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3 July 2010

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Abstract

While most studies looking at the consequences of tenurial insecurity on land markets in developing countries focus on the effects of tenurial insecurity on the investment behavior of landowners, this paper studies the hitherto unexplored relationship between tenurial insecurity and contract choice in land tenancy. Based on a distinct feature of the interaction between formal law and customary rights in Madagascar, this paper augments the canonical model of share tenancy by making the strength of the landlord's property right increasing in the amount of risk she chooses to bear within the contract. Sharecropping may thus emerge as the optimal contract even when the tenant is risk-neutral. Using data on landlords' subjective perceptions of tenurial insecurity in a rural area of Madagascar, empirical tests strongly support the hypothesis that insecure property rights drive contract choice while offering little support in favor of the canonical hypothesis that risk sharing considerations drive contract choice.

Keywords: Sharecropping, Property Rights, Tenurial Insecurity, Subjective Expectations.
JEL Classification Codes: D86, K11, O12, O13, Q15.
Running Title: Insecure Land Rights and Share Tenancy

[*] I am grateful to two anonymous referees and to the associate editor in charge for valuable comments. I also thank Chris Barrett, Pierre Dubois, David Just, Ravi Kanbur, and Bart Minten for their guidance as well as several seminar audiences for comments and suggestions. I am also indebted to Nate Engle for patiently sharing his extensive knowledge of Lac Alaotra as well as to Mamy Randrianarisoa and his survey team for data assistance. I have benefited from the generous financial support received of the National Science Foundation through Doctoral Dissertation Improvement Grant SES-0350713; from USAID through grant LAG-A-00-96-90016-00 to the BASIS CRSP; and from the Social Science Research Council's Program in Applied Economics with funds provided from the John D. and Catherine T. MacArthur Foundation. All remaining errors are mine.
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1. Introduction

What are the impacts of tenurial insecurity on the behavior of individuals and households in developing countries? Do weak property rights push landowners to underinvest in improving their plots of land? Does tenurial insecurity make landowners who no longer can or want to exploit their land think twice about leasing out their plots of land and becoming landlords? Do weak property rights force landlords to discriminate between potential tenants? More generally, what actions, if any, are taken by landowners in developing countries to hedge against the risk of losing their claim to their land?

Although there exists an important literature on the impacts of tenurial insecurity on the investment behavior of landowners (see Jacoby et al. 2002; Carter and Olinto 2003; Deininger and Jin 2003 and 2006; Field 2005; and Goldstein and Udry 2008 for recent studies), the impacts of tenurial insecurity on other aspects of the land market (i.e., land sales, land tenancy, etc.) are relatively less well-known. Conning and Robinson (2007) develop a general equilibrium model in which landowners adopt inefficient measures in an effort to curb tenurial insecurity and find support for their model when testing it using data from India. Similarly, Deininger et al. (2009) report evidence that suggests that tenurial insecurity prevents the land lease market from functioning efficiently in Ethiopia, a finding echoed by Lunduka et al. (2009), who find that tenurial insecurity also constrains the functioning of the land market in Malawi. Finally, Macours et al. (2010) find that tenurial insecurity adversely affects the matching of landlords and tenants in Nicaragua, as it forces landlords to contract with socio-economically similar tenants.

This paper studies the impact of tenurial insecurity on the tenancy contracts landlords offer their tenants. Based on field observations as well as conversations with rural landowners in Madagascar, this paper first develops a transaction cost-based alternative hypothesis to the canonical risk sharing explanation. Indeed, since the seminal contribution of Stiglitz (1974), the canonical explanation for the existence of sharecropping has been that it balances out risk sharing and incentives. So when the landlord is risk-neutral or risk-averse and the tenant is risk-averse, a sharecropping contract dominates a fixed rent contract because it partially insures the tenant against production risk while still tying pay to performance. When the tenant is risk-neutral, however, there is no longer a need to insure the tenant against production risk, so that a fixed rent contract becomes optimal.

Because sharecropping has been observed in both high- and low-risk environments, however, another school of thought – the transaction costs school of thought – posits that sharecropping emerges because the presence of one or more transaction costs which make sharecropping more attractive relative to fixed rent (Cheung 1968; Allen and Lueck 2002). It could be the case, for example, that the tenant is risk-neutral but that a fixed rent contract would push him to deplete soil fertility by virtue of providing him with stronger incentives given that he gets to keep the entire crop. In this case, the landlord could choose a sharecropping contract in order to preserve soil fertility, a hypothesis for which Dubois (2002) has found empirical support in the Philippines.

The theoretical framework developed in this paper explains sharecropping as a result of an important transaction cost, viz. tenurial insecurity. That is, if the strength of the landlord's property right is an increasing function of the production risk she chooses to bear (e.g., as she would in a fixed rent contract relative to a sharecropping contract), she might choose a sharecropping contract even when the tenant is risk-neutral, even though such a contract leaves her exposed to a sub-optimal amount of production risk and leads to moral hazard, at least in principle.[1]

The hypothesis developed in this paper is rooted in the interaction between the formal legal system and customary rights in Madagascar. Indeed, both the law and customs hold that property is a reward that varies in proportion with the effort one puts in cultivating the land, and economists have long recognized the disincentive effects of sharecropping relative to rental contracts when it comes to agricultural productivity. Moreover, the administration of lands is often left to village elders in Madagascar, and there seems to be a collective distaste for landlords who do not bear enough of the risk inherent in cultivating own plots, as in the case of a sharecropping contract relative to a fixed rent contract.

After incorporating tenurial insecurity in the canonical model, this paper then uses on the landlords' subjective perceptions of tenurial insecurity to test whether these drive contract choice. Using plot-level data from Lac Alaotra, Madagascar's most premier rice-growing region, contract choice equations are estimated that control for both the matching process and the match between the landlord and the tenant. The data ultimately strongly support the hypothesis that

[1] See Shaban (1987), Arcand et al. (2007), and Jacoby and Mansuri (2009) for evidence in favor of moral hazard in India and Pakistan, respectively. Sadoulet et al. (1997), however, find that contracts between kin eliminate the moral hazard problem in the Philippines. Likewise, Kassie and Holden (2007) find that the threat of eviction eliminates moral hazard in Ethiopia, but that this effect disappears in contracts between kin. Lastly, Braido (2008) finds no evidence of moral hazard due to sharecropping in India, finding instead that the efficiency loss arises because sharecropping typically occurs on lower-quality land than fixed rent. Given data limitations, it is not possible to conduct a cleanly identified test of moral hazard in the present context.

tenurial insecurity drives contract choice but offer little to no support in favor of the canonical risk sharing hypothesis. In short, for a one-percent increase in the landlord's subjective perception of the degree of tenurial insecurity, the likelihood of observing a sharecropping contract increases by two percent on average.

This paper therefore offers a threefold contribution to the literature. First and foremost, whereas the majority of studies looking at tenurial insecurity focus on investment, this paper studies the hitherto unexplored relationship between tenurial insecurity and contract choice on the land tenancy market.

Second, this paper contributes to the growing literature on subjective expectations in development economics (Luseno et al. 2003; Doss, McPeak, and Barrett 2006; Lybbert et al. 2007; Cardenas and Carpenter 2008; see Delavande et al. 2010 for a survey of the literature) by eliciting subjective assessments of tenurial insecurity from landlords and using these to test the implications of the theory. Moreover, this paper is the first to incorporate subjective expectations in an applied contract-theoretic setting, in this case the subjective expectations of the principal regarding her risk of losing a productive asset contracted upon.[2]

Third, this paper studies the oft-observed yet relatively unknown institution known as "reverse tenancy," i.e., land tenancy in which the landlord is poorer than the tenant, which is very frequent in Madagascar (Minten and Razafindraibe, 2003) and which has also been observed in

[2] Given that data collection focused on the contracts themselves and not on land redistribution mechanisms or village-level institutions, this paper takes tenurial insecurity as given. Although it would be of interest to open the "black box" of tenurial insecurity and land redistribution, it is beyond the scope of this paper to do so. Bellemare (2009) studies the determinants of the subjective expectations used in this paper and finds that few, if any, variables explain how these subjective expectations are formed.

places as diverse as Bangladesh (Pearce 1983), Eritrea (Tikabo 2003), Ethiopia (Bezabih 2007), India (Singh 1989), Lesotho (Lawry 1993), Malaysia (Pearce 1983), the Philippines (Roumasset 2002), and South Africa (Lyne and Thomson 1995). In such cases, however, if tenants are risk-neutral (or act as if risk-neutral because they have better opportunities for diversifying risk or better access to insurance by virtue of being wealthier), the canonical model is inconsistent with the existence of reverse share tenancy, and it needs to be modified to account for whatever makes the existence of reverse share tenancy possible. This paper modifies the canonical model so as to accommodate the existence of reverse share tenancy if tenants can indeed be assumed to be risk-neutral.[3] Moreover, if the tenurial insecurity hypothesis developed in this paper is supported by the data, it may be useful to know whether tenurial insecurity plays a more important role for landlords who are poorer than their tenants than for the average landlord.

The remainder of this paper is organized as follows. In section 2, some background on land tenancy and the contractual environment in Madagascar is given with emphasis on the interaction between formal and informal institutions that combine to give rise to tenurial insecurity. Section 3 extends the canonical principal-agent model of land tenancy by endogenizing the strength of the landlord's property right to make it a function of the contract terms, thereby introducing a potentially important transaction cost. In section 4, the empirical framework used to test the tenurial insecurity hypothesis developed in this paper along with the usual risk sharing hypothesis is presented, giving special attention to identification and testing strategies. Section 5 presents the data and some descriptive statistics. In section 6, the estimation results are presented, and hypothesis tests are conducted which offer strong support for the

[3] Indeed, if no one could be assumed risk-neutral or to act as if risk-neutral because of better opportunities for risk diversification or better access to insurance, one would never observe fixed rent contracts in the real world.

tenurial insecurity hypothesis but only limited support for the risk sharing hypothesis. Section 7 concludes.

