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**LIQUIDITY CONSTRAINTS AND LAND TENANCY MARKET
PARTICIPATION: EVIDENCE FROM LAC ALAOTRA REGION
(MADAGASCAR)¹**

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ABSTRACT

This article intends to explore the relationship between liquidity constraints faced by households and their participation in the tenancy market, using original data from Madagascar and a combination of qualitative and quantitative analysis. By showing how households combine credit and land inputs in their strategies and behavior, the paper intends to bridge gaps between the often disconnected strands of literature dealing with credit on the one side, land markets on the other side. Our results show that liquidity constraints play a role both on the supply and on the demand side. On the supply side, they contribute to the decision to lease out land, and the nature of the constraint can drive the contractual choice: fixed-rent with ex ante payment in case of immediate need of cash, share-tenancy otherwise On the demand side, liquidity constraints drive the contractual choice towards share tenancy. As such, share tenancy can be conceived of as a compromise for household who face liquidity constraints on both supply and demand side. Our data also indicate that the level of fixed-rent is substantially lower than the expected value of the share of the production in the case of share tenancy. The difference can be interpreted as a quasi-loan from landowners to tenants, even when landowners are themselves liquidity constrained for the cultivation of their plots.

Keywords: Liquidity constraints, Tenancy market, Madagascar.
Code JEL: D4-D8-O1-Q1

1 Introduction

Land and financial capacities are critical inputs for agricultural production and income of rural households in developing countries (Deininger and Feder, 2001; World-Bank, 2007; Demirgüç-Kunt et al., 2008). Land and credit markets are often dealt with separately in the literature on development economics, although empirical data on household strategies and behavior indicate that land and finance interact in many ways. This article sets out to explore the interaction between these two markets based on original household data collected in Madagascar.

Credit markets imperfections cause differential access to credit for households. This differential access to credit may have different effects on how individuals participate in tenancy market: liquidity constraints may determine the households mode of production (Eswaran and Kotwal, 1986); households can participate in land tenancy market under interlinked contracts in which landowner may provide credit to tenant who faced liquidity constraints in the financing of production costs (Bardhan and Rudra, 1978; Bardhan, 1980; Braverman and Srinivasan, 1981) or under reverse tenancy contracts in which the tenant is richer than the landowner (Singh, 1989; Amblard and Colin, 2009); poor households can have restrictions on contractual choice (it might be difficult for them to contract under fixe-rent contract with ex ante payment of the rent), this can generate distress renting: credit markets imperfections may influence the insurance mechanisms of tenancy market (Deininger, 2003). Liquidity constraints can influence the tenancy market participation of “Constrained Households” and tenancy can allow them to overcome liquidity constraints some of which derive from credit market imperfection. These strategies can be a an institutional response to credit markets imperfections (Bardhan, 1991).

In this article, we intend to test the relationship between households’ liquidity constraints and their participation to tenancy market using an original database from Lake Alaotra region with combination of quantitative and qualitative analysis. In Lake Alaotra region (“rice bowl of Madagascar”), land tenancy market is active and the analysis of motivations in land tenancy market participation can be related to liquidity constraints. Our data on credit encompass both formal and informal credit sources and data on tenancy market both on the demand side and the supply side. These data allow us to construct a "liquidity constraints" variable that goes beyond the usual dichotomy access/ no access to credit and we analyse the effect of liquidity constraints on: (i) tenancy market participation (leases in or not, leases out or not), (ii) intensity of participation (area leased in), and (iii) contractual choice

(rent in/share in, rent out/share out). Our results show that liquidity constraints play a role in the decision to lease land (in/out) and in the contractual choice.

This paper is organized as follows: section 2 presents an overview of the literature on participation in land tenancy markets and credit markets, and the interactions between the two; section 3 present data and qualitative overview, section 4, empirical analysis and results. Finally, section 5 concludes.

