts are reduced, and property rights are more effectively enforced. These simulations are based on an empirical estimation of the matching between landlords and tenants in these markets. The underlying theoretical model uses a principal-agent framework, in which the landlord chooses his tenant taking into account the incentive that the tenant has to squat and the risk that this would result in loss of the plot. Estimation results support the hypothesis that property rights insecurity not only reduces the level of activity on the land rental market, creating inefficiencies, but also affects the choice of tenant, confining land transactions within the same social class. Insecurity of property rights is then a powerful mechanism through which social inequalities are reproduced at the local level.

2. Security of property rights and inequality

The literature on security of property rights and inequality has evidenced the difference in insecurity between rich and poor, with the rich and powerful better able to protect their assets than the poor

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[1] The macro-empirical evidence based on cross-country growth remains however inconclusive (see Banerjee and Duflo, 2003).

(de Soto, 2000; Lanjouw and Levy, 2002; Goldstein and Udry, 2005). This difference can lead to the perpetuation of weak property rights institutions in unequal societies as rich elites are not necessarily interested in using the state to increase the security of property rights (Glaeser et al., 2003; Gradstein, 2007).

There is also a growing body of evidence showing the impact of security of property rights on investment and efficiency at the micro-level through their effects on investment incentives and access to credit for owners (Feder and Feeny, 1991; Besley, 1995; Jacoby, Li, and Rozelle (2002); Johnson, McMillan, and Woodruff, 2002). The relation can sometimes be negative: Braselle, Gaspart, and Platteau (2002) show how land tenure insecurity in Burkina Faso induces investment in tree planting as a way of establishing rights. In other cases, the relation is weak or socially confined: Do and Iyer (2007) find positive but small investment effects of a property rights reform in Vietnam, and Carter and Olinto (2003) show that greater property rights security only leads to positive investment effects among wealthier producers. But there is also evidence that the relation can be positive and large: Field (2005, 2007) and Galiani and Schargrodsky (2005) find positive effects of stronger property rights on labor supply and housing investments in urban squatting settings in Peru and Argentina. Di Tella et al. (2007) uncover a potentially important mechanism whereby this happens as property rights security enhances people's beliefs in the market economy.

A vicious circle of rising inequality can then emerge if inequality leads to differential property rights security between rich and poor (with weak interest from elites to strengthen property rights), which then induces (via incentives, access to credit, and beliefs) a growing divergence in investment and efficiency.

This paper uncovers a different channel through which property rights insecurity can lead to the perpetuation of inequality. It shows that property rights insecurity over productive assets can have an impact not only on direct use of assets by owners, but also on how they select households with whom they decide to interact in markets for these assets. As such it relates to papers that consider the effects of property rights insecurity on land market activity (Gine, 2005; Conning and Robinson, 2007). In this case, the risk of loss of the land to the tenant induces landlords to select households from the same social class, reproducing social inequalities. We recognize that insecurity can be caused not only by lack of formal titles but also by lack of informal enforcement of property rights and by the recent history of land conflicts.[2] The paper measures the extent to which land rental market activity can be socially biased as a consequence of the lack of formal or informal property rights, contributing to reproduce social inequalities.

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[2] Most papers in the literature focus either on the impact of formal titles or look at informal property rights. With the exception of Lanjouw and Levy (2002), the different dimensions of property rights security are often not considered together.

3. The land rental market and property rights insecurity in the Dominican Republic

The highly unequal distribution of land ownership in many Latin American countries suggests that there is room for redistribution of land under cultivation through the land rental market. Yet, only 12% of agricultural land is rented in Latin America and 14% in the Dominican Republic, as opposed to 67% in Belgium and 41% in the United States (FAO, 1981). Field observations provide plenty of evidence that land markets do not function well in the Dominican Republic. In our dataset, 64% of all households that do not rent to others would like to rent more land from others. In spite of this, casual observations in these communities suggest that there are extensive tracts of underused land, mainly in the hands of large landowners who use it at most for extensive grazing when it could be rented out more profitably.

Furthermore, Latin American land rental markets are often segmented, with the land being transacted mainly among people of the same socio-economic class (Carter and Chamorro (2001) for Nicaragua). We hypothesize that this segmentation deepens with insecurity of property rights. Table 1 shows the correspondence in living standards of landlords and their tenants in our survey, distinguishing between communities with and without recent land invasions.[3] The first panel shows that in communities with recent land invasions, there is a very strong positive assortative matching along living standards. More than half of the transactions are between members of the same class. Less than 7 % of the land transacted by the rich is rented out to the poor (low living standard), and vice versa. By contrast, transactions are more equally distributed across classes in communities without land invasions (second panel), with 41% of the plots rented out by the rich going to the poor. A Kolmogorov-Smirnov test confirms that the proportion of observations along the diagonal is larger in communities with recent land conflicts at the 1% significance level.

The insecurity of property rights that induces fear among landlords to lose their land is not unique to the Dominican Republic. It characterizes many Latin American countries with agrarian laws put into place during the period of state-led expropriative land reforms and institutional weaknesses in the land administration and judicial systems. These agrarian laws cause property rights insecurity because of regulations on land ownership (e.g., in many countries, laws grant ownership rights to occupants), or because of inconsistencies between constitutional constraints on land use to merit ownership and the Civil Code (e.g., Brazil and Venezuela). Lack of titles, outdated or overlapping titles, and slow, costly, and inaccessible legal systems further impede property rights security (Macours et al., 2002). In the Dominican Republic, land ownership and distribution have been affected by the different property rights regimes of successive foreign powers (Spanish, French, and United States) that were introduced without abolishing the

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[3] Section 4.3 explains how living standard classes are defined.

previous system, and by the redistributive land reform initiated in the 1960s that remained inconclusive. Within a few years of the reform, redistribution of expropriated land, although now officially owned by the Dominican state, was stalled and the former - often absentee - owners maintained possession of most of the property. This invited land invasions by the rural population who claims that this land is property of the Dominican people and hence fundamentally theirs. Legislation remains in place that allows for expropriation of under-used land, creating further incentives for land invasions (Gill, 2000). The resulting climate of property rights insecurity also induced squatting on other lands.

In the regions studied, invasions have had mixed results. In some cases, invaded land has been vacated by (military) force, but more often, invasions have led to some type of negotiated settlement, or long-term possession with continued uncertainty on property rights. In cases of squatting, property rights enforcement is also often weak, even when landlords have verifiable property rights. When a tenant seeks to squat, attempts to resolve the conflict can pass through different stages. First landlords might try to evict the tenant personally, possibly with the help of his family. In case this is unsuccessful, they might resort to community organizations to mediate the conflict. And in a next step, cases can be taken to court. The outcome of each of these processes is typically far from certain. Even in cases when landlords have verifiable property rights, enforcement can be weak, in part because the law often leaves room for competing claims. E.g., in a number of squatting cases that went through litigation, court decisions favored poor squatters over rich landlords, based on land reform legislation that provides strong rights to occupants. On the other hand, among the poor there is also a perception that the justice system in other cases has favored the rich.

There is a relatively strong correlation between the recent occurrence of land invasions, and squatting. Of the 18 communities in the dataset, 8 communities had a land invasion in the last 5 years, and in 7 of these 8 communities there were also cases of land squatting. And only 3 other communities of the remaining 10 had a case of squatting in the last 5 years. Extensive field interviews revealed that in communities with land invasions, local conflict resolution would often favor squatters, further increasing the incentives to squat, and therefore augmenting the general perception of property rights insecurity. It is important to note, however, that there is only a handful of plots on which tenants attempted to squat in any of these communities. This is not surprising given that landlords attempt to avoid such cases by carefully choosing their tenants.[4]

The impediments to land rental compound with the fact that land rental markets, by the very nature of the traded good, are local and small. Options are limited for landlords, and that is why they may end-up choosing not to rent-out. Conversely, potential tenants' opportunities to have access to a plot of land

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[4] Unfortunately, the dataset does not contain quantitative data on the specific number of squatting cases, or the likelihood of eviction in these cases.

are limited by the relationships they have with landlords in the community. 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 in the community, and on the institutional context that might influence the landlords' preferences.

4. Modeling the land rental market in the context of insecurity of property rights

To guide the empirical specification, we develop a model that focuses on enforcement through social ties as an explanation for the observed market segmentation. In deciding whom to rent out to, landlords take into account the probability of losing their land. They can pay a premium to reduce the incentive to squat.[5] We assume that enforcement against squatting is easier for members of the same socio-economic class, and that this holds for landlords from all classes.[6] This is because people from the same class depend on each others for various other interactions, such as loans, referrals on labor markets, and mutual insurance.