2. Background and Contractual Environment

The tenurial insecurity hypothesis put forth in this paper may seem *prima facie* surprising. Although the impacts of eviction threats on tenant behavior have been explored both theoretically (Banerjee and Ghatak 2004) and empirically (Kassie and Holden 2007 and 2009), the hypothesis that the strength of a landlord's claim to her plot of land could be a function of how much risk she chooses to bear when leasing her plot out is unheard of under more familiar (i.e., Western) legal systems. Yet this was the reason invoked by several landowners for choosing sharecropping over fixed rent during preliminary visits to Madagascar, where landlords who choose not to bear any production risk are often perceived as uninterested in their land and are thus discussed with contempt by third parties.

Indeed, in his chapter on tenure security in Madagascar, Teyssier (1998) notes how the Lac Alaotra region, where the data used in this paper have been collected, has been attracting migrants since the 19th century. For the Sihanaka (i.e., the dominant ethnic group in Lac Alaotra), the land belongs to the individuals who were born on it. The land where one was born is therefore not perceived only as simply production input: in a country where the cult of the ancestors regiments one's existence, it also serves as a link between one and one's ancestors. Teyssier (1998, 586) writes that for other ethnic groups, who have composed the bulk of the immigration to Lac Alaotra, however "[t]he land belongs to the individual who cultivates it. This conception is also that of the central government, for whom the titling of a portion of the private national domain in an individual's name is necessarily associated with previous cultivation by the same individual. *Property is thus conceived of as a 'reward' that varies in proportion to the effort put in cultivating the land.*" [Emphasis added.]

Recall that in the canonical principal-agent model of land tenancy (Stiglitz 1974), the provision of effort by the tenant is curbed by the weaker incentives provided by a sharecropping contract relative to a fixed rent contract. It is likely that this is directly taken into account by landlords when contemplating whether to offer their tenants a sharecropping or a fixed rent contract. In his descriptive study of sharecropping in Lac Alaotra, Charmes (1975) notes how landlords in sharecropping contracts are almost always involved in some aspect of production (e.g., plowing, pricking out, harvesting, threshing, husking, and milling), whereas the involvement of landlords in fixed rent contracts is only consists in providing the plot of land on which production takes place.

Likewise, in his case study of the informal economy of lower Antananarivo, Turcotte (2006, 330) hints at the fact that tenurial insecurity drives contract choice when he writes that

"[a]ccess to rice is related to the property rights which some individuals still have on inherited plots (…). Although it occurs that rice plots owned in the countryside (or in town) are not exploited or are exploited by and for someone else, one is more likely to lease out such plots under a sharecropping agreement to one's kin or to someone whom one trusts." [Author's translation.]

What conditions lead to the emergence of a land rights system in which the terms of the contract chosen by the landlord affect her likelihood of retaining her claim to the land? As is often the case in Sub-Saharan Africa (Platteau 2000), formal legal institutions coexist with customary rights in Madagascar. According to Karsenty and Le Roy (1996), land is conceived of as the land of the ancestors in Madagascar, and in rural areas, the activities of the living largely focus on preserving the land of the ancestors. Consequently, land can only become private property if it is titled, the process leading to which is not only extremely slow and costly in terms of both time and money, but also perceived as useless by 25 percent of Minten and Razafindraibe's (2003) respondents. In many communities the administration of plots is left to the village elders, who allocate plots to members of the clan. Further, Malagasy tradition holds that (i) taking possession of the fruits of the land; and (ii) bearing agricultural risk both ensure continued access to the land, much as direct cultivation does under more familiar property rights regimes.

Formal institutions which may have been put in place so as to make informal institutions official also contribute to the landlords' perceptions of tenurial insecurity in Madagascar. First, under Western property rights regimes, one often encounters the legal doctrine of adverse possession, which holds that an individual may take possession of a plot of land belonging to another by occupying or exploiting it for a certain amount of time (Posner 2007). In Madagascar, Keck et al. (1994, 47) write that

"[i]n 1962 and 1964, legislation defined property rights as more than a right to enjoy and dispense of one's property in an absolute sense; property rights represented an ensemble of prerogatives defined by the greater public good. Thus, property took on a more prominent social function; individuals unable to use the land had no right to keep it, and the land was to be transferred to a more productive owner/user."

It is thus possible for a tenant to obtain his landlord's plot legally through adverse possession, which is often dependent on the general attitude towards rights to future use, about which Posner (2007, 49) writes that it is itself "related to the age-old hostility to speculation – the purchase of a good not to use but to hold in the hope that it will appreciate in value." Even more important for the tenurial insecurity hypothesis however, Keck et al. (1994, 48) note further that

"[o]rdinance 74-022 developed additional specifications for land improvement in rural areas. (…) Once the land improvement work was complete, the beneficiary could either become the owner or remain as a land user. In either case, the beneficiary was expected to work the land in a 'rational fashion' in keeping with a set of pre-established conditions."

Adam Smith (1776, 1976) himself had intuited that sharecroppers face fewer incentives to make improvements to the land than fixed renters, as formalized by Johnson (1950). In this sense, according to the formal legal system in Madagascar, if a landlord wishes to maximize her chances of keeping her claim to her plot of land, she may be better off bearing some production risk by offering her tenant a sharecropping rather than a fixed rent contract. In the data used in the application below, 48 percent of fixed rent tenants versus 40 percent of sharecroppers had invested in improving the land.

Lastly, the land sales market is exceptionally thin in Madagascar, where only 3 percent of households in the nationally representative data set used by Randrianarisoa and Minten (2001) reported having sold land in the last five years and only 13 percent of the plots in the nationally representative data set used by Minten and Razafindraibe (2003) had been purchased by their owners. The land rental market is comparatively more active with almost 8 percent of cultivated land under some form of tenancy. According to Randrianarisoa and Minten, the land rental market mostly allows households from the middle of the income distribution to lease in land from both poorer and wealthier households.

The data used in the application below show that in Lac Alaotra, 37 percent of all plots are leased out, and 24 percent of all plots are sharecropped. In addition, reverse tenancy occurs on 22 percent of plots if one looks at household wealth levels (a precise definition of which is given below; this number and the core findings in this paper do not change substantially whether one looks at household wealth in levels, per capita, or per adult equivalent), and over 15 percent of plots are under reverse share tenancy, i.e., sharecropping in which the landlord is poorer than the tenant.

3. Theoretical Framework

This section develops a dynamic principal-agent model in which sharecropping can emerge as the optimal contract even when the tenant is risk-neutral. This result hinges upon the presence of tenurial insecurity, in a way such that the more (less) production risk is borne by the landlord, the stronger (weaker) her subsequent claim to the land.

The model developed in this section thus nests both the canonical principal-agent model of share tenancy as well as the transaction cost-based explanation developed in this paper. As such, it is closely related to that of Dubois (2002), but with one important difference: whereas in Dubois' model, the terms of the contract influence future production possibilities via tenant effort, in this paper, the terms of the contract affect the landlord's (expected) plot value.

Assume a production technology $f(e_t)$, where e_t is effort in period t, $f_e > 0$, $f_{ee} < 0$, and $f(\cdot)$ is twice continuously differentiable. Assume further that $f(\cdot)$ is linear homogeneous with respect to land. For a fixed amount of land h_t, the production function is such that $q_t = \upsilon_t f(e_t)$, where υ_t is an exogenous shock with $E(\upsilon_t) = 1$.

The law of motion for the plot under contract is $h_t = s(a_t)h_{t-1} + \epsilon$, where a is the share of output that goes to the tenant and ϵ is an exogenous shock with $E(\epsilon_t) = 0$ so that $E(h_t) = s(a_t)h_{t-1}$.[4] The function $s(\cdot)$ represents the strength of the landlord's property right (i.e., her tenurial security), with $s_a < 0$.

Assume that the landlord is risk-averse and, without any loss of generality, that the tenant is risk-neutral. The tenant's expected payoff is then such that

$$a_t E[\upsilon_t f(e_t)] + b_t - \psi(e_t), \qquad (1)$$

where b_t is a side payment and $\psi(\cdot)$ is the agent's effort cost function, $\psi_e > 0$, $\psi_{ee} > 0$, and $\psi(\cdot)$ is twice continuously differentiable. Likewise, the landlord's expected payoff is such that

$$EU[(1 - a_t)\upsilon_t f(e_t) - b_t], \qquad (2)$$

where $U(\cdot)$ is a von Neumann-Morgenstern utility function such that $U' > 0$, $U'' < 0$, and $U(\cdot)$ is twice continuously differentiable. Finally, let $\overline{U}$ denote the tenant's reservation utility. Then, the landlord's problem is to solve

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[4] As in Dubois (2002), this section focuses on linear contracts, both because the tools of contract theory do not allow determining the shape of the optimal contract in a dynamic setting and because linear contracts are used in the vast majority of land tenancy agreements in the real world, probably as a means of eliminating contracting costs.

$$v_0(h) = \max_{a_t,b_t} E_{v_t,\epsilon_t} \sum_{t=0}^{\infty} \delta^t \, EU[(1-a_t)v_t f(e_t) - b_t] \text{ s.t., } \forall t \geq 0 \tag{3}$$

$$a_t E[v_t f(e_t)] + b_t - \psi(e_t) \geq \overline{U}, \tag{4}$$

$$e_t \in \operatorname{argmax}_{\hat{e} \in E} \, a_t E[v_t f(e_t)] + b_t - \psi(e_t), \text{ and} \tag{5}$$

$$E(h_t) = s(a_t)h_{t-1}, \tag{6}$$

where $\delta \in (0,1)$ is the landlord's discount factor.