2 Review of the literature

2.1 Land tenancy market: determinants and contractual forms.

2.1.1 Household's participation in tenancy market

Households' participation in tenancy market can be influenced by a set of factors (Holden et al., 2009). For some authors, households use this market to equilibrate inputs, such as family labor and draft power, to ownership land holdings (Skoufias, 1995). This view fits broadly into the models based on factor endowments (land, labor, oxen, productive assets...). For Skoufias (1995), the key element of all models on factor endowments is that the costs associated with transactions involving these factors are such that they lead to imperfections or lack of markets on these factors. Household who participate in tenancy market may solve this problem by looking for a partner who has the assets he don't have (Eswaran and Kotwal, 1985). So, household who have small areas compared to their labor force can be motivated to increase their farmed areas or rent the surplus labor on the labor market. On the other side, those who have important land areas compared to their labor force, can lease out all or a part of their land in the tenancy market or seek for hired labour (Otsuka et al., 1992).

Credit (and insurance) market imperfections can lead household to have different access to credit market and then to tenancy markets and different mode of production (Eswaran and Kotwal, 1986; Kochar, 1997). Interlinked contracts where transactions involves credit and land is often related to an opportunity for landlord to internalise externalities generated by moral hazard considerations when production uncertainty and information asymmetries between agents prevail (Bardhan, 1980; Braverman and Guasch, 1986; Eswaran and Kotwal, 1986; Shetty, 1988; Swain, 1999). This view is derived form only landowner point of view. On the demand side, interlinked contracts can be an opportunity for the tenant to solve the liquidity constraints he faced.

For Holden et al (2009: 22): "A broader perspective on land market participation takes into account trust, reputation, and availability of potential partners (landlords and

tenants) in assessing the functioning of the market. If the initial fixed costs for farming are high, this may also contribute to a land market entry barrier. Likewise, transaction cost related to search for partners, negotiation, monitoring, and enforcement of contract can hinder and reduce the degree of participation.”

2.1.2 Contractual choice: sharecropping versus fixed-rent contract

In the literature on tenancy markets, sharecropping is often presented as an inefficient mode of production. Indeed, if the effort of tenant cannot be controlled by the landlord (moral hazard), tenant has an incentive to undersupply his effort because he should pay some fraction of the output (Marshall, 1920). In considering others factors such as risk, transaction costs, market imperfections, neo institutional theories provide an analytical framework for the analysis of contractual choice.

The risk aversion of households can affect their contractual choices. Risk adverse households may prefer a share contract than a lease contract because in lease contract only landowner or tenant bear all the production. In share tenancy contract, output sharing permit to deal the production risk between the landlord and the tenant (Stiglitz, 1974; Allen and Lueck, 1995).

Differences in factors endowment (indivisible assets, mechanization, land and family labour) of household and their characteristics (managerial ability, access to credit) may lead household to choose share tenancy contract (resource pooling) in order to have access to the factors they don't have. The others households who would enhance their skills may choose fixed-rent contracts (Eswaran and Kotwal, 1985; Shetty, 1988; Skoufias, 1995).

Tenure security can be also a potential determinant of households' participation. Household in many studies consider fixed-rent more riskier than sharecropping contract (Bellemare, 2009; Macours et al., 2010).

Some transaction costs may result from the monitoring of hired labour. Information asymmetries about hired labour and labour market imperfections may increase transaction costs in looking for skilled hired labour (Eswaran and Kotwal, 1986; Otsuka et al., 1992; Deininger, 2003). When they might be too high, landowners are more likely to choose a share tenancy contract than a process of production with hired labour (Murrell, 1983; Allen and Lueck, 1993). Landowners may also rent out their land but this can lead to an overexploitation of land quality (Dubois, 1999).

Another factor that may affect contractual choice is liquidity constraints. In this case, sharecropping is rarely seen as the result of financial constraints (lack of access to credit and

low accumulation) faced by the tenants or owners. However, in these circumstances it may be difficult to finance agricultural production and contractual choice may reflect household liquidity constraints. So, fixed-rent contract with an ex-ante payment may not be feasible for poor household, and individuals are thus more likely to engage in sharecropping contracts, while better-off tenants can seek for fixed-rent contract (Colin and Bouquet, 2001; Colin, 2005). This question of the relationship between liquidity constraints and household's participation in land tenancy market is the concern of this article.