As markets are local, landlords in any village only face a limited number of potential tenants, and may have to compete for the best tenants. In equilibrium, each landlord's strategy must be optimal given the strategies of the other landlords. Because of the localized nature of land rental transactions, we assume that landlords and tenants have full information on asset ownership and on the productive capacity of all potential partners. The assumption of perfect information about these characteristics is warranted for village communities in the Dominican Republic, as information sharing (gossiping) is an inherent part of social life. Furthermore, in the last 10 years, few new households have immigrated into the communities studied here. Studies in other parts of the world find that information on attributes of others is widely available in village communities (Bardhan, 1984; Bell, 1988; and Lanjouw, 1999).

Ackerberg and Botticini (2002) pointed out the importance of accounting for endogenous matching between landlords and tenants when analyzing land rental markets. They account for matching along one trait and instrument using regional differences reflecting the context. Relatively little empirical work has been done on matching accounting for more than one trait at the individual level.[7] Two papers

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[5] In particular, landlords can provide incentives not to squat through the contract terms (e.g., by providing services to the tenants for the commercialization of their crops).

[6] Given that an alternative assumption might be that enforcement against squatting is only important for rich landlords renting to poor tenants, the empirical analysis will specifically test for such asymmetric effects.

[7] Most empirical work analyzing matching in the labor market estimates aggregate matching functions (explaining the number of matches in the labor market as a function of unemployment and vacancies), or individual transitions using panel data (see, e.g., Petrongolo and Pissarides (2001) for an overview). Some work on marriage market matching also models individual transitions (e.g., Wong, 2003).

empirically estimate the individual determinants of matching in the marriage market to test the hypothesis of assortative mating (Becker, 1973). Jepsen and Jepsen (2002) estimate a conditional logit that models the matching process as a choice by one of the partners, determined by the absolute value of the differences in traits between the chooser and potential matches. It therefore corresponds to a one-directional decision process that does not account for utility maximization of the other side, nor for competition in the market. In large markets, the effect of such competition (i.e., the probability that your preferred choice is already matched with somebody else that he/she prefers) is likely to be negligible. There always exists another potential partner with (almost) the same characteristics who will be a close substitute for the most preferred match. But, 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 cannot choose the same alternative. Suen and Lui (1999) explore a method that directly derives from the Becker model of efficient competitive matching in the marriage market, i.e, a matching process that maximizes marital output. This model has the advantage that it takes the reservation utility of potential partners into account, but does not allow including the non-chosen alternatives in the estimation.

In the local land markets that we consider here, many potential tenants end up not being matched to a landlord/plot. Our empirical specification is therefore based on a principal-agent model in which the landlord makes an offer to the tenant, and the tenant accepts or rejects. This modeling approach is justified by field observations that confirmed that it is the landlord who takes the first step and determines the terms of the contract. Competition among landlords comes through the reservation utility of tenants, as tenants that are wanted by many landlords will have a higher reservation utility. Hence, while our model is similar to Jepsen and Jepsen's in modeling the choice by one partner, it differs in accounting for the reservation utility of tenants and competition among landlords in the market. The model also incorporates the possibility of choosing not to match, and allows for matching along various characteristics.

4.1. Theoretical model

As few landlords in the dataset rent out more than one plot at a time, all landlord plot rental decisions are treated independently, and i designs both a landlord and his plot. The landlord-tenant relationship can be thought of as emerging from a two-step decision process (Figure 1). The landlord decides whether to rent out plot i or not and, if he chooses to rent, to which tenant j to offer the contract. He also decides the contract terms. He can offer the tenant a premium above his reservation utility to provide an incentive for non-squatting. Tenant j decides whether to squat, i.e., stay on the land and continue cultivating without paying the rent, or not to squat. The probability of success in squatting depends on the plot's property rights security. Squatting entails a cost in the loss of benefits from future social interactions.

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If squatting is successful, the tenant de facto keeps the land in perpetuity. If squatting fails, however, the tenant has to pay its due rent and return the land.
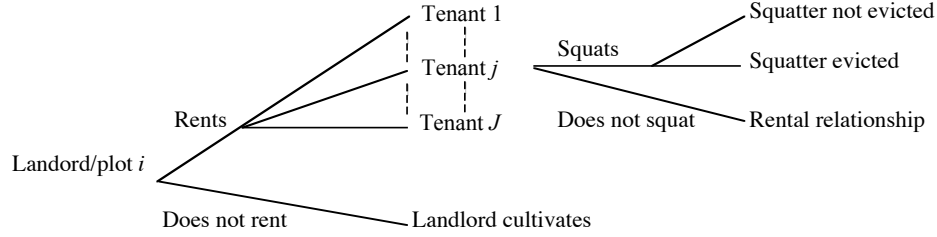

Figure 1. Landlord and tenant decisions and possible outcomes

The contractual arrangement is a rental contract for one period. The potential loss of land is however a long-term asset loss. Let $\bar{\pi}_i$ be the expected annual flow of income from the land (under the best possible arrangement) in a given market, for whoever controls the land.[8] We first solve for the tenant's decision, which will be anticipated by the landlord.

The tenant's decision to squat

Each tenant j has an opportunity cost w_j outside the rental market. Landlord i can choose to offer the tenant a premium dw_{ij} above his opportunity cost if he does not squat. By squatting, the tenant loses the benefit of future social interactions $R\left(\Delta_{ij}\right)$ that we assume to depend on the social distance Δ_{ij} between the landlord and the tenant. If squatting is successful, the tenant keeps the plot of land, which has a value of $\bar{\pi}_i$. If squatting fails, however, the tenant returns the land and must accept an income equal to his opportunity cost w_j. The expected return U to a tenant who decides to squat ($s_{ij} = 1$) is thus:

$$E\left(U|s_{ij} = 1\right) = \frac{1}{1-\delta}\left(\text{pr}\left(S_i = 1\right)\bar{\pi}_i + w_j - R\left(\Delta_{ij}\right)\right),$$

where $\text{pr}\left(S_i = 1\right)$ is the probability that squatting on plot i is successful, and δ the discount factor. If he does not squat, the tenant receives $w_j + dw_{ij}$, where dw_{ij} is the premium for not squatting. With an expectation of constant premium for not squatting, the tenant's decision to squat is expected to be the same

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[8] This life-time value of the plot could be endogenized in a dynamic model. The rental market would then be modeled as an annual repeated game, where a landlord chooses a tenant with the described process every year. However, unless one introduces some genuine dynamic process, the dynamic model gives no further insights than a static model. The tenant's decision to squat would be the same every year, and hence either he squats the first year or never squats. We therefore keep a simple static model.

every year, and hence either he squats the first year or never squats. The expected return under no squatting ($s_{ij} = 0$) is thus:

$$E\left(U \mid s_{ij} = 0\right) = \frac{1}{1-\delta}\left(w_j + dw_{ij}\right).$$

Assume some unobserved "distaste" for squatting ε_j in addition to these economic returns. The tenant's optimal decision is thus to:

$$\begin{cases} \text{squat} & s_{ij} = 1 \quad \text{if} \quad \text{pr}\left(S_i = 1\right)\bar{\pi}_i - R\left(\Delta_{ij}\right) - dw_{ij} - \varepsilon_j > 0 \\ \text{not squat} & s_{ij} = 0 \quad \text{otherwise} \end{cases} \tag{1}$$

The landlord's decision to rent out and the choice of tenant

The tenant decides to squat or not based on his best guess of future expected value and his taste for squatting. The taste for squatting of individual potential tenants is not known to the landlord.[9] Assuming that it follows a distribution with cumulative function $F(.)$, the landlord's appreciation of the risk that tenant j may squat on his plot i is given by:

$$\text{pr}\left(s_{ij} = 1\right) = F\left(\text{pr}\left(S_i = 1\right)\bar{\pi}_i - R\left(\Delta_{ij}\right) - dw_{ij}\right). \tag{2}$$

Knowing the squatting risk and productive capacity of all potential tenants, the landlord can proceed to compare alternative rental contracts.

Let π_{ij} be the net return to the land for the landlord when the land is cultivated under a rental agreement with tenant j, π_{i0} when exploited by the landlord alone.[10] The landlord's utilities for renting out plot i to tenant j, V_{ij}, and for not renting it, V_{i0}, are:

$$V_{ij} = \pi_{ij} + \frac{\delta}{1-\delta}\bar{\pi}_i - \left(1 - \text{pr}\left(s_{ij} = 1\right)\right)dw_{ij} - \text{pr}\left(s_{ij} = 1\right)\text{pr}\left(S_i = 1\right)\frac{\delta}{1-\delta}\bar{\pi}_i, \tag{3}$$

$$V_{i0} = \pi_{i0} + \frac{\delta}{1-\delta}\bar{\pi}_i. \tag{4}$$

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[9] Hence there is some asymmetric information, but – in contrast with most of the labor literature – it cannot be reduced through a costly search.