Applying the first-order approach (Rogerson 1985; Jewitt 1987), one can rewrite the agent's incentive compatibility constraint as

$$a_t E[v_t f_e] - \psi_e = 0. \tag{7}$$

The Bellman equation for the above problem is then

$$v_0(h_0) = \max_{a,b} EU[(1-a)vf(e) - b + \delta v_0(h_1)] \text{ , s.t.} \tag{8}$$

$$aE[vf(e)] + b - \psi(e) \geq \overline{U}, \text{ and} \tag{9}$$

$$aE[vf_e - \psi_e] = 0, \tag{10}$$

where h_0 denotes initial plot size, and $h_1 = s(a)h_0 + \epsilon$. Before deriving the optimal contract, however, it is necessary to establish the following results.

Lemma 1 Tenant effort is increasing in crop share, i.e., $e_a > 0$.

Proof From equation 7, $a = \psi_e / E[\upsilon f_e]$. As a increases, $\psi_e / E[\upsilon f_e]$ also increases. Since $\psi_{ee} > 0$ and $f_{ee} < 0$, this means that as a increases, $e(a)$ also increases, so that $e_a > 0$. ■

Lemma 2 The side payment is decreasing in crop share, i.e., $b_a < 0$.

Proof From equation 4, the side payment is such that $b(a) = \overline{U} + \psi\big(e(a)\big) - aE[\upsilon f(e(a))]$. But then, $b_a = -e_a\{aE[\upsilon f_e] - \psi_e\} - E[\upsilon f(e)]$, and from equation 7, $aE[\upsilon f_e] - \psi_e = 0$ at an optimum, so that $b_a = -E[\upsilon f(e)] < 0$. ■

Lemma 3 The value function is strictly increasing, i.e.,$v_0' > 0$.

Proof See Stokey and Lucas (1989). ■

Lemma 4 The value function is strictly concave, i.e., $v_0'' < 0$.

Proof See Stokey and Lucas (1989). ■

These intermediate results then lead to the following results.

Proposition 1 (Optimal Contract) *Given the assumptions made so far, in the presence of tenurial insecurity, sharecropping emerges as the optimal contract between a risk-averse landlord and a risk-neutral tenant.*

Proof To solve the Bellman equation, one must compute the first-order condition with respect to a. Using the substitution method to solve yields the crop share in the optimal contract, a^*, such that $a^* = 1 + \frac{\delta E v_0' s_a h}{E v U' f_e e_a}$, where the first term is the first-best (i.e., fixed rent) contract and the second term is the effect of tenurial insecurity, i.e., the strength of the landlord's claim to the land. Since all the variables in the second term are positive except for s_a, the incentives are weaker than under the first-best contract, and sharecropping emerges as the optimal solution. ■

Proposition 2 (Comparative Statics) *Given the assumptions made so far, in the absence of tenurial insecurity, the landlord offers the tenant a sequence of fixed rent contracts, i.e.,* $a^* = 1$ *in all time periods. With tenurial insecurity,* $\frac{da^*}{ds_a} > 0$, *i.e., the stronger the landlord's claim to the land, the more likely she is to offer the tenant a fixed rent contract. Conversely, the weaker her claim to the land, the more likely she is to offer a sharecropping contract.*

Proof Taking the derivative of the slope of the optimal contract with respect to s_a yields , $\frac{da^*}{ds_a} = \frac{\delta[E v_0' h + E v_0'' a^* s_a h^2]}{E v U' f_e e_a} > 0$, so as s_a increases, the slope of the optimal contract increases. Because $s_a < 0$, in the limit, $s_a = 0$ and $a^* = 1$, i.e., without tenurial insecurity, a fixed rent (i.e., first-best) contract obtains between a risk-averse landlord and a risk-neutral tenant. With tenurial insecurity, however, $a^* < 1$. ■

Proposition 2 provides a useful testable implication: given data on the landlords' perception of tenurial insecurity and on the contracts they choose, one can test the null hypothesis that tenurial insecurity has no effect on the probability of observing a sharecropping contract relative to the probability of observing a fixed rent contract. In what follows, this hypothesis is tested concurrently with the usual risk sharing hypothesis to determine what causes of share tenancy to emerge in the data.

4. Empirical Framework

The core specification of the contract choice equation to be estimated in this paper is such that

$$y_i = \alpha + \beta_P x_{Pi} + \beta_L x_{Li} + \beta_T x_{Ti} + \gamma s_{ai} + \epsilon_i, \quad (11)$$

where i denotes the plot; $y_i = 1$ if plot i is under fixed rent and $y_i = 0$ if it is under sharecropping; x_P, x_L, and x_T are vectors of plot-, landlord household- and tenant household-specific characteristics; s_a is the variable of interest, a discussion of which can be found below; and ϵ is an error term with mean zero. Equation 11 is estimated by ordinary least squares (OLS) with robust standard errors, and thus constitutes a reduced form linear probability model (LPM) of contract choice.

One could estimate a probit or a logit instead of an LPM, but the latter is chosen so as to simplify the interpretation of the estimated coefficients. In the LPM defined by equation 11, each estimated coefficient can be interpreted as the percentage change in the likelihood of observing a fixed rent contract rather than a sharecropping contract resulting from a unit change in the explanatory variable it is attached to. In addition, while it is common to estimate equation 11 by estimating a probit or a logit because (i) the predictions of the LPM can in principle lie outside the $[0,1]$ interval; and (ii) its error variance is not constant, i.e., its error term is heteroskedastic, the goal of this paper is not to forecast contract choice but to study the structural relationships between contract choice and a few key explanatory variables; and all equations are estimated with robust standard errors. The following sections discuss in turn the identification and testing strategies relied upon in this paper.

4.1 Identification Strategy

Estimating equation 11 would pose no particular problem if ϵ_{1i} were orthogonal to x_P, x_L, x_T, and s_a. In practice, however, endogeneity problems plague the cross-sectional analysis of contracts.

A well-known problem is the endogenous matching between landlords and tenants (Ackerberg and Botticini 2002). In this context, an endogenous matching problem could arise because wealth is used as a proxy for risk aversion. Let w_L and w_T denote the wealth levels of the landlord and the tenant, which are used here as proxies for risk preferences. In other words, $w_L = r_L + \zeta_L$, and $w_T = r_T + \zeta_T$, where r_L and r_T are the landlord and the tenant's coefficients of absolute or relative risk aversion and ζ_L and ζ_T are error terms included in ϵ_{1i} when relying on wealth as a proxy for risk aversion. But then, if the landlord and the tenant match along risk preferences (i.e., if w_L is correlated with ζ_T or w_T is correlated with ζ_L,), the estimated coefficients for the wealth levels are biased.

In order to control for the possibility that there is endogenous matching in the data, two types of controls are included. The first is a set of dummy variables that control for how the landlord and the tenant came to know each other. The second is a set of dummy variables that control for why the landlord chose this particular tenant. These two sets of dummy variables are discussed further below, when describing the data.

For some, another potentially important endogeneity problem could result from the selection of landowners into landlord status. Indeed, Dubois (2002) estimates a two-stage empirical model in which the first-stage equation accounts for the landowner's selection into landlord status (i.e., the decision to lease the plot out) and in which the second-stage equation accounts for the landlord's choice of contract. This paper does not model the decision to lease out and focuses instead on contract choice conditional on the fact that the landowner has chosen to become a landlord.

Indeed, it is important for the econometrician to control for selection in a context where one wishes to generalize his findings to an entire population. For example, when one wants to know whether the vitamin C absorbed from consuming orange juice has positive effects on health, one needs to estimate those impacts for everyone in the population, and not just on the subset of the population who already consumes orange juice, who may be consuming orange juice because they are *a priori* more health-conscious individuals. In this context, however, it makes little sense to want to generalize the findings of the contract choice equation to everybody, since not every landowner is a potential landlord. Consequently, because no attempt is made at controlling for the selection of landowners into landlord status, it stands to reason that the findings in section 5 below are only valid for the subset of the landowner population that selects into landlord status.

Ultimately, clean identification is difficult if not impossible to obtain when conducting applied work on contracts using cross-sectional data. To generalize to an entire population of landlords, the ideal observational data set would include (i) experimentally-derived (rather than estimated) measures of risk aversion for each landlord and each tenant (Lybbert and Just 2007); and (ii) multiple observations for each landlord, each tenant, and each landlord-tenant match so as to allow controlling for the unobserved heterogeneity between landlords, tenants, and matches via landlord, tenant, and match fixed effects. Such an ideal data set, however, would be extremely costly and time-consuming to collect, and nothing guarantees that there would be enough variation in the contracts entered by each party or in the landlord-tenant matches observed. People tend to contract with the same partners, and they tend to enter to the same contracts over and over. As a consequence, in most cases, the best one can do is to include a rich enough set of controls.

4.2 Testing Strategy

This section discusses how the tenurial insecurity hypothesis developed above is tested along with the canonical risk sharing hypothesis concurrently in this paper.