2.2 Rural credit market: features and implications for tenancy market

Participation in credit markets can allow household to alleviate their liquidity constraints. However rural credit markets is characterised by the phenomenon of rationing which can increase household's liquidity constraints. Calomiris and Longhofer (2008:1) define rationing as "a situation in which lenders are unwilling to advance additional funds to borrowers at the prevailing market interest rate". According to this definition, rationing can be view as a phenomenon which emerges from supply side (credit restriction, credit refusal...) and which is related to either information asymmetries between households and credit institutions (Stiglitz and Weiss, 1981) or government intervention : interest ceiling rates, direct credit...(Kochar, 1997; Conning and Udry, 2007). Rationing can also emerge from demand side when households take into account their risk aversion (possibility to lose collateral), transaction costs (credit application) in their decision to participate or not in the credit markets (Boucher and Guirking, 2007; Guirking, 2008; Boucher et al., 2009). So, there are several sources of rationing depending on whether one is on the supply side or on the demand side of the credit market.

Rationing increase households liquidity constraints and this may have effect on their tenancy market participation. Theoretically households' liquidity constraints can have different effects on their tenancy market participation. On the supply side, landowners who faced urgent need of liquidity may require a fixed-rent with an ex-ante payment of the rent. When liquidity constrains is related to the financing of production costs, landowners can seek for a rich tenant (reverse tenancy).

On the demand side, liquidity constraints make fixe-rent contract difficult to have for poor households. Sharecropping with cost sharing can help both landowner and tenant overcome some liquidity constraints (Braverman and Guasch, 1986; Eswaran and Kotwal, 1986; Shetty, 1988; Basu, 1995; Deininger, 2003).

2.3 Household's liquidity constraints and land tenancy market in

Madagascar.

According to the literature, land tenancy market is relatively common in Madagascar, particularly in peri-urban areas and in areas where land has a greater agricultural value (Minten and Razafindraibe, 2003). These authors distinguish between two categories of landowners (poor ones and rich ones) and identify quite different motivations behind leasing out for each category. For poor landowners, lack of liquidity to finance hired labour and marketed inputs are the main reasons to lease out land. For rich landowners, other reasons can drive them to lease out land including lack of time to monitor hired labour, distant plots, low quality of land. The most common contracts are fixed-rent contracts with ex-ante payment of the rent and share-tenancy contracts with ex-post payment of the rent; the most common sharing rates of output are $\frac{1}{2}$ and $\frac{1}{3}$ in favour of landowners (Minten and Razafindraibe, 2003). About credit markets, Zeller (1994:11-12) states that the financial sector in Madagascar (formal and informal) "ration loan demands in view of total household wealth and of leverage of the household, which is defined as the ratio of outstanding debt service obligations over income". This generates inequalities in loan rationing between the poorer and the richer households. However, land is not a criterion for rationing for formal and informal lenders (Zeller, 1994).

In the highland of Madagascar and especially in Lake Alaotra region ("rice bowl of Madagascar"), the land tenancy market is very active and most of studies relate motivations in leasing in and leasing out mainly to the lack of productive assets: oxen, mechanization, labour (Charmes, 1975; Jarosz, 1991; Karsenty and Le Roy, 1996). Bellemare (2009) relate the predominance of share tenancy in reverse tenancy contract to the probability for the landowners to lose their plot which is higher in fixe-rent contract than in share tenancy contract: weak property rights effect. This rationale derives from only the point of view of landowner. In our study, we intend to take into account both landowner and tenant point of view and relate the predominance of share tenancy contract in general to liquidity constraints effects for both landowners and tenants. To our knowledge, few studies on Lake Alaotra region analyse the role of liquidity constraints on households' participation and contract choice in tenancy market. However, our qualitative surveys show that liquidity constraints are one the main determinants of households' participation in tenancy market in Lake Alaotra region.

3 Data and descriptive statistics

3.1 Data

The data were collected in the lac Alaotra region during October 2009. Lac Alaotra is located 300 km to the northeast of Antananarivo, the country's capital, and constitutes the most important rice-growing region of Madagascar. Tenancy market is very active (Charmes, 1976; Karsenty and Le Roy, 1996; Barrett et al., 2009) and formal credit market have experienced significant development in recent years. Formal and informal credits coexist and finance rural and agricultural activities (Wampfler et al., forthcoming).

For our study, we use two types of data: the first relies on qualitative and explorative interviews on 41 households who are a subsample of our quantitative surveys. These households were asked about their practices, their motivations in lease in or lease out land, and about the general patterns in the villages on land tenancy markets. Households' characteristics on rural credit markets (formal and informal) were also explored.