[10] π_{i0} is smaller or equal to $\bar{\pi}_i$ as the later refers to the return under the best possible arrangements, while the former refers to the return when the plot is cultivated by the landlord alone.

The landlord's problem consists in deciding to rent out or not, and if he decides to rent, in choosing j and the premium to offer this tenant in order to maximize expected utility from plot i:

$$EV_i = \max_{j=0,1,\dots,J} V_{ij}.$$ (5)

This can be solved in two steps. First, the landlord defines the optimal premium dw_{ij} to give any potential tenant j, should he decide to offer him a contract. This is the solution to maximizing (3), or:

$$\min_{dw_{ij}} \left(\left(1 - \mathrm{pr}\left(s_{ij} = 1\right)\right) dw_{ij} + \mathrm{pr}\left(s_{ij} = 1\right) \mathrm{pr}\left(S_i = 1\right) \frac{\delta}{1-\delta} \bar{\pi}_i \right),$$ (6)

where the probability of squatting $\mathrm{pr}\left(s_{ij} = 1\right)$ is given in (2). This shows that the optimal premium dw_{ij} and the probability of squatting are a function of the plot characteristics, through the term $\mathrm{pr}\left(S_i = 1\right)\bar{\pi}_i$, and of the social interaction between landlord and tenants, through $R\left(\Delta_{ij}\right)$. This solution illustrates the tradeoff for the landlord between giving a large premium and the risk of squatting. Plots with higher values and weaker ability to enforce property rights (higher probability that squatting will be successful) garner a higher premium to the tenant, and tenants with lower cost to squatting R are offered a higher premium to counteract their incentive to squat. This mechanism thus reinforces the landlords' incentives to choose tenants with whom they have stronger ties. [11]

Second, the landlord decides on whether to rent out his land and to which tenant j if he does rent out, comparing utilities under the different options, as in (5), given the solution to (6) for each potential tenant.

4.2. Empirical specification

Assuming a linear approximation for the utility functions, we write:

$$V_{ij} = X_{ij}\beta + X_{i1}\alpha_1 + \mu_{ij} \equiv V_{ij}^* + \mu_{ij}$$

and $\quad V_{i0} = X_{i0}\alpha_0 + \mu_{i0} \equiv V_{i0}^* + \mu_{i0},$

where X_{ij} represents the variables in (3) that characterize either the tenant or the tenant-landlord pair, and X_{i1} and X_{i0} the variables that characterize the landlord/plot in expressions (3) and (4), respectively, and μ_{ij} and μ_{i0} are unobserved terms to the econometricians.

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[11] Hence, the predictions of the model do not change for cases in which landlords are unable to offer a premium.

Elements of X_{ij} include the determinants of the return to land π_{ij}, of the probability of squatting $\text{pr}\left(s_{ij} = 1\right)$, and the expected transfer of value through squatting $\text{pr}\left(s_{ij} = 1\right)\text{pr}\left(S_i = 1\right)\bar{\pi}_i$. They correspond to the productive assets of the tenant, possibly some interaction between the assets of the tenant and the landlord/plot that might affect the return to land, the social distance between the landlord and the tenant that affect the probability of squatting, and its interaction with the plot characteristics and its formal and informal property rights. Elements of X_{i1} include the landlord and plot characteristics that affect the value of the plot $\bar{\pi}_i$, the return π_{ij}, and the probability that the landlord will be able to defeat an attempt by the tenant to squat. Finally, elements of X_{i0} include the determinants of the return to land when managed by the landlord alone, π_{i0}, and the value of the plot $\bar{\pi}_i$, i.e., the characteristics of the plot itself and the landlord productive assets.

We assume that the vector $\mu_i = \left(\mu_{i0}, \mu_{i1}, \ldots, \mu_{iJ}\right)$ follows a Generalized Extreme Value distribution, with the alternative choices grouped into two sets, $\{0\}$ for not renting out, and $\Im = \{1, \ldots, J\}$ for renting to any potential tenant available to i. This leads to a nested logit model, which corresponds to the landlord's decision depicted in figure 1.

The model is written:

$$P\left(V_{ij} = \max_{k=0,\ldots,J} V_{ik}\right) = \frac{e^{X_{ij}\beta}}{\sum_{k \in \Im} e^{X_{ik}\beta}} \frac{e^{\lambda I_i + X_i\alpha}}{e^{\lambda I_i + X_i\alpha} + 1}, \text{ for } j \in \Im,$$

and

$$P\left(V_{i0} = \max_{k=0,\ldots,J} V_{ik}\right) = \frac{1}{e^{\lambda I_i + X_i\alpha} + 1}, \text{ for } j = 0,$$

where $I_i = \ln\left(\sum_{k \in \Im} e^{X_{ik}\beta}\right)$ is the inclusive value that summarizes the characteristics of all potential tenants for landlord i, $X_i = \{X_{i0}, X_{i1}\}$, and $\alpha = \alpha_1 - \alpha_0$.

The model can be decomposed into two logit models. In the lower level model, the conditional choice among tenants for a landlord that would rent ($d_i = 1$) follows a conditional logit model. The probability that a landlord chooses tenant j for his plot i ($d_{ij} = 1; d_{ik} = 0, \forall k \neq j$) is:

$$P\left(d_{ij} = 1 \middle| d_i = 1\right) = \frac{e^{X_{ij}\beta}}{\sum_{k \in \Im} e^{X_{ik}\beta}}. \tag{7}$$

Note that this expression does not include any landlord/plot characteristics X_{i1} separate from its interaction with the tenant characteristics. This is because terms that affect the return to land with any tenant cancel out in the landlord choice of tenants, conditional on the decision to rent out.

In the upper level model, the landlord chooses among the alternative of renting out ($d_i = 1$) and not renting out, following the logit model:

$$P\left(d_i = 1\right) = \frac{e^{\lambda I_i + X_i \alpha}}{e^{\lambda I_i + X_i \alpha} + 1}. \tag{8}$$

Whether to rent out or not depends on the landlord's characteristics X_i that affect the return to land under tenancy or in independent exploitation and on the utility that could be derived from putting the land in tenancy, given the available choice of tenants, as summarized by the inclusive value I_i.

4.3. Data

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 private matters of individual community members that are locally public knowledge. A similar approach has recently been used to study land market activity by Bardhan and Mookherjee (2005). Data collection started with a census of all 2523 households in 18 communities, and a census of all the plots that they own, rent-in, and rent-out. This information allows classification of households into 366 landlords, 465 tenants, and 1692 other households. The data set for the analysis consists of information on all landlords, all tenants, and 910 other households randomly sampled by community. For those households that do not rent land to others, we know whether they would like to rent land from others (or rent more land than they currently do) under the most common contract in the community. This allows us to control for the demand side in the estimation. The information is used to define the potential tenants (525 households out of the 910 households not currently engaged in the tenancy market), in addition to the 465 actual tenants. The number of potential tenants varies from 13 to 146 across the communities. The set of potential landlords consists of all land-owning households, whether they currently participate or not in the land rental market. Together they own 737 plots, of which 316 are rented out to community members.[12]

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[12] This excludes the 163 plots that are owned by households living in the community but rented out to households outside of the community. Many of these plots are not located in the landlord's community. By excluding these plots, the empirical results are only representative for rental transactions within local markets. As such, the results of the paper only allow concluding that property rights insecurity contributes

A short community questionnaire was used to gather data about the history of land conflicts in each of the communities, including those that involved absentee owners. This information was complemented with extensive qualitative interviews that allow characterizing the nature and history of the land invasions. The communities are located in two regions that have similar characteristics. Both regions have mainly seasonal crops, relatively intensive agricultural production with high input use (fertilizer, pesticides, labor), and multiple crops per year. A substantial share of agricultural production is commercialized, agricultural income is an important part of the households' budgets, and in both regions there is an excess demand for land. In one of the regions (where rice is the main crop), the land reform of the 60s played a larger role. Nevertheless, land ownership inequality remains high in both regions, with community-level land Gini coefficients ranging from 0.63 to 0.94, and the cumulative share owned by the 10% largest holders is on average 80%.

The dataset contains information on demographic characteristics of the household, and characteristics of all the plots that they own or rent from others. In addition, the informant was asked to assign each household according to their overall living standard to one of four possible living standard categories: "very low", "low", "regular", and "high". To obtain a measure of class, the informants were instructed explicitly not to consider the productive assets of the households to judge their living standard. Instead it was agreed they should be considering broad indicators of consumption or expenditures such as characteristics of their house, food, health care, transport means, and the level of education of the children.[13] Because few households were categorized as "very low", we consider the "very low" and "low" living standards together as one category.