To test the risk sharing hypothesis, the landlord's choice of contract is regressed on proxies for the landlord and the tenant's risk preferences, as in Laffont and Matoussi (1995), Ackerberg and Botticini (2002), Dubois (2002), and Fukunaga and Huffman (2009). Following Bellemare and

Brown (2010), however, when using wealth or income as a proxy for risk aversion, one can only test that (i) the landlord is risk-neutral or her preferences exhibit constant absolute risk aversion (CARA); and (ii) the agent is risk-neutral.[5] Letting β_{W_L} and β_{W_T} denote the coefficients attached to the landlord and the tenant's wealth levels, one can therefore only test the null hypothesis $H_0: \beta_{W_L} = 0 \; and \; \beta_{W_T} = 0$ versus the alternative hypothesis $H_A: \beta_{W_L} \neq 0 \; and \; \beta_{W_T} \neq 0$. This means that a rejection of the null is not very informative in this context, as it only serves to reject that the landlord is risk-neutral or her preferences exhibit CARA and the tenant is risk-neutral. Moreover, we know from first principles that failing to reject the null is not informative, given that it does not allow one to accept the null. At best, failing to reject the null suggests that the conditions posed in the null hypothesis *may* hold in the data.

Turning to the tenurial insecurity hypothesis, given that the landlord's optimal choice of contract in the tenurial insecurity model depends on s_a rather than on $s(a)$, the following identification strategy is adopted. The landlords' subjective perceptions of tenurial insecurity (i.e., the inverse of $s(a)$; that is, $1 - s(a)$) were elicited as follows during the survey.

Given the contract signed by the landlord with her tenant, the landlord was given 20 tokens and asked to distribute them between two boxes, one labeled “0”, and one labeled “1”. The landlord was told that the latter box represented a state of the world where she lost her claim to the land as a result of the contract signed, whereas the former box represented a state of the world where she kept her claim to the land. Data on the landlord's hypothetical perception of tenurial insecurity

[5] See section 4 for a precise definition of wealth in the context of this paper.

under the alternate contract were also collected.[6] This allows computing the discrete change in $s(a)$ due to a (hypothetical) change of contracts from sharecropping to fixed rent.

To do so, let $s(1)$ and $s(0.5)$ respectively denote the perceived security of tenure of a landlord entering a fixed rent or sharecropping contract, and $s^h(1)$ and $s^h(0.5)$ respectively denote the hypothetical security of tenure of a landlord entering a fixed rent or sharecropping contract.[7] The variable of interest in testing the tenurial insecurity hypothesis (i.e., s_a) can then be computed as follows:

$$s_a = \frac{\Delta s(a)}{\Delta a} = \left[\frac{s^h(1)-s(.05)}{1-0.5}\right]^{I(a=0.5)} \cdot \left[\frac{s(1)-s^h(0.5)}{1-0.5}\right]^{I(a=1)}, \qquad (12)$$

where $I(\cdot)$ is an indicator function equal to one if the condition between the parentheses is true and equal to zero otherwise.

Because *a* takes only two discrete values in the data, $s(a)$ has no curvature, i.e., $s_{aa} = \frac{\Delta^2 s(a)}{\Delta a^2}$ is undefined. This allows assuming that s_a is exogenous in the contract choice equation. Intuitively, because there are only two possible values of contract choice, which contract is chosen has no effect on the *rate* at which the likelihood of keeping the land changes as contract choice changes, because such a rate is undefined. There are no second-order effects of *y* on *s*, so that the rate of change in the landlord's perceived likelihood of keeping her plot due to a change of contract choice is exogenous to contract choice.

[6] This is the perception of tenurial insecurity under the alternative contract. The two tenurial insecurity questions were asked four months apart to eliminate the risk of anchoring (Tversky and Kahneman, 1982).
[7] For all sharecropping contracts in the data, *a* = 0.5.

In other words, the landlord's perception of tenure security does not depend on the chosen contract but is driven by social norms. The exogeneity of s_a is further justified by the fact that almost 80 percent of landlords have been involved in land tenancy in the past, and so their subjective expectations of tenure security were already formed prior to signing the current contract.

For s_a then, the null hypothesis is thus $H_0: \frac{\partial y}{\partial s_a} = 0$ versus the alternative hypothesis $H_0: \frac{\partial y}{\partial s_a} \neq 0$, i.e., a test of whether the change in perceived security of tenure due to a change in contract decreases the likelihood of observing a sharecropping contract. Consequently, rejecting the null in favor of $H_0: \frac{\partial y}{\partial s_a} > 0$ will provide support in favor of the tenurial insecurity hypothesis. Lastly, $\gamma = \frac{\partial y}{\partial s_a}$ can be interpreted below as the change in the likelihood of observing sharecropping over fixed rent due to a 100 percent increase in s_a, so $\gamma/100$ gives the percentage change in the likelihood of observing sharecropping over fixed rent due to a 1 percent increase in s_a.

5. Data and Descriptive Statistics

The data used in this paper were collected by the author in Lac Alaotra, Madagascar, between March and August 2004. Lac Alaotra, which lies about 300 km to the northeast Antananarivo, is the country's premier region for rice cultivation. Since sharecropping is mostly observed on rice plots in Madagascar (Karsenty and Le Roy 1996), that rice is the Malagasy staple, and that previous studies of sharecropping in Madagascar focused on Lac Alaotra, it is natural to focus on that region for the first formal empirical study of share tenancy in Madagascar.[8]

The survey methodology was as follows. First, the six communes with the highest density of sharecropping around Lac Alaotra were selected from the 2001 commune census conducted by Cornell University in collaboration with Madagascar's Institut national de la statistique and Centre national de la recherche appliquée au développement (Minten and Razafindraibe 2003).[9] Then, the two villages with the highest density of sharecropping were chosen in each commune after determining the density of sharecropping in each village by going through communal records. In an effort to oversample sharecropping so as to increase precision, five households known not to lease in or lease out land were selected, five households known to lease in or lease out under a fixed rent contract were selected, and 15 households known to lease in or lease out under a sharecropping contract were selected in each village. All households were within the sampling frame in each village, and so the end result is a sample of 300 selected households.[10]

For each selected household, data were collected at the plot, household, and contract levels. Household- and (leased-in) plot-level data for the tenants of the 300 selected households and household-level and contract-level data for the landlords of the 300 selected households were then collected. The data covered a total of 1,029 plots, 387 of which were under land tenancy.

[8] See the descriptive studies of sharecropping in Lac Alaotra by Charmes (1975) and Jarosz (1990, 1991).
[9] A commune is roughly the equivalent of a district in the United States.
[10] All descriptive statistics and estimation results control for the oversampling of households that enter sharecropping agreements by using sampling weights. Ideally, one should also control for the choice-based nature of the sample (Manski and Lerman, 1977). Unfortunately, population proportions at the contract-level have never been collected in Madagascar, making the choice-based sampling correction impossible to implement.

Because of missing data, the empirical application below retains a sample of 353 land tenancy contracts. Table 1 defines some of the variables used in the estimation.

Table 2 presents descriptive statistics for the variables used in the contract choice equation. Almost 70 percent of the plots are sharecropped, with the remaining 30 percent leased out under a fixed rent contract. The average plot covers a little over one hectare, is worth about US$650 to its owner,[11] and roughly 40 percent of the plots are titled.[12] Almost 87 percent of the plots in the data are rice plots with the remainder split two to one between lowland and hillside plots, and the average plot is 33 walking minutes away from the landlord's house.

The average landlord household is composed of 5.5 individuals, a little under half of whom are dependents (i.e., under the age of 15 or over the age of 64). About fifteen percent of landlords are female, and the average landlord is 53 years old and has five years of formal education. In terms of resources, the average landlord household has US$107 worth of assets per capita, and an annual income per capita of US$53.[13] Lastly, 25 percent of landlords report being liquidity-constrained, proxied here by whether the landlord or his wife requested a formal or an informal loan in the 12 months preceding the survey.

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[11] US$1 ≈ 2000 Ariary.

[12] Due to an error in survey design, both the plot value and the formal title dummy variables had to be imputed. See appendix table A1 for the imputations. Robustness checks were conducted that omitted these imputed variables, which did not change the core findings of this paper.

[13] The value of landholdings is omitted from wealth calculations given that land markets are extremely thin in Madagascar. Minten and Razafindraibe (2003) report that only 13 percent of the plots in their nationally representative sample had been purchased by their owners, and that 73 percent of plots had been inherited. While it is easy to recover land value in the former case, it is near impossible in the latter case, and although a household's landholdings are an important factor in determining its wealth, its livestock holdings, which are included in this paper's measure of assets, are often a better indicator of household wealth (Minten and Razafindraibe 2003).

Turning to tenants, the average tenant household is composed of 5.7 individuals, a little under half of whom are dependents. The average tenant is 39 years old and has six years of formal education. In terms of resources, the average tenant household has US$150 worth of assets per capita and an annual income per capita of US$54. Lastly, 37 percent of tenants report being liquidity-constrained, also proxied here by whether the tenant or his wife requested a formal or an informal loan in the 12 months preceding the survey.

Comparing landlords and tenants, household characteristics are mostly similar between parties to the contract, but while the levels of income per capita of landlord and tenant households are similar, tenants are on average 41 percent than landlords, given their respective levels of assets per capita. Although tenants are on average wealthier than landlords, tenants are more likely to be liquidity-constrained. This is not inconsistent with the fact that landlords are poorer than their tenants in these data. Indeed, the liquidity constraint dummies measure whether household heads or their wives have requested a formal or an informal loan during the 12 months preceding the survey. As such, landlords were simply less likely to request loans than their tenants, so that the liquidity constraint dummies are really lower bounds.