Landlords and tenants clearly differ by the amount of land they own. Landlords own on average 1.6 plots on 2.27 ha, while tenants own 0.3 plots on 0.3 ha. Landlords and tenants do not correspond however to dramatically different welfare classes, as can be seen in Table 1. 33% of the landlords are from the lower class, 39% from the intermediate, and 28% from the higher class, while those numbers are 29%, 43%, and 27% for tenants.

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to the reproduction of land access inequality within these communities. While landlords who rent out plots located outside of their communities are likely to rely on different enforcement mechanisms in the presence of property rights insecurity, it seems unlikely that these mechanisms would have an opposite effect on inequality.

[13] The living standard measure was regressed on these indicators which shows strong correlations. Productive assets (land, education, etc.) are not significant, once the other factors are controlled for. This shows that indeed the informant considered welfare measures, as opposed to measures of the productive assets, when categorizing the different households.

Combining each actual landlord-plot with his corresponding potential tenants, from the same community, gives almost 24,000 potential matches. The variables used in the estimations are the following:

- Plot characteristics that affect production $\left(x_i^p\right)$ are the plot size, and a dummy for whether the plot has irrigation potential, measured by the proximity to an irrigation canal or natural stream.

- Landlord's and tenant's productive characteristics and assets $\left(z_i, z_j\right)$ are the gender, age, and education of the household head, the number of adult household members, and machinery ownership characterized by two dummy variables for owning any machinery and owning a lot of machinery. In addition, we consider for landlords the area they own and for tenants the number of other plots they are cultivating as an indicator of their opportunity cost. Finally a dummy variable, "agricultural engineer", identifies the few households in which the head owns a lot of machinery and has a university degree.

- The social distance between the landlord and the tenant $\left(\Delta_{ij}\right)$ is captured by two dummy variables: one variable equaling 1 for matches between people with a regular and high living standard, or between people with a low and regular living standard; the other variable equaling 1 for matches between high and low living standards.[14]

- Plot/landlord characteristics that affect the probability that squatting will be successful $\left(x_i^S\right)$ are dummy variables for whether the plot has a title, which measures the formal strength of the property right to the plot; whether the landlord has a large family in the community, which is a proxy for the informal strength of the property rights; and whether there were cases of land invasions during the last five years in the community, which also proxies informal property right strength. Finally, we include a regional dummy for the rice region, since it is a region with a long history of land reforms and related conflicts.

The explanatory variables $\left(X_{ij}\right)$ for the lower level model (7) include social distance $\left(\Delta_{ij}\right)$, interaction terms $\left(\Delta_{ij} x_i^S\right)$ to test the hypothesis that social distance matters more when the insecurity of property rights is higher, and tenants' characteristics $\left(z_j\right)$. Tenant characteristics affect the decisions of landlords both through their effect on the total expected profit and through their effect on the tenants' reservation utility, and as such can have offsetting effects on the landlord's net return π_{ij}. We also include

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[14] The specification assumes that effects of low-regular and regular-high matches are similar, and that the effects of social distance are symmetric. Both assumptions were empirically tested and could not be rejected (see section 5).

some interaction terms $\left(x_i^p z_j \right)$ to account for the fact that tenant's endowments might be more important for cultivating large and irrigated plots.[15]

The explanatory variables $\left(X_i \right)$ for the upper level model (8) include plot's and landlord's characteristics $\left(x_i^p, z_i \right)$ and the insecurity of property rights variables $\left(x_i^S \right)$.

4.4. Econometric issues

While having a complete characterization of the land market presents great advantage in terms of effectively observing the two sides of all the matches, and characterizing the opportunities, it does raise some econometric problems. In our sample, as in the real world of a community, all potential tenants in any community consist of a finite number of persons who are common to all landlords of the community. Hence the unobserved terms μ_{ij} in equation (2) could be correlated across landlords i if they contain some tenant j's unobserved characteristics. We will thus proceed with an estimation of the model with tenant fixed effects as an alternative to the estimation with tenants' characteristics.

The second econometric problem comes from a possible negative correlation between the terms μ_{ij} due to the fact that tenants do not cultivate more than a few plots. Hence if one landlord contracts with a given tenant, it reduces the probability that another landlord can contract with the same tenant. This creates a negative correlation across landlords' decisions for the same tenant. In the core estimation, we account for this competition by inclusion of a variable measuring the number of other plots the tenant is currently cultivating. This is motivated by the assumption that each landlord takes the decision of the tenants and of the other landlords as given. Inclusion of such a variable cannot be done with the tenant's fixed effects model because of collinearity, and hence the fixed effect estimation gives consistent, but not efficient, results (McFadden, 1999).

Finally, as we used an indirect survey approach and relied on an informant to obtain the information for all the households of his community, one may suspect an informant effect that could create correlation between the error terms of the observations from the same community. In the lower level model, an additive informant effect would not pose a problem since all potential tenants would have the same term that cancels out in their comparison. In addition, we check for robustness of the results allowing

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[15] In addition, π_{ij}, and hence the matching between landlords and tenants, could potentially depend on the complementarities or substitutability between the productive asset endowments of the landlord and the tenant, in line with Becker's theory of assortative matching in the marriage market. E.g. landlords with low labor endowments might prefer tenants with high labor endowments, or vice versa. We therefore test for interactions between landlord and tenant's assets in section 5.2.

for correlation of observations obtained from the same informant. In the upper-level estimation, we check for the possibility of either correlated errors or an informant fixed effect.

4.5. Identification

Our model assumes that the variables used to measure informal and formal property rights are not correlated with possible unobserved factors that affect decisions on the land rental markets. This can be motivated by the specific choice of variables, the empirical specification, and the specific context in the regions of study. The presence of family, the first measure of informal enforcement, is a result of historical fertility and migration decisions of other households in the community, that can arguably be considered a given for landowners making decisions in the land rental markets. Land invasions, our second indicator, are measured at the level of the community, and reflect past large-scale conflicts. We only consider large-scale land invasions, rather than past individual cases of squatting, as the latter are endogenous to past equilibrium contract choices. In contrast, interviews with participants of the large-scale invasions revealed that these invasions were escalations of lingering conflicts between the community and large absentee landlords. Such conflicts, that involve the occupation of farms of absentee owners by large groups of peasants, were typically driven by historical tensions. They are very distinct from the individual squatting cases that landowners who live in the communities fear in the rental market.[16] The positive correlation between assortative matching and land rental decisions when property rights are insecure is hence unlikely to reflect reverse causality and correlation over time. Past land invasions do, however, create general perceptions of property rights insecurity, which according to our model influence assortative matching in the land rental markets.

The title status of a plot, the measure of formal property rights, is determined by a combination of historical factors: different property rights regimes installed by various former colonizing powers, the land reforms in the 60s, and the year in which the plot was affected by the reform (beneficiaries of land that was expropriated in the early years of the land reforms received titles, others didn't). Hence, the title status of a plot is largely determined by different historical events that are beyond the control of current occupants. Note also that the variable indicates whether the plot has a title, not whether it is registered under the name of the owner. In fact, in many cases the titles are not updated to the current owner.

Given the cross-section nature of our dataset, there might be remaining endogeneity concerns. As there is no plausible instrumental variable approach for our data, we instead control for unobservables and

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[16] The assertion that the prevalence of conflicts is not driven by current land market outcomes and related inequality within the community is supported by the very low correlation between land Gini coefficient (measuring inequality between community members) and land conflicts in our dataset. We will also test the robustness of our results to inclusion of the land Gini coefficient (see section 5.2).

test for robustness of the results. Our model specification implies in itself control for a number of unobserved effects: the lower level logit (equation 7) is a fixed effect model (i.e., a conditional logit), and hence all fixed plot level (and landlord and community level) unobservables are controlled for in all the matching regressions. We also present an estimation that includes tenant fixed effects. In the upper level logit we test for robustness of our result to inclusion of informant and community fixed effects. Furthermore, we show that our results are robust to inclusion of different sets of control variables and alternative specifications.

5. Estimation results

5.1. Main results

Estimation of the lower level logit (equation (7)) on the choice by a landlord of a particular tenant among potential tenants is reported in Table 2. The regressions were done on the 301 out of 316 rented plots for which we have data on both sides of the transaction. The first three columns establish the main result of the paper: Landlords and tenants match assortatively by living standard status and the larger the social distance the less likely they are to match (col. 1). These results are robust to controlling for the tenant's characteristics (col. 2). Assortative matching, however, only takes place in communities that have experienced land invasions and is less likely for landlords with large numbers of family members in the community (col. 3). The effects are again stronger when social distance is larger. Hence, the presence of conflicts reduces the likelihood of renting out to people whose living standard is different from one's own, and the presence of family within the community increases the likelihood of renting out to people from a different living standard class. The presence of family in the community is likely to increase the possibilities of contract enforcement, both directly and indirectly: Directly, because alternative enforcement mechanisms based on family ties might increase the likelihood of renting out to a family member, even if she is from a different socio-economic class. And indirectly because the presence of family members in the community can help landlords enforce contracts with third parties, as it increases the costs (loss of social benefits) of squatting for tenants.[17] Interestingly, formal titling does not affect matching. This particular result might, however, be driven by lack of variation as many of the plots that are actually rented out have a formal title.

Looking at tenants' characteristics, landlords are more likely to rent out to households with more educated and male household heads, and with machinery. This suggests that the positive effect of productive assets on expected profit compensates the negative effect through the reservation utility.

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[17] Because we do not have information about the family ties between each landlord and each potential tenant, we cannot distinguish between the direct and the indirect effect.

However, landlords are less likely to rent out to tenants who already cultivate other plots, which is consistent with competition between landlords raising the reservation utility of the tenants.[18]

In column 4, we report a regression with interaction effects between plot and tenant characteristics. Among the many potential interactions, we have only kept those that are consistently significant across the different possible specifications. They show that endowments of machinery and education are more important for larger plots, and large families are an advantage for renting in plots with irrigation potential. From our field experience, the latter is related to the fact that irrigation allows for labor and capital-intensive cultivation, and large households can provide either supervision and/or a source of cash flow for purchasing inputs. Overall these interaction effects are consistent with the hypothesis that the landlord faces a trade-off between the positive effect of a tenant's assets on expected profit and the negative effect on reservation utility, as a tenant's assets make him more likely to get matched with plots of higher productive potential.

The key results are robust to introduction of an informant cluster effect (col. 5). The next column shows a specification excluding variables that are not robustly significant, except for those that also enter with interaction effects, which will be used for the calculation of the inclusive value and the simulation.[19] The last column reports results of the estimates with tenant fixed effects. In this estimation, 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 from any landlord. Results show that the effect of informal property rights strength (family protection and land invasions) on matching between high and low living standard classes is robust to including the fixed effects.

Estimation results for the upper level logit (equation (8)) for the choice of a landlord to rent out are reported in Table 3. The regression was done on the 700 out of 737 plots for which we have complete data. The first column reports the core estimation, the second column reports results with informant fixed effects, and the third column the results allowing for correlation across observations from the same informant in both estimation levels. As expected, the inclusive value (derived from the estimation reported in Table 2, col. 6), measuring the average utility the landowner can expect from the potential tenants in his community, has a positive effect on the decision to rent out. A title on the plot has a positive effect on the probability that it be rented out, controlling for the matching. The effects of past land conflicts and family protection have, however, no direct effect, but only an indirect effect through their influence on the average

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[18] The significance of the variable capturing competition in our reduced model estimation suggests that additional insights might be gained from estimating a more structural model of such competition, which we leave for future work.

[19] The interaction effects with the regional dummy are, though insignificant, also included in this specification, to keep controlling for regional differences.

expected utility of a match. In the last column, we estimate a simplified model to be used in the simulation, taking out variables that are not consistently significant or that are potentially endogenous to the choice of renting out (engineer and number of active adults in the household).

5.2. Robustness checks

The hypothesis of positive assortative matching in our model implies that landlords of all classes prefer renting to tenants from their own socio-economic class if property rights are insecure. One could alternatively hypothesize that the probability of squatting would be higher for poor tenants, and that both rich landlords and poor landlords would avoid renting to poor tenants when property rights are insecure. Such a mechanism could provide an alternative explanation for the empirical findings presented above. We therefore test this hypothesis explicitly by replacing the social distance variables with the tenant's class. The second column in Table 4 shows that, while tenants with low living standards have a lower overall probability of being chosen (possibly because poor tenants tend to have less productive assets), none of the interaction effects of tenant's class with the property rights variables are significant. Hence, we do not find empirical evidence for the alternative hypothesis, supporting our original interpretation of assortative matching because of property rights insecurity.

A related concern might be that, by measuring the social distance as an absolute value of the difference between landlord and tenant characteristics, we have assumed that the effect of social distance is independent from the direction of the difference. To test whether property rights insecurity only restricts renting from rich landlords to poor tenants, or also in the reverse direction, the model was also estimated allowing the coefficient of the interaction terms with the property rights variables to differ depending on the direction. Column 3 shows that the results of our base variables are robust to the specification in which additional variables were added to allow for these asymmetric effects. The hypothesis that the coefficients of the interaction effects with property rights are independent of the direction of the difference cannot be rejected. The P-value of the joint F-test of the variables capturing possible asymmetric effects is 0.61.

Finally, the assumption that low-regular matches and regular-high matches have the same effects was tested by including separate variables allowing the coefficients to be different. Again, we cannot reject that the coefficients of these dummies were significantly different for any of the interaction effects, the P-value of the joint F-test if 0.37, and the key results are robust (column 4). Hence, overall, the robustness checks indicate that property rights insecurity leads to similar assortative matching by social distance in all classes, consistent with the theoretical model.

In addition to property rights insecurity, matching between landlords and tenants might also be driven by other factors. The evidence in table 2 suggests that it depends in part on interactions between the

plot and tenant characteristics. But it could potentially also depend on the complementarities or substitutability between the productive asset endowments of the landlord and the tenant, in line with Becker's theory of assortative matching in the marriage market. We therefore estimated a model that controls for differences in asset endowments between landlords and tenants (age, labor, machinery, and education). Column 5 shows that there is some evidence for such interactions between landlord and tenant characteristics. More importantly, the relationship between property rights and social matching is robust in this alternative specification.

A different type of concern could arise from the use of key informants, i.e., that informant characteristics themselves could be causing an omitted variable problem. We therefore present results that control for an interaction effect between the informant's living standard and the landlord-tenant social distance variables (table 5, column 2) and for the difference between living standards of informants and tenants (column 3).[20] These variables are not significant and results remain robust. Results of the upper level model are also robust to inclusion of dummies indicating the social distance between informant and landowner or the living standard class of the informant itself. Hence we do not find evidence of significant effects of the informant variables, which reduces concerns related to possible informant bias.

Next, because there are some communities for which there was more than one informant, and because it might be important to allow for clustering of standard errors at the community level, we also estimate the regressions allowing for clustering of standard errors by community (column 4). In the upper level model, we estimated specifications with a community (instead of an informant) fixed effect, and specifications allowing for clustering at the community level. We find that controlling for community-level correlation does not affect the results.

Another potential concern related to our empirical model is the use of the variable measuring the number of other plots to capture competition among landlords. While this variable is exogenous to each individual landlord, one could argue that it is determined in the local market together with the matches we analyze. Column 5 shows that excluding this variable from the regression does not affect our main results. Indeed in the model that included the tenant-fixed effects, this variable was also excluded. The results are also robust to alternative characterizations of the effect of landlord competition on the reservation utility of the tenants, using either total amount of other land cultivated (column 6) or the total amount per capita (column 7).

Finally, our regression results are robust to including interactions between social distance variables and the land Gini coefficient (column 8). This indicates that the differences in the prevalence of

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[20] The class of the informant and any other fixed informant characteristics are further controlled for through the fixed effect.

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conflicts seem to be related to other factors (such as history of land reform, social cohesion, etc.) rather than to differences in current land access inequalities. This might be due to the fact that land inequality is high in all the communities.

6. Effects of security of property rights and capital endowment on market size, efficiency, and equity

To show the importance of property rights security in the reproduction of land access inequality, the estimated model is now used to quantify the extent to which both formal and informal property rights can limit land access through rental for the poor. In order to do so, we use the estimated parameters to simulate the effect of strengthening property rights on land rental market decisions in these local markets.[21] These simulations give an indication of the importance of property rights insecurity for both equity and efficiency outcomes. In addition, we consider the importance of access to working capital for accessing land.

6.1. Simulation of the land rental market

Simulation of the market equilibrium is done for each community separately, with an iterative procedure that accounts for competition in the market. The iterative process simulates what is in fact a simultaneous process with full information. For each of the simulations, the probability of being rented out, $P(d_i = 1)$ is first predicted for each plot i, based on the coefficients obtained in Table 3, col. 4. Consider then a community with I sampled landlord-plots $i \in I = \{1,\ldots,I\}$, each with a sampling weight ω_i, and J sampled tenants $j \in J = \{1,\ldots,J\}$, each with a sampling weight ω_j. The full land rental market thus includes $I^* = \sum_i \omega_i$ landlord-plots and $J^* = \sum_j \omega_j$ tenants. The market is modeled as working in successive rounds of offers from landlords. In the first round, each landlord-plot makes one offer, selecting the tenant j with the highest conditional probability $P(d_{ij} = 1 | d_i = 1)$.[22] In the illustration given in Figure 2, for example, landlord $i1$ selects tenant $j1$, while landlords $i2$ and $i3$ select tenant $j2$. The tenant only accepts the offer that maximizes $P(d_i = 1)P(d_{ij} = 1 | d_i = 1)$, i.e., the tenant exercises his options in choosing the landlord-plot with which he has the highest probability to match. The probability that the match effectively occurs $P(d_{ij} = 1)$ is computed as the product of the probability that a given plot is rented out $P(d_i = 1)$ and the conditional probability of the match $P(d_{ij} = 1 | d_i = 1)$. The number of effective

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[21] Using specifications from Table 2, col. 6, and Table 3, col. 4.