As regards the match and the matching process between the average landlord and the average tenant, sixty-five percent of land tenancy agreements in the data are signed between kin, with the remainder signed between the landlord and a friend (27 percent) or a stranger introduced by kin (5 percent) or someone else (3 percent). The high proportion of kin contracts is consistent with the theoretical hypothesis of tenurial insecurity. Indeed, with tenurial insecurity, contracting with kin might offer partial insurance against adverse possession. Of course, this is merely suggestive, as it does not control for confounding factors.

In cases where the landlord was considering more than one potential tenant, she chose the current tenant for his honesty in 14 percent of cases, for his wealth in 8 percent of cases, for his ability to bear risk in less than 1 percent of cases, to return a favor in less than 1 percent of cases, and for other reasons in the remainder of cases. The average landlord spent 1.2 days looking for a tenant and considered 1.5 other potential tenants, and the average landlord-tenant match has lasted for two years.

Tables 3 and 4 report descriptive statistics for the same variables respectively by contract choice (i.e., by whether an observation is a sharecropping or a fixed rent contract) and by type of tenancy (i.e., by whether an observation constitutes a case of "regular" tenancy, in which the landlord is wealthier than the tenant, or a case of reverse tenancy, in which the landlord is poorer than the tenant).

Table 3 indicates that hillside plots are more likely to be leased out under a sharecropping contract. If the tenurial insecurity hypothesis developed in this paper turns out to be supported by the data, this would be consistent with Teyssier's (1998) observation that hillside plots are among the most contested ones in Lac Alaotra. Irrigated plots are more likely to be leased out under a fixed rent contract. Although landlord individual and household characteristics do not differ significantly between sharecropping and fixed rent contracts, sharecroppers tend to be less educated and their households tend to have higher dependency ratios than tenants in fixed rent contracts. Sharecroppers also have lower incomes per capita than tenants in fixed rent contracts, suggesting that as his income increases, a tenant becomes more likely to accept bearing more risk. This presupposes, however, that risk aversion is decreasing in income, and that income is a valid proxy for risk aversion. Lastly, when the landlord chooses her tenant in order to return a favor, she is more likely to choose a sharecropping contract.

Similarly, table 4 indicates that plots under reverse tenancy agreements are more likely to be titled than plots under regular tenancy and that plots under reverse tenancy agreements are on average further away from the landlord's house than plots under regular tenancy. Leaving aside the wealth difference between landlord and tenants (along which the concepts of regular and reverse tenancy are defined in this paper, so that the wealth ordering observed in table 4 is true by construction), landlords in reverse tenancy agreements are significantly older and less educated, and they have substantially lower incomes than landlords in regular tenancy agreements. Although landlords in reverse tenancy agreements are less likely to report being liquidity-constrained than landlords in regular tenancy agreements, recall that this variable only measures whether the landlord has requested a formal or an informal loan which was then denied during the 12 months preceding the survey. Consequently, the sign of the difference likely reflects the landlord selection into requesting loans. Tenants in reverse tenancy agreements have significantly smaller households and are more educated than tenants in regular tenancy agreements, and they also have substantially higher incomes than tenants in regular tenancy agreements. Surprisingly, landlords in sharecropping agreements (table 3) or in reverse tenancy (table 4) are neither more likely to be female nor more likely to be elderly, two findings which contradict the conventional wisdom about land tenancy in Madagascar (Jarosz 1990 and 1991) and about reverse tenancy elsewhere (Bezabih 2007), which often talks of landlords in reverse share tenancy agreements being disproportionately single, elderly women.

Looking at the differences between the landlord-tenant match and the matching process between the landlord and the tenant between the regular and reverse tenancy sub-samples, the landlord and the tenant are slightly more likely to be kin under regular than under reverse tenancy, but while this difference is statistically significant, it barely registers as economically significant. Lastly, tenants in regular tenancy agreements are more likely to have been chosen for their honesty or because the landlord owe them a favor than tenants in reverse tenancy agreements.

Finally, turning to the variable of interest in this paper, i.e., the subjective expectations of the landlord, table 5 reports the average landlord's perceptions of tenurial security, i.e., her subjective perception of the likelihood that she will retain her claim to the land. Table 5 is split into three panels. The upper panel of table 5 reports subjective expectations for the full sample of all land tenancy contracts in the data. Then, because there is a large proportion of reverse tenancy (i.e., contracts in which the landlord is poorer than the tenant) in the data, the middle and bottom panels of table 5 respectively report subjective expectations for the "regular" tenancy (i.e., contracts in which the landlord is wealthier than the tenant) and reverse tenancy sub-samples.

In all three panels, landlords are highly confident that they will retain their plot of land whether one considers actual (i.e., under the contract signed) tenure security $s(a)$; hypothetical (i.e., under the alternative contract) tenure security $s^h(a)$; tenure security under sharecropping $s(0.5)$; or tenure security under fixed rent $s(1)$.

Indeed, in all cases, landlords report subjective perceptions of tenure security above 98 percent. Such high percentages are not inconsistent with the theoretical model of section 2, since individuals commonly overweight small-probability events (Kahneman and Tversky 1979). Nagin et al. (2002), for example, conducted a field experiment in which even a likelihood as low as 3 percent of being monitored managed to induce optimal effort on the part of call center employees, and recent field experiments in China have shown that farmers significantly overweight small-probability events (Liu 2008). In this case, if the tenurial insecurity hypothesis for the emergence of share tenancy developed in section 2 is true, landlords seemingly overweight the probability of losing their plots.

More telling is the change in s_a associated with a move from sharecropping to fixed rent. In all three panels of table 5, a positive change in s_a is associated with a move from sharecropping to fixed rent. Using the notation of section 4, this suggests that $\frac{\partial y}{\partial s_a} > 0$, which is the empirical equivalent of proposition 2 above. Of course, this merely suggests that the hypothesized relationship between tenurial insecurity and land tenancy holds in these data given that it fails to control for confounding factors. The next section investigates the relationship between tenurial insecurity and land tenancy more rigorously.

6. Empirical Results

Table 6 presents estimation results for the contract choice equation presented in equation 11. The first column reports estimation results for a naïve specification that fails to control for the match and the matching process between the landlord and the tenant, and the second column reports estimation results for a specification that controls for the match and the matching process between the landlord and the tenant.

In the naïve specification in column 1, irrigated plots are more than 20 percent more likely to be leased out under fixed rent than non-irrigated plots, perhaps because production is irrigated plots than it is on rain-fed plots. On the landlord's side, every additional year of age increases by 0.5 percent the likelihood of observing a fixed rent contract, and every additional year of education increases it by 2 percent. This last finding could mean that better educated landlords have a better knowledge of the law and are thus in a better position to face adverse possession claims by their tenants.

On the tenant's side, a 10 percent increase in the dependency ratio, which roughly measure labor quality within the household, implies a 3.1 percent decrease in the likelihood of observing a fixed rent contract, and for every additional $50 of income, the likelihood of observing a fixed rent contract increases by 5 percent.

This last finding offers some support for the risk sharing hypothesis as it suggests that as tenants get wealthier, they are more likely to bear more production risk. It is important to note, however, that expected utility is defined in theory over final wealth rather than on income (Bellemare and Brown 2010), so this is merely suggestive. Perhaps more importantly, this interpretation would implicitly assume that the preferences of the tenant exhibit decreasing absolute risk aversion. The wealth levels of the landlord and the tenant, however, are neither jointly nor separately significant in this naïve specification, so that if one considers wealth, it is not possible to reject that the landlord is risk-neutral or her preferences exhibit CARA and that the tenant is risk-neutral. If one considers income, however, the income levels of the landlord and the tenant are barely significant at the ten percent level.

More importantly, the tenurial insecurity hypothesis is supported by the data in this specification. Specifically, a one-percent increase in the landlord's subjective perception of tenurial security (i.e., s_a) increases the likelihood of observing a fixed rent contract by 1.9 percent, and this finding is significant at the 1 percent level.

Few things change in the specification controlling for the characteristics of the match and of the matching process between the landlord and the tenant in column 2. At the plot level, larger plots are less likely to be leased out under a fixed rent contract, but while this is statistically significant, it is only marginally economically significant: for every additional 100 square meters of plot size, the likelihood of observing a fixed rent contract decreases by 0.1 percent. Moreover, whereas the presence of irrigation on the plot entailed a 20 percent increase in the likelihood of observing a fixed rent contract in the previous specification, this is no longer significant when controlling for the characteristics of the match and the matching process. Likewise, the age of the landlord is no longer significant once the match and the matching process are accounted for.

As regards the landlord-tenant match, for every additional year the landlord and the tenant have been contracting together, the likelihood of observing a sharecropping contract increases by 2.4 percent. Laffont and Matoussi (1995) report a similar finding, with their interpretation being that successful repeated interactions lead to landlords trusting tenants a little bit more not to shirk in the face of the weaker incentives provided by a sharecropping relative to fixed rent. As for the matching process between the landlord and the tenant, for every additional potential tenant the landlord has considered before settling on her current tenant, the likelihood that she chooses a fixed rent contract decreases by 2 percent. This suggests that the more potential tenants there are, the more valuable a plot is perceived to be, and so the broader the scope for adverse possession, *ceteris paribus*.