[22] In the utility framework, this implies that the tenant will only accept a match that maximizes total utility.

matches ω_{ij} corresponding to a sample match ij is the minimum between the number of landlord-plots ω_i and the number ω_j of tenants j. Hence, after the first round matches are settled, each sample match ij leaves either some landlord plots $\omega_i - \omega_j$ not rented, if this number is positive, or some available tenants $\omega_j - \omega_i$ in the opposite case.[23]
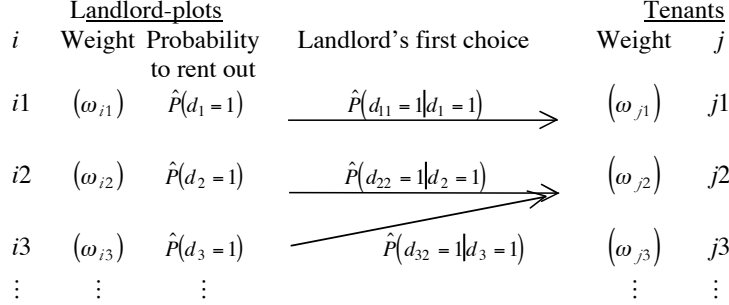
	Landlord-plots		Landlord's first choice	Tenants	
i	Weight	Probability to rent out		Weight	j
$i1$	(ω_{i1})	$\hat{P}(d_1 = 1)$	$\hat{P}(d_{11} = 1 \mid d_1 = 1)$	(ω_{j1})	$j1$
$i2$	(ω_{i2})	$\hat{P}(d_2 = 1)$	$\hat{P}(d_{22} = 1 \mid d_2 = 1)$	(ω_{j2})	$j2$
$i3$	(ω_{i3})	$\hat{P}(d_3 = 1)$	$\hat{P}(d_{32} = 1 \mid d_3 = 1)$	(ω_{j3})	$j3$
$\vdots$	$\vdots$	$\vdots$		$\vdots$	$\vdots$

Figure 2. Simulation of the matching process

The market is then cleared of the matches that have been settled, and we repeat the process until all landlord-plots are matched to a tenant.[24]

The outcome of this procedure gives sample matches $ij \in M$, each with a sampling weight ω_{ij}. Note that, by construction, all landlord-plots $i \in I$ are matched to tenants, i.e., $\sum_j \omega_{ij} = \omega_i$.[25] Not all tenants $j \in J$, however, are necessarily chosen by a landlord. If $\sum_i \omega_{ij} > \omega_j$, then all tenants represented by sample tenant j can have at least one plot in rental. But if $\sum_i \omega_{ij} < \omega_j$, then sample tenant j is only partially matched in the tenancy market. It is easier to think about this by splitting j in two tenants: tenant $j1$, with sampling weight $\sum_i \omega_{ij}$ who has access to a rental plot, and tenant $j2$, with sampling weight $\omega_j - \sum_i \omega_{ij}$ without a rental plot.

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[23] In the first round, tenants will not accept an offer that implies a lower utility than a match with a landlord for whom he might be the second choice. Therefore, the results of the iterative process are the same than a process in which landlords would be allowed to go for their second choice in the first round (if their first choice was not feasible).

[24] Matched tenants stay available for additional matches but the number of plots they cultivate is updated after each match, which, because of the negative coefficient on that variable, decreases the likelihood of a future match. The number of matches is limited to the actual number of plots tenants rent for those who do not want to rent in more land, and not limited for the others.

[25] Note however that many of these plots might have a low probability to be rented out, which is accounted for in the simulation through $P(d_i = 1)$ and which will be reflected in the aggregation (see 6.2).

6.2. Simulated effects of secure property rights and endowing tenants with capital

Summary statistics reported in Table 6 are obtained by aggregating the simulated matches. Aggregation of landlord-plot characteristics v_i (such as the total number of plots and area rented out) are calculated as:

$$\sum_i P(d_i = 1) \omega_i v_i .$$

Aggregation of tenants characteristics v_j (such as the number of tenants and the number of poor tenants) are calculated as:

$$\sum_j \min\left(\sum_i P(d_i = 1) \omega_{ij}, \omega_j \right) v_j .$$

Finally, aggregation of matched landlord-tenant characteristics (such as area rented to poor tenant, land-labor ratio on plots rented by poor landlords) are computed as:

$$\sum_i P(d_i = 1) \sum_{j | ij \in M} \omega_{ij} v_i v_j .$$

The first column in Table 6 reports characteristics of the observed rented plots and tenants, and the second column reports the characteristics of the simulated plots and tenants. We see that the simulations replicate relatively closely the observed situation. The third column simulates the matches that would occur if the property rights to all plots had been secure, i.e., if all plots had a full title, plots had as much security as with informal family protection, and there had been no past conflicts in any community. In rendering property rights secure, we contrast between the role of a title (column 4), and the role of enhancing protection and reducing land conflicts (column 5). Column 6 shows the joint effect of property rights security and providing working capital (machinery) to all tenants and column 7 the effect of working capital alone.

We see that with secure property rights (column 3), 21% more plots get rented out and 13% more households obtain access to rentals. Most of this gain is due to the increase in the inclusive value (the value a landlord can expect from matches with tenants in his community) that accompanies property rights security. Importantly, there is a higher than proportional increase for poor tenants, with a 59% increase in their number, 65% in the number of plots rented out to poor tenants, and 63% in the area rented out to poor tenants.

The results suggest that segmentation of the land rental market due to property rights insecurity leads to important inefficiencies. With insecure property rights (column 2), the average land-to-labor ratio on plots rented out by the non-poor is substantially higher than on plots rented out by the poor (3.44 vs. 1.13). This suggests that labor might not be optimally allocated. The difference disappears once property

rights are secure (3.11 vs 2.94) (column 3).[26] The difference in availability of machinery (i.e., either the tenant or the landowner has machinery) between plots rented by poor and non-poor landlords also disappears.

Decomposing the instruments used to make property rights secure is revealing of which programs may create the greatest gains in this setting. Granting formal land titles increases the area rented to the poor by 11%, while reducing land conflicts and enhancing land protection increases it by another 55% to 63%. This suggests that titling programs as pursued by some donor agencies might only achieve high payoffs if accompanied by initiatives to help resolve conflicts and enforce the law. These latter programs have been much less present in efforts to strengthen property rights.

The last two columns show that a policy intervention that would provide not only secure property rights to landlords but also access to working capital to potential tenants would lead to a more equitable outcome on the land rental market. With secure property rights and access to capital, the number of plots rented to the poor increases by 180%, and the area rented to the poor by 310%. In fact, the poor would rent more than half of both plots and area in the market. Comparing these results with the effects of only providing working capital, we see that capital and property rights security have complementary effects on access to land for the poor. Interestingly, while in the current situation plots owned by non-poor landlords are much less intensively cultivated, the difference almost disappears with the combination of these two policies.[27] Hence, policies that guarantee the security of property rights and enhance access to working capital for potential tenants reinforce each others in putting into place a larger, more equitable, and more efficient land rental market.

7. Conclusions

Social inequalities are known to be generally detrimental to growth and poverty reduction. A fundamental question is consequently to uncover how deep levels of inequality get to be reproduced over time if they have such high efficiency and equity costs. Insecurity of property rights can play an important role as it lowers incentives to invest and use the assets efficiently. If the rich are better able to protect their rights, this can lead to the reproduction and deepening of social inequalities. In this paper, we reveal another mechanism that happens via the assets market. This occurs when landlords with insecure rights

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[26] The overall increase of the land/labor ratio with secure property rights is caused by the fact that there is a larger increase in the area rented than in the number of tenants.