More importantly, the tenurial insecurity hypothesis is once again supported by the data: a 1 percent increase in s_a increases the likelihood of observing a fixed rent contract by 2.2 percent, a finding that is significant at the 1 percent level. As for the risk sharing hypothesis, it is once again the case that for every additional $50 of tenant income, the likelihood of observing a fixed rent contract increases by 5 percent, which again offers some partial support for the risk sharing hypothesis. In this specification, however, one fails to reject the null hypothesis that the risk preferences of the landlord and the tenant jointly determine contract choice both when risk preferences are proxied for by wealth and when they are proxied for by income.

Table 7 is almost identical to table 6 except that it presents estimation results for the sub-sample of reverse tenancy, i.e., for the sub-sample of cases where the landlord is poorer than the tenant, which is a defining feature of land tenancy in Madagascar. In the interest of brevity, the remainder of this section focuses on the variables of interest, i.e., the change in the landlord's perception of tenurial security and the proxies for the risk preferences of the landlord and of the tenant.

Once again, the tenurial insecurity hypothesis is supported by the data at the 1 percent significance level in the reverse tenancy sub-sample. The important difference between tables 5 and 7 is that tenurial insecurity has a stronger impact than in the reverse tenancy sample than it does in the full sample. Whereas in the naïve specification which fails to control for the characteristics of the landlord-tenant match and matching process, a 1 percent increase in s_a increased the likelihood of observing a fixed rent contract by 1.9 percent in the full sample, a 1 percent increase in s_a increases the likelihood of observing a fixed rent contract by 2.4 percent in the reverse tenancy sample. Likewise, whereas in the specification which controls for the characteristics of the landlord-tenant match and matching process, a 1 percent increase in s_a increased the likelihood of observing a fixed rent contract by 2.2 percent in the full sample, a 1 percent increase in s_a increases the likelihood of observing a fixed rent contract by 3.9 percent in the reverse tenancy sample.

This strengthening of this paper's core result when considering the reverse tenancy sample suggests that landlords whose tenants are wealthier than they are perceive that their claim to their own plot of land is weaker than it is for the average landlord, i.e., that landlords in reverse tenancy agreements believe they have less bargaining power than the average landlord.

Finally, as regards the risk sharing hypothesis in the reverse tenancy sample, it is once again the case that for every additional $50 of tenant income, the likelihood of observing a fixed rent contract increases significantly. The magnitude of this impact, however, is decreased slightly, from 5 percent in table 6 to 4 percent in table 7. While this once again offers partial support in favor of the risk sharing hypothesis, in neither specification can one reject the null hypothesis that the risk preferences of the landlord and the tenant jointly determine contract choice in table 7, both when one uses wealth or income as proxies for risk preferences.

The results in tables 6 and 7 thus offer strong support for the hypothesis that tenurial insecurity drives the emergence of sharecropping in these data, especially since (i) s_a has the expected effect; and (ii) one cannot reject the hypothesis that the risk preferences of the landlord and the tenant do not jointly determine contract choice.

Indeed, following Bellemare and Brown (2010), and allowing for the possibility that risk preferences are defined over income rather than over final wealth, the results in tables 6 and 7 lead one to (i) fail to reject the null that the average landlord is risk-neutral or that her preferences exhibit CARA; and (ii) reject the null that the average tenant is risk-neutral. To conclude that this is empirical support for the canonical risk sharing hypothesis, however, one would need to make the *additional* assumption that tenant preferences exhibit decreasing absolute risk aversion (DARA). But then, there is no reason to believe that tenant preferences exhibit DARA, especially since failure to reject the hypothesis that the average landlord's preferences exhibit CARA in tables 6 and 7.

The results in tables 6 and 7 are thus especially favorable to the theoretical model of section 3 given that one rejects the null hypothesis that tenurial insecurity plays no role in explaining contract choice while finding little support for the canonical risk sharing hypothesis. So even though Jacoby and Minten (2007) find that land titles would have little to no impact on agricultural investment and productivity or on the value of plots in Lac Alaotra, it appears that tenurial insecurity does shape some aspects of economic behavior in the region. Indeed, Bellemare (2010) shows that while *de facto* land rights – land titles – indeed have no impact on agricultural productivity in Madagascar, landowners' subjective perceptions of their *de jure* land rights – what they can or cannot do with their plots – do affect productivity. The findings in this paper thus do not contradict those of Jacoby and Minten. Indeed, their conclusion that land titles do not increase tenurial security does not mean that there is no tenurial *in*security, the effects of which have been shown empirically in this paper to be considerable on the land tenancy market.

7. Conclusion

This paper has developed a theoretical explanation for the emergence of sharecropping in Lac Alaotra, Madagascar's most important rice-growing region. In this setting, conversations with landowners during preliminary visits to the field have shown that some landlords perceive more tenurial insecurity when leasing out under a fixed rent contract than when leasing out under a sharecropping contract. The theoretical framework developed in this paper thus dynamicizes the canonical principal-agent model of sharecropping (Stiglitz 1974) and augments it by incorporating an important transaction cost, viz. the risk that the landlord will lose her plot as a result of the contract she chooses to sign with her tenant.

Then, using data on the landlords' subjective perceptions of tenurial insecurity and incorporating recent advances in applied contract theory (Bellemare and Brown 2010), this paper has concurrently tested the hypotheses that (i) contract-dependent tenurial insecurity drives contract choice; (ii) risk preferences drive contract choice. The data strongly support the tenurial insecurity hypothesis developed in this paper at the expense of the risk sharing hypothesis, showing that a 1 percent increase in the landlords' subjective perception of tenurial insecurity increases the likelihood of observing a sharecropping contract by about 2 percent. This finding is robust to whether one considers the full sample of land tenancy or the restricted sample of reverse tenancy (i.e., land tenancy contracts in which the landlord is poorer than the tenant). This finding is also strengthened by for the characteristics of the landlord-tenant match and of the matching process between the landlord and the tenant (Ackerberg and Botticini 2002).

One shortcoming of the empirical analysis in this paper is that it is impossible to fully control for the unobserved heterogeneity between landlords, tenants, and landlord-tenant matches using the data at hand. To be fair, however, this is common to almost all empirical investigations of contract theory. An exception to this would be Karlan and Zinman's (2009) recent randomized study of the credit market in South Africa, which allows them to disentangle the effects of adverse selection and moral hazard.

Another, perhaps more important shortcoming of the empirical analysis of this paper is that it could not investigate the precise reason why tenurial insecurity affects contract choice. Institutions – both formal and informal – are conducive to contract choice affecting one's subjective perception of tenurial insecurity in Madagascar, but it is impossible to identify the exact mechanism through which this happens. Addressing this concern would require a careful investigation of the way individuals form their expectations regarding tenurial insecurity.

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Table 1. Data Description for Selected Variables

Variable	Description
Dependency Ratio	Percentage of individuals under 15 and over 64 within the household.
Assets (100,000 Ariary)	Sum of the values of the household's assets (i.e., animals, house, television, radio, car, and bank account balance) and agricultural equipment (i.e., hoe, harrow, cart, plow, tractor, and small tractor).
Income (100,000 Ariary)	Sum of the proceeds from animal sales, agricultural and non-agricultural wages, and proceeds from leases of cattle and equipment.
Liquidity Constraint Dummy	Dummy for whether the household is liquidity constrained.
Plot Size	Area covered by the plot in ares (1 are = 0.01 hectare = 100 square meters.)
Plot Value (100,000 Ariary)	Price expected by the landowner if she were to sell her plot.
Formal Title Dummy	Dummy for the presence of a formal title.
Relationship Length	Number of years the landlord and tenant have been contracting with one another.
Kin Dummy	Dummy for a contract signed between kin.
Tenant Introduced by Kin	Dummy for a contract signed with a tenant whom the landlord met through a member of her extended family.
Introduced by Other than Kin	Dummy for a contract signed with a tenant whom the landlord met through someone who is not a member of her extended family.
Tenant is Friend	Dummy for a contract signed with a tenant who is a friend of the landlord.
Tenant Chosen for His Wealth	Dummy for whether this particular tenant was chosen because of his wealth.
Tenant Chosen for His Honesty	Dummy for whether this particular tenant was chosen because of his honesty.
Tenant Chosen for His Ability to Bear Risk	Dummy for whether this particular tenant was chosen because of his ability to bear risk.
Tenant Chosen to Return a Favor	Dummy for whether this particular tenant was chosen because the landlord wanted to return a favor.
Time Spent Looking for a Tenant	Number of days spent looking for a potential tenant.
Other Potential Tenants Considered	Number of other potential tenants considered when looking for a tenant.

Table 2. Descriptive Statistics (n=353)

Variable	Mean	(Std. Err.)
Dependent Variable		
Contract (=1 if Fixed Rent; = 0 if Sharecropping)	0.293	(0.031)
Plot Characteristics		
Plot Size (Ares)	108.812	(5.095)
Imputed Land Value (100,000 Ariary)	13.026	(0.567)
Imputed Land Title Dummy	0.402	(0.013)
Rice Plot Dummy	0.866	(0.024)
Hillside Plot Dummy	0.054	(0.015)
Lowland Plot Dummy	0.105	(0.022)
Irrigated Plot Dummy	0.762	(0.029)
Distance from House to Plot (Walking Minutes)	32.769	(2.047)
Landlord Household characteristics		
L Household Size (Individuals)	5.539	(0.157)
L Household Dependency Ratio	0.456	(0.016)
L Age (Years)	52.889	(1.038)
L Female Dummy	0.153	(0.022)
L Education (Completed Years)	5.228	(0.280)
L Household Assets Per Capita (100,000 Ariary)	2.142	(0.313)
L Household Income Per Capita (100,000 Ariary)	1.058	(0.147)
L Household Liquidity Constraint Dummy	0.249	(0.029)
Tenant Household Characteristics		
T Household Size (Individuals)	5.695	(0.166)
T Dependency Ratio	0.430	(0.015)
T Age (Years)	38.482	(0.637)
T Education (Completed Years)	6.082	(0.228)
T Household Assets Per Capita (100,000 Ariary)	3.012	(0.335)
T Household Income Per Capita (100,000 Ariary)	1.085	(0.112)
T Household Liquidity Constraint Dummy	0.365	(0.033)
Landlord-Tenant Match Characteristics		
T is Kin Dummy	0.654	(0.033)
T Introduced by Kin Dummy	0.051	(0.016)
T Introduced by Other than Kin Dummy	0.028	(0.011)
T is a Friend Dummy	0.267	(0.031)
T Chosen because Kin Dummy	0.243	(0.028)
T Chosen for His Wealth Dummy	0.076	(0.018)
T Chosen for His Honesty Dummy	0.136	(0.025)
T Chosen for His Risk-Bearing Ability Dummy	0.004	(0.003)
T Chosen to Return a Favor Dummy	0.004	(0.002)
Time Spent Looking for a Tenant (Days)	1.210	(0.134)
Other Potential Tenants Considered (Individuals)	1.528	(0.179)
Relationship Length (Years)	2.142	(0.133)
Geographical Indicators		
Commune 1	0.095	(0.016)
Commune 2	0.233	(0.030)
Commune 3	0.204	(0.026)
Commune 4	0.114	(0.021)
Commune 5	0.271	(0.033)
Commune 6	0.083	(0.015)

Note: The acronyms L and T respectively denote the landlord and the tenant.

Table 3. Descriptive Statistics by Type of Contract

Variable	Sharecropping (n=248) Mean	(Std. Err.)	Fixed Rent (n=105) Mean	(Std. Err.)	Difference
Plot Characteristics					
Plot Size	108.561	(5.718)	109.418	(10.618)	
Imputed Land Value	12.328	(0.629)	14.711	(1.142)	
Imputed Land Title	0.394	(0.015)	0.421	(0.026)	
Rice Plot	0.850	(0.030)	0.906	(0.035)	
Hillside Plot	0.061	(0.019)	0.037	(0.023)	*
Lowland Plot	0.109	(0.026)	0.096	(0.037)	
Irrigated Plot	0.730	(0.036)	0.840	(0.044)	*
Distance from House to Plot	31.751	(2.106)	35.228	(4.786)	
Landlord Household Characteristics					
L Household Size	5.629	(0.178)	5.321	(0.319)	
L Household Dependency Ratio	0.463	(0.018)	0.439	(0.032)	
L Age	51.658	(1.214)	55.865	(1.819)	
L Female	0.147	(0.024)	0.169	(0.044)	
L Education	5.092	(0.276)	5.557	(0.681)	
L Household Assets Per Capita	1.929	(0.198)	2.658	(0.947)	
L Household Income Per Capita	1.034	(0.170)	1.116	(0.289)	
L Household Liquidity-Constrained	0.248	(0.035)	0.252	(0.055)	
Tenant Household Characteristics					
T Household Size	5.566	(0.197)	6.007	(0.301)	
T Dependency Ratio	0.441	(0.019)	0.404	(0.024)	**
T Age	37.777	(0.700)	40.184	(1.333)	
T Education	6.007	(0.276)	6.262	(0.405)	**
T Household Assets Per Capita	2.794	(0.383)	3.539	(0.663)	
T Household Income Per Capita	0.931	(0.120)	1.456	(0.245)	**
T Household Liquidity-Constrained	0.355	(0.038)	0.390	(0.062)	
Landlord-Tenant Match Characteristics					
T is Kin	0.652	(0.039)	0.661	(0.062)	
T Introduced by Kin	0.033	(0.011)	0.094	(0.046)	
T Introduced by Other than Kin	0.030	(0.014)	0.022	(0.016)	
T is a Friend	0.286	(0.037)	0.223	(0.051)	
T Chosen because Kin	0.258	(0.034)	0.207	(0.048)	
T Chosen for His Wealth	0.099	(0.025)	0.022	(0.011)	
T Chosen for His Honesty	0.138	(0.029)	0.129	(0.049)	
T Chosen for His Risk-Bearing Ability	0.002	(0.002)	0.008	(0.008)	
T Chosen to Return a Favor	0.005	(0.003)	0.000	(0.000)	*
Time Spent Looking for a Tenant	1.088	(0.148)	1.506	(0.283)	
Other Potential Tenants Considered	1.582	(0.184)	1.398	(0.426)	
Relationship Length	2.245	(0.166)	1.893	(0.213)	
Geographical Indicators					
Commune 1	0.118	(0.021)	0.041	(0.020)	***
Commune 2	0.255	(0.037)	0.180	(0.048)	
Commune 3	0.224	(0.032)	0.156	(0.042)	
Commune 4	0.072	(0.018)	0.214	(0.054)	**
Commune 5	0.287	(0.040)	0.231	(0.062)	*
Commune 6	0.044	(0.011)	0.177	(0.043)	**

Note: The symbols *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Table 4. Descriptive Statistics by Type of Land Tenancy

Variable	Regular Tenancy (n=128) Mean	(Std. Err.)	Reverse Tenancy (n=225) Mean	(Std. Err.)	Difference
Plot Characteristics					
Plot Size	108.173	(7.135)	109.152	(6.826)	
Imputed Land Value	13.158	(0.837)	12.955	(0.748)	
Imputed Land Title	0.375	(0.021)	0.415	(0.017)	*
Rice Plot	0.885	(0.036)	0.856	(0.031)	
Hillside Plot	0.046	(0.021)	0.058	(0.020)	
Lowland Plot	0.106	(0.036)	0.105	(0.027)	
Irrigated Plot	0.763	(0.048)	0.762	(0.036)	
Distance from House to Plot	28.401	(2.933)	35.090	(2.702)	*
Landlord Household Characteristics					
L Household Size	4.483	(0.207)	6.101	(0.202)	***
L Household Dependency Ratio	0.447	(0.029)	0.461	(0.018)	
L Age	53.302	(1.964)	52.670	(1.204)	
L Female	0.184	(0.040)	0.137	(0.025)	
L Education	5.710	(0.462)	4.971	(0.352)	***
L Household Assets Per Capita	4.552	(0.833)	0.862	(0.086)	***
L Household Income Per Capita	1.843	(0.362)	0.640	(0.101)	***
L Household Liquidity-Constrained	0.316	(0.055)	0.214	(0.033)	**
Tenant Household Characteristics					
T Household Size	5.997	(0.265)	5.534	(0.211)	*
T Dependency Ratio	0.445	(0.024)	0.423	(0.019)	
T Age	37.958	(1.066)	38.760	(0.794)	
T Education	5.437	(0.360)	6.424	(0.287)	*
T Household Assets Per Capita	1.051	(0.099)	4.055	(0.484)	***
T Household Income Per Capita	0.660	(0.097)	1.311	(0.159)	***
T Household Liquidity-Constrained	0.369	(0.054)	0.364	(0.041)	
Landlord-Tenant Match Characteristics					
T is Kin	0.663	(0.053)	0.650	(0.042)	
T Introduced by Kin	0.052	(0.020)	0.050	(0.022)	**
T Introduced by Other than Kin	0.059	(0.028)	0.011	(0.007)	
T is a Friend	0.226	(0.047)	0.290	(0.039)	
T Chosen because Kin	0.323	(0.054)	0.201	(0.030)	
T Chosen for His Wealth	0.043	(0.021)	0.094	(0.025)	
T Chosen for His Honesty	0.170	(0.044)	0.117	(0.031)	*
T Chosen for His Risk-Bearing Ability	0.000	(0.000)	0.006	(0.004)	
T Chosen to Return a Favor	0.006	(0.005)	0.002	(0.002)	*
Time Spent Looking for a Tenant	1.229	(0.161)	1.200	(0.186)	
Other Potential Tenants Considered	1.363	(0.177)	1.616	(0.258)	
Relationship Length	2.176	(0.221)	2.124	(0.168)	
Geographical Indicators					
Commune 1	0.128	(0.034)	0.078	(0.017)	
Commune 2	0.160	(0.043)	0.272	(0.039)	
Commune 3	0.270	(0.048)	0.169	(0.030)	*
Commune 4	0.094	(0.023)	0.124	(0.029)	
Commune 5	0.285	(0.057)	0.263	(0.041)	
Commune 6	0.063	(0.023)	0.094	(0.020)	

Note: The symbols *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Table 5. Subjective Expectations of the Landlord

Variable	Mean	(Std. Err.)
Full Sample (n=353)		
Actual *s(a)*	0.994	(0.003)
Hypothetical *s(a)*	0.983	(0.003)
s(a) under Sharecropping	0.992	(0.004)
s(a) under Fixed Rent	0.997	(0.002)
Slope of *s(a)* (i.e., s_a) under Sharecropping	-0.004	(0.003)
Slope of *s(a)* (i.e., s_a) under Fixed Rent	0.016	(0.004)
Regular Tenancy (n=128)		
Actual *s(a)*	0.994	(0.004)
Hypothetical *s(a)*	0.987	(0.005)
s(a) under Sharecropping	0.991	(0.004)
s(a) under Fixed Rent	0.990	(0.004)
Slope of *s(a)* (i.e., s_a) under Sharecropping	-0.002	(0.005)
Slope of *s(a)* (i.e., s_a) under Fixed Rent	0.007	(0.004)
Reverse Tenancy (n=225)		
Actual *s(a)*	0.994	(0.004)
Hypothetical *s(a)*	0.981	(0.005)
s(a) under Sharecropping	0.985	(0.005)
s(a) under Fixed Rent	0.990	(0.004)
Slope of *s(a)* (i.e., s_a) under Sharecropping	-0.005	(0.004)
Slope of *s(a)* (i.e., s_a) under Fixed Rent	0.020	(0.006)

Note: All *s(a)* measures are in the [0,1] set and represent the landlord's subjective likelihood that she will retain the plot. The s_a measures are obtained from equation 12 and are the variable of interest in the application.