[27] Land/labor ratio of landowner's plots were calculated by taking the weighted average of tenant's and landowner's land/labor ratio, with the probability of renting out constituting the weight. Tenant's and landowner's land/labor ratio were calculated using land cultivated by both after accounting for all matches and their probabilities.

protect themselves from loss of their land by confining rental transactions to tenants from the same social class. They might do this because social proximity determines the benefits of future social interactions that would be lost as a consequence of failing to return rented land, deterring tenant misbehavior. With land highly unequally distributed in Latin America, a socially segmented land rental market prevents the poor from accessing land held by the rich. The result is not only inefficiency in land use, as much land remains extensively used and often idle, but also reproduction of social inequalities.

Using survey data from the Dominican Republic, this paper has shown that insecurity of property rights can have a large impact in local land rental markets. The empirical results suggest that, for the regions studied, guaranteeing secure property rights could increase the number of rental transactions by 21%. Strengthening property rights security not only has substantial consequences for the landowners, but also for those with whom the owners might interact in the rental markets. In particular, simulations suggest that it would increase access to land for the poor by 63%, while at the same time increasing the efficiency of land allocation.

The simulations show that large equity and efficiency gains are achieved when enforcement mechanisms and reduction of large land conflicts accompany the granting of a formal title. This suggests that land titling programs should be complemented with reliable land conflict resolution mechanisms in order to capture maximum gains. Results also show that participation in the land rental market for the poor is constrained by lack of access to working capital. Simulations suggest that increasing both tenure security and the machinery endowments of tenants would increase the number of poor that get access to land through rental by 151% and the total area rented by the poor by 310%. Formal land titling, reduction of land conflicts induced in large part by ill-designed programs of access to land and tenant protection, and enforcement of property rights, complemented by greater access to capital for the working poor, can thus be important instruments for the reduction of local inefficiencies and stubbornly high inequalities.

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Table 1. Distribution of transactions by living standard of tenant and landlord in communities with and without recent land invasions

Living standard of landlord	Living standard of tenant			Total	Number of observations
	Low	Regular	High		
Communities with recent land invasions					
Low	52%	41%	7%	100%	46
Regular	21%	52%	27%	100%	70
High	7%	33%	60%	100%	45
Total	26%	43%	30%	100%	161
Communities without recent land invasions					
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 2. Landlord choice of tenant
Lower level estimation in the nested logit model of the landlord choice in the tenancy market

	Mean	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Social distance landlord-tenant (and interaction terms)								
|1 living standard|[1] Δ_{ij}	0.48	-0.235*	-0.190	0.284	0.344	0.344	0.219	-0.091
		(1.81)	(1.48)	(0.69)	(0.82)	(1.08)	(0.97)	(0.34)
|2 living standard|[1]	0.13	-0.576**	-0.501**	0.207	0.403	0.403	-0.273	-0.435
		(2.49)	(2.18)	(0.30)	(0.55)	(0.46)	(0.69)	(0.71)
|1 living standard| * title $\Delta_{ij}x_i^S$	0.42			-0.205	-0.163	-0.163		
				(0.50)	(0.39)	(0.61)		
|2 living standard| * title	0.12			-0.727	-0.789	-0.789		
				(1.03)	(1.08)	(0.95)		
|1 living standard| * family protection	0.20			0.564**	0.488*	0.488**	0.452**	0.425
				(2.04)	(1.72)	(2.36)	(2.00)	(1.58)
|2 living standard| * family protection	0.06			1.503***	1.493***	1.493***	1.428***	0.966*
				(2.84)	(2.76)	(3.08)	(2.77)	(1.73)
|1 living standard| * land invasion	0.33			-0.625**	-0.550*	-0.550	-0.588*	-0.126
				(2.23)	(1.91)	(1.63)	(1.73)	(0.36)
|2 living standard| * land invasion	0.08			-2.088***	-1.976***	-1.976***	-1.988***	-1.227***
				(3.55)	(3.32)	(4.09)	(4.40)	(2.60)
|1 living standard| * rice region	0.10			-0.416	-0.543*	-0.543	-0.504	-1.049**
				(1.35)	(1.71)	(1.48)	(1.44)	(2.33)
|2 living standard| * rice region	0.03			0.170	-0.133	-0.133	-0.125	-0.696
				(0.29)	(0.22)	(0.23)	(0.22)	(0.90)
Tenant's assets and characteristics z_j								
Number of other parcels cultivated	0.97		-0.282***	-0.282***	-0.307***	-0.307**	-0.310**	
			(4.13)	(4.12)	(4.31)	(2.02)	(2.10)	
Female household head	0.09		-0.561**	-0.491*	-0.493*	-0.493		
			(2.07)	(1.81)	(1.80)	(1.21)		
Age of household head	42.5		-0.010*	-0.011*	-0.010*	-0.010		
			(1.78)	(1.90)	(1.75)	(1.43)		
Household head with primary education	0.75		0.654***	0.695***	0.092	0.092	0.179	
			(3.64)	(3.69)	(0.33)	(0.30)	(0.69)	
Machinery ownership	0.15		0.973***	1.005***	0.736***	0.736*	0.751*	
			(5.36)	(5.43)	(2.83)	(1.90)	(1.79)	
Large machinery ownership	0.06		0.719***	0.712***	0.252	0.252	0.269	
			(2.71)	(2.64)	(0.65)	(0.58)	(0.74)	
Agricultural engineer	0.01		2.441***	2.395***	2.567***	2.567***	2.575***	
			(5.22)	(5.10)	(5.16)	(3.25)	(3.30)	
Number of active adults in household	2.34		-0.024	-0.040	-0.186*	-0.186*	-0.212**	
			(0.33)	(0.54)	(1.91)	(1.92)	(2.02)	
Interaction plot-tenant characteristics $x_i^P z_j$								
Household head with primary education * plot size	23.3				0.031***	0.031***	0.031***	0.049**
					(2.79)	(2.97)	(3.05)	(1.98)
Machinery ownership * plot size	4.68				0.012**	0.012**	0.013***	0.019***
					(1.99)	(2.55)	(2.61)	(3.59)
Large machinery ownership * plot size	2.01				0.012*	0.012***	0.012***	0.009***
					(1.74)	(3.17)	(3.08)	(4.37)
Number of active household members * irrigation potential	0.75				0.371**	0.371***	0.352***	0.359*
					(2.48)	(2.86)	(2.59)	(1.87)
Observations								
Number of landlord-plots		301	300	287	287	287	288	289
Average number of potential tenants per plot		80	80	80	80	80	80	23
LR chi[2]		7.44	132.15	155.11	268.32	268.32	258.42	249.73
Informant correlation		No	No	No	No	Yes	Yes	Yes
Tenant fixed effects		No	No	No	No	No	No	Yes
Observations		23965	23870	23060	23060	23060	23123	6722

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
[1] \|1 living standard\| is a dummy variable for landlord and tenant being from low and regular living standard, or from regular and high living standards. \|2 living standard\| is a dummy variable for landlord and tenant being from low and high living standar
(1)-(6): all potential tenants in community included; (7) only actual tenants in community included

Table 3. Landlord decision of renting out
Upper level estimation in the nested logit model of the landlord choice in the tenancy market

	Mean	(1)	(2)	(3)	(4)
Landlord characteristics z_i					
Amount of land owned (ha)	5.2	0.056*	0.052	0.056*	
		(1.89)	(1.47)	(1.88)	
Female household head (dummy)	0.20	1.185***	1.395***	1.185***	1.294***
		(4.98)	(5.61)	(5.03)	(5.62)
Age of household head	56	0.033***	0.038***	0.033***	0.046***
		(4.18)	(4.45)	(3.46)	(7.04)
Household head with primary education	1.62	-0.057	0.010	-0.057	
		(0.26)	(0.04)	(0.20)	
Machinery ownership	0.25	-0.548*	-0.479	-0.548	
		(1.77)	(1.45)	(1.34)	
Large machinery ownership	0.07	-0.591	-0.629	-0.591**	
		(1.15)	(1.19)	(2.24)	
Agricultural engineer	0.01	2.729**	2.919***	2.729**	
		(2.58)	(2.77)	(2.48)	
Number of active adults in household	2.57	-0.248***	-0.184**	-0.248***	
		(3.07)	(2.11)	(2.79)	
Plot characteristics x_i^p					
Plot size (ha)	2.5	-0.770***	-0.691***	-0.770***	-0.635***
		(6.12)	(3.84)	(4.96)	(5.95)
Irrigation potential (dummy)	0.44	-0.204	-0.347	-0.204	
		(0.80)	(1.15)	(0.50)	
Insecurity of property rights x_i^S					
Plot with title (dummy)	0.76	0.530**	0.963***	0.530*	0.558**
		(2.25)	(3.11)	(1.76)	(2.38)
Land invasions in community (dummy)	0.75	0.288		0.288	
		(1.34)		(0.91)	
Many family members in community (dummy)	0.57	-0.289	-0.007	-0.289	
		(1.44)	(0.03)	(1.26)	
Rice region (dummy)	0.45	-1.425***		-1.425***	-1.483***
		(4.83)		(2.97)	(6.87)
Inclusive value[a] $I_{\mathfrak{I}}$	5.00	0.825***	0.720***	0.825***	0.717***
		(5.22)	(3.09)	(3.87)	(5.12)
Constant		-4.436***	-5.928***	-4.436***	-5.524***
		(5.20)	(5.16)	(4.08)	(7.88)
Observations		697	697	697	700
Informant controls		No	Fixed effects	Correlated errors	No

Robust z statistics in parentheses - Observations were weighted to account for sampling frame
* significant at 10%; ** significant at 5%; *** significant at 1%
[a]Estimation in Table 2 (column 6) reports the first step, used for the calculation of the inclusive values.