Table 6. Linear Probability Models of Contract Choice in the Full Sample (n=353)

Variable	(1) Linear Probability Model Without Matching Controls Coefficient		(Std. Err.)	(2) Linear Probability Model With Matching Controls Coefficient		(Std. Err.)
Dependent Variable: = 1 if Fixed Rent; = 0 if Sharecropping						
Plot						
Plot Size	-0.001		(0.001)	-0.001	**	(0.001)
Plot Value	0.004		(0.010)	0.012		(0.010)
Plot Titled	-0.269		(0.276)	-0.342		(0.275)
Hillside Plot	-0.073		(0.166)	-0.050		(0.160)
Lowland Plot	0.058		(0.152)	0.071		(0.153)
Irrigated Plot	0.203	**	(0.098)	0.155		(0.105)
Distance from House	0.001		(0.001)	0.001		(0.001)
Landlord Household						
L Household Size	-0.012		(0.013)	-0.011		(0.012)
L Dependency Ratio	-0.016		(0.138)	0.073		(0.140)
L Age	0.005	**	(0.002)	0.003		(0.002)
L Female	-0.008		(0.077)	0.008		(0.086)
L Education	0.020	**	(0.010)	0.020	*	(0.011)
L Assets Per Capita	0.002		(0.009)	0.002		(0.009)
L Income Per Capita	-0.007		(0.013)	0.001		(0.013)
L Liquidity-Constrained	0.042		(0.070)	0.015		(0.068)
Landlord-Tenant Match						
Relationship Length				-0.024	**	(0.011)
T is Kin				0.193		(0.240)
T Introduced by Kin				0.346		(0.265)
T is a Friend				0.086		(0.238)
T Chosen for His Wealth				-0.114		(0.095)
T Chosen for His Honesty				-0.026		(0.089)
T Chosen for His Risk Capacity				0.378		(0.263)
T Chosen to Return a Favor				0.534		(0.558)
Time Spent Looking				0.018		(0.016)
Number of Potential Tenants				-0.022	*	(0.012)
Tenant Household						
T Household Size	0.020		(0.017)	0.025		(0.018)
T Dependency Ratio	-0.312	*	(0.163)	-0.357	**	(0.160)
T Age	0.002		(0.003)	0.003		(0.004)
T Education	0.000		(0.011)	0.001		(0.011)
T Assets Per Capita	-0.005		(0.008)	-0.005		(0.008)
T Income Per Capita	0.048	**	(0.022)	0.045	**	(0.023)
T Liquidity-Constrained	0.034		(0.057)	0.035		(0.059)
Slope of $s(a)$	1.879	***	(0.710)	2.188	***	(0.758)
Intercept	-0.282		(0.279)	-0.404		(0.361)
Number of Observations	353			353		
Bootstrap Replications	500			500		
Commune Dummies	Yes			Yes		
p-value (All Coefficients)	0.00			0.00		
p-value (Risk Sharing, Assets)	0.81			0.80		
p-value (Risk Sharing, Income)	0.10			0.13		
R^2	0.22			0.28		

Note: The symbols *, **, and *** denote significance at the 10, 5, and 1 percent levels. The tests of risk sharing are tests of joint significance of the coefficients on the landlord and the tenant's asset and income levels.

Table 7. Linear Probability Models of Contract Choice in the Reverse Tenancy Sample (n=225)

	(1) Linear Probability Model Without Matching Controls			(2) Linear Probability Model With Matching Controls		
Variable	**Coefficient**		**(Std. Err.)**	**Coefficient**		**(Std. Err.)**
Dependent Variable: = 1 if Fixed Rent; = 0 if Sharecropping						
Plot						
Plot Size	0.000		(0.001)	-0.001		(0.001)
Plot Value	-0.002		(0.013)	0.003		(0.014)
Plot Titled	-0.227		(0.352)	-0.203		(0.373)
Hillside Plot	0.017		(0.217)	-0.003		(0.206)
Lowland Plot	0.022		(0.174)	0.011		(0.181)
Irrigated Plot	0.180		(0.127)	0.124		(0.135)
Distance from House	0.001		(0.002)	0.001		(0.002)
Landlord Household						
L Household Size	-0.014		(0.016)	-0.021		(0.016)
L Dependency Ratio	-0.105		(0.173)	0.018		(0.192)
L Age	0.006	**	(0.003)	0.004		(0.003)
L Female	0.051		(0.106)	0.004		(0.118)
L Education	0.041	***	(0.012)	0.044	***	(0.014)
L Assets Per Capita	-0.016		(0.043)	-0.015		(0.039)
L Income Per Capita	-0.038		(0.033)	-0.023		(0.037)
L Liquidity-Constrained	0.066		(0.092)	0.038		(0.091)
Landlord-Tenant Match						
Relationship Length				-0.013		(0.012)
T is Kin				-0.209		(0.887)
T Introduced by Kin				0.033		(0.909)
T is a Friend				-0.265		(0.885)
T Chosen for His Wealth				-0.098		(0.123)
T Chosen for His Honesty				-0.091		(0.129)
T Chosen for His Risk Capacity				0.213		(0.289)
T Chosen to Return a Favor				2.055	*	(1.070)
Time Spent Looking				0.018		(0.021)
Number of Potential Tenants				-0.024		(0.015)
Tenant Household						
T Household Size	0.030		(0.020)	0.033		(0.022)
T Dependency Ratio	-0.468	**	(0.229)	-0.441	*	(0.226)
T Age	0.000		(0.004)	0.001		(0.004)
T Education	-0.017		(0.014)	-0.019		(0.015)
T Assets Per Capita	-0.007		(0.008)	-0.006		(0.007)
T Income Per Capita	0.044	*	(0.025)	0.043	*	(0.025)
T Liquidity-Constrained	0.049		(0.076)	0.089		(0.073)
Slope of $s(a)$	2.437	***	(1.078)	3.930	***	(1.014)
Intercept	-0.053		(0.347)	0.163		(0.970)
Number of Observations	225			225		
Bootstrap Replications	500			500		
Commune Dummies	Yes			Yes		
p-value (All Coefficients)	0.00			0.00		
p-value (Risk Sharing, Assets)	0.61			0.64		
p-value (Risk Sharing, Income)	0.15			0.22		
R^2	0.32			0.39		

Note: The symbols *, **, and *** denote significance at the 10, 5, and 1 percent levels. The tests of risk sharing are tests of joint significance of the coefficients on the landlord and the tenant's asset and income levels.

Appendix

Table A1. Imputations of Land Value and Formal Title

	Land Value		Formal Title	
Variable	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**
Plot Size	0.051***	(0.017)	0.000***	(0.000)
Family-Owned Plot	-0.040	(2.221)	0.028	(0.046)
Hillside Plot	-2.339**	(2.499)	-0.001	(0.000)
Lowland Plot	-2.384	(2.019)	-0.120	(0.130)
Distance from House	-0.061	(0.026)	-0.001***	(0.001)
Distance from Road	0.033	(0.046)	-0.043*	(0.136)
Sand Deposit	-196.673**	(91.667)	-0.721	(0.441)
Sediment Deposit	-0.764	(2.994)	-0.243*	(0.139)
Weak Slope	0.748	(1.788)	0.084	(0.054)
Moderate Slope	9.621	(6.419)	0.047	(0.073)
Steep Slope	12.492	(9.962)	0.076	(0.147)
Sand Soil	-2.748	(2.474)	-0.071	(0.110)
Clay Soil	-0.849	(2.119)	-0.044	(0.099)
Loam Soil	-5.459*	(2.922)	-0.063	(0.123)
Irrigated Plot	4.734***	(1.669)	0.026	(0.102)
Irrigated by Retention Dam	2.242	(4.387)	0.003	(0.142)
Irrigation by Derivation Dam	4.221	(3.825)	0.375***	(0.133)
Irrigated by Spring	-1.919	(4.055)	0.250*	(0.139)
Irrigated by Rain	2.427	(3.703)	0.113	(0.097)
Hill Bottom Rice Plot	-5.826**	(2.421)	-0.116	(0.265)
Terraced Rice Plot	-3.321	(2.792)	0.678***	(0.141)
Hill Bottom Plot	-4.391**	(2.054)	-0.094	(0.120)
Hillside Plot (Sloped)	-10.144	(7.476)	-0.058	(0.148)
Hilltop Plot (Flat)	-8.103	(5.418)	-0.091	(0.157)
Very Bad Soil Quality	0.301	(10.197)	0.156	(0.164)
Bad Soil Quality	-0.502	(2.156)	0.004	(0.064)
Good Soil Quality	2.903	(2.004)	0.026	(0.056)
Very Good Soil Quality	0.069	(3.065)	0.151*	(0.086)
Intercept	2.320	(3.627)	0.155	(0.117)
Number of Observations	731		736	
Commune Dummies	Yes		Yes	
p-value (All Coefficients)	0.00		0.00	
R^2	0.44		0.23	

Note: The symbols *, **, and *** denote significance at the 10, 5, and 1 percent levels.