Table 4. Landlord choice of tenant with different specifications: robustness checks

	(1) Base	(2) Tenant's class	(3) Assymetric Effects	(4) Unequal Distance 1	(5) Assortative Matching
Social Distance landlord-tenant with interaction terms					
l1 livingstandardl*family protection	0.452**		0.533	0.661*	0.392
	(2.00)		(1.40)	(1.86)	(1.57)
l2 livingstandardl*family protection	1.428***		0.996*	1.498***	1.312***
	(2.77)		(1.67)	(2.86)	(2.78)
l1 livingstandardl*land invasion	-0.588*		-0.820*	-0.851	-0.642*
	(1.73)		(1.80)	(1.47)	(1.90)
l2 livingstandardl*land invasion	-1.988***		-2.111**	-2.197***	-2.207***
	(4.40)		(2.47)	(4.72)	(4.27)
l1 livingstandardl*rice region	-0.504		-0.585	-1.262**	-0.334
	(1.44)		(1.60)	(2.08)	(0.89)
l2 livingstandardl*rice region	-0.125		-0.991	-0.329	0.198
	(0.22)		(0.98)	(0.51)	(0.29)
Tenant's living standard (and interaction terms)					
Regular		-0.539			
		(1.33)			
Low		-1.330**			
		(2.26)			
Regular*family protection		-0.254			
		(0.76)			
Low*family protection		0.196			
		(0.59)			
Regular*land invasion		0.206			
		(0.41)			
Low*land invasion		0.351			
		(0.45)			
Regular*rice region		1.019			
		(1.61)			
Low*rice region		0.786			
		(1.11)			
Difference in productive assets between landlords and tenants					
lΔ number of adult household membersl					-0.057
					(0.40)
lΔ age household headl					0.009
					(1.33)
lΔ education level household headl					0.031
					(0.28)
lΔ machinery ownershipl					0.302*
					(1.79)
Interaction plot-tenant characteristics	yes	yes	yes	yes	no
Assymetric effects social distance	no	no	yes	no	no
Difference between high-regular and regular-low	no	no	no	yes	no
Observations					
Number of landlord-plots	288	288	288	288	296
Average number of potential tenants per plot	80	80	80	80	80

All regressions include controls for social distance between landlord and tenant; and tenant characteristics.
Absolute value of z statistics in parentheses (standard errors clustered by informant)
* significant at 10%; ** significant at 5%; *** significant at 1%.
[1] l1 living standardl is a dummy variable for landlord and tenant being from low and regular living standard, or from regular and high living standards. l2 living standardl is a dummy variable for landlord and tenant being from low and high living standard.

Table 5. Landlord choice of tenant : futher robustness checks

	(1) Base	(2) Social dist. * informant class	(3) Social dist. informant - tenant	(4) Community cluster	(5) Without other plots	(6) Other land cultivaed per capita	(7) Other land cultivated	(8) Gini
Social Distance landlord-tenant with interaction terms								
l1 livingstandardl*family protection	0.452**	0.480**	0.449**	0.452**	0.437*	0.455**	0.457**	0.464**
	(2.00)	(2.15)	(2.01)	(2.00)	(1.92)	(2.02)	(2.03)	(1.97)
l2 livingstandardl*family protection	1.428***	1.385***	1.423***	1.428***	1.256***	1.365***	1.346***	1.413***
	(2.77)	(2.58)	(2.68)	(2.97)	(2.83)	(2.90)	(2.88)	(3.02)
l1 livingstandardl*land invasion	-0.588*	-0.594*	-0.590*	-0.588*	-0.561*	-0.558	-0.555	-0.433*
	(1.73)	(1.73)	(1.72)	(1.91)	(1.68)	(1.64)	(1.64)	(1.83)
l2 livingstandardl*land invasion	-1.988***	-1.997***	-1.989***	-1.988***	-1.902***	-1.875***	-1.843***	-1.894***
	(4.40)	(4.39)	(4.36)	(4.69)	(4.58)	(4.35)	(4.43)	(4.77)
l1 livingstandardl*rice region	-0.504	-0.486	-0.508	-0.504	-0.497	-0.518	-0.521	-1.048***
	(1.44)	(1.53)	(1.47)	(1.40)	(1.49)	(1.54)	(1.55)	(2.69)
l2 livingstandardl*rice region	-0.125	-0.164	-0.132	-0.125	-0.238	-0.210	-0.265	-0.930*
	(0.22)	(0.31)	(0.23)	(0.23)	(0.53)	(0.40)	(0.53)	(1.70)
Social Distance landlord-tenant with additional controls								
l1 livingstandardl*informant class		0.289						
		(0.53)						
l2 livingstandardl*informant class		-0.468						
		(0.69)						
l1 livingstandard(informant-tenant)l			-0.016					
			(0.12)					
l2 livingstandard(informant-tenant)l			0.046					
			(0.06)					
l1 livingstandardl*land Gini								-8.534***
								(3.90)
l2 livingstandardl*land Gini								-10.299***
								(3.66)
Tenant's assets and characteristics								
Number of other plots cultivated	-0.310**	-0.314**	-0.311**	-0.310*				-0.332**
	(2.10)	(2.16)	(2.10)	(1.85)				(2.32)
Amount of other land cultivated						-0.003*		
						(1.86)		
Amount of other land cultivated per capita							-0.006*	
							(1.75)	
Observations								
Number of landlord-plots	288	288	288	288	288	288	288	288
Average number of potential tenants per plot	80	80	80	80	80	80	79	80
Informant correlation	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes

All regressions include controls for social distance between landlord and tenant; for other tenant characteristics, and for interaction between plot-tenant characteristics
* significant at 10%; ** significant at 5%; *** significant at 1%. Absolute value of z statistics in parentheses.
[1] l1 living standardl is a dummy variable for landlord and tenant being from low and regular living standard, or from regular and high living standards.
 l2 living standardl is a dummy variable for landlord and tenant being from low and high living standards.

Table 6. Characteristics of simulated matched plots and tenants with different policy interventions

	Insecure property rights		Secure property rights			Title, protection, and no conflict with capital	Only capital
	Observed values (1)	Simulated values (2)	Title, protection, and no conflict (3)	Only title (4)	Only protection, and no conflict (5)	(6)	(7)
Quantitative effects*							
Number of plots	302	307	21%	6%	14%	54%	30%
Number of plots to poor tenants	89	89	65%	10%	57%	180%	75%
Number of tenants	246	245	13%	6%	9%	55%	45%
Number of poor tenants	85	86	59%	10%	52%	151%	72%
Total area rented (ha)	526	543	20%	4%	15%	66%	40%
Total area rented to poor (ha)	102	114	63%	11%	55%	310%	115%
Equity effects							
Percent of plots to poor tenants	29	29	40	30	40	53	39
Percent of poor among tenants	35	35	50	36	49	57	42
Percent of area rented to poor	19	21	29	22	28	52	32
Efficiency effects							
Land/labor ratio on plots rented out by poor[a]	1.01	1.13	2.94	1.24	3.1	3.46	1.32
Land/labor ratio on plots rented out by non-poor[a]	2.28	3.44	3.11	3.42	2.91	2.11	2.55
Machinery on plots rented out by poor[b]	0.23	0.39	0.59	0.38	0.61	-	-
Machinery on plots rented out by non-poor[b]	0.54	0.65	0.61	0.65	0.61	-	-
Land/labor ratio on plots owned by the poor[c]	0.88	0.75	1.42	0.80	1.42	1.75	0.79
Land/labor ratio on plots owned by the non-poor[c]	2.50	2.64	2.52	2.66	2.42	1.97	2.22

Simulations are based on estimations in Tables 2 (col. 6) and 3 (col. 4).

* Columns 3-7 report the % change relative to the simulated value in column 2.

[a] Total amount of land cultivated by the tenant household divided by the number of adult households members

[b] Dummy variable equals 1 if either landowner or tenant owns machinery

[c] Weighed average of plots rented to others and owner-cultivated plots