The second dataset relies on quantitative surveys on 448 households in 5 communes and 10 fokontany (Village) around Lake Alaotra. The sampling methodology was as follows: first, the 5 communes were selected on the basis of whether or not an offer of formal credit exists. In each commune, we selected 2 fokontany on the basis of their relative accessibility and 40 households in each fokontany in order to over-represent⁴ household who participate in formal credit market. This survey covers households' activities, credit markets and tenancy market participation during June 2008-June 2009. The design of the survey questionnaire was adapted from other surveys undertaken in Latin America under the basis project (Boucher et al., 2009). On the household's credit markets participation (formal and informal), we have detailed data on amounts received, the gap between amount which was applied for and the amount received, the household's motivations when they didn't make an application in credit markets... These data allow us to construct a "liquidity constraints" variable that goes beyond the use of the amount of credit received or the usual dichotomy access/ no access to credit of in the literature (Kochar, 1997; Stephens and Barrett, 2011). Regarding tenancy market participation, we have detailed data on the different types of contract, the crops in these contracts, the household's rationales in their participation in tenancy market, and their preference about the different contracts.

⁴ All descriptive statistics and regressions were reweighted according to our sampling design

3.2 Descriptive statistics

About households' participation on tenancy market, our sample contains 295 households (66%) who participate (546 contracts) in land tenancy market (table 1). According to the characteristics of the region, the paddy fields are the main type of land in tenancy market.

We have more households who declare their contracts on the demand side (222 households-400 contracts) than on the supply side (98 households-146 contracts). The low level of reported fixed-rent contracts on the supply side is the main reason (25 contracts). In this region, our qualitative survey indicates that leasing out land under fixed-rent contract is generally associated with a downward spiral of impoverishment and indebtedness. These effects can be related to an existence of liquidity constraints which prevent households to undertake income-generating activities. It is therefore no surprise that households be reluctant to declare this type of contract. These probable underreporting of fixed-rent contract could reduce the efficiency of the contractual choice estimation on the supply side.

Most of the fixed-rent contracts are characterized by an ex-ante cash payment of the rent. According to other findings in Madagascar (Minten and Razafindraibe, 2003), these characteristics may indicate that landowners need cash and don't have an alternative source of funding. Share tenancy contracts are characterized by an ex-post payment of the rent and the most common sharing rates of output are $\frac{1}{2}$ in favour of landowners. In 78% of sharecropping contracts, landowners and tenants share the cost of various inputs. So, this high percentage implies that sharecropping, according to the literature, can be a possible way for the households (either landowner or tenants or both) to equilibrate differences in the tradable and non-tradable inputs.

Table 1 : households' tenancy market participation in our sample

Type of contract	Lease out			Lease in			Total
	Sharecropping	Fixed-rent	Total lease out	sharecropping	Fixed-rent	Total lease in	
Number of each type of contract	121	25	146	195	205	400	546
Total Areas (ha)	102	18	120	141	152	293	
Total household	74	27	98 ⁵	144	110	222 ⁶	295

⁵ Sum of columns is different from total because of combination of share cropping and fixed-rent contracts by households

⁶ Idem

Our data suggest also that liquidity constraints may have an effect on contractual choice on the demand side. A majority of households who are involved in sharecropping contract (58%) declare that they would have preferred a fixed-rent contract but they do not have enough money to finance the ex-ante payment of the rent. Thus sharecropping can be considered as a second best contract subject to the liquidity constrained tenants. On the contrary, 62 % of households involved in fixed-rent declare that fixed-rent is their first best contract. Liquidity constraints thus appears to limit contractual choice for constrained household; on the other hand, risk aversion doesn't seem to have much of an influence in tenant decision regarding one contractual form or the other: risk effect is noted in only 18 of 546 contract.

3.3 Liquidity constraints

Our database contains 290 households (65%) who participate in the credit market: formal and informal loan. 48% (205) of the households in our database participate into formal sector and 32% (145) of households have informal loans (with family member: 67% of informal loan). 60 households combine formal and informal loans.

Formal credit market is driven by two microfinance institutions and two banks which allow many types of collaterals: oxen, land, other tradable assets...About land, all four formal institutions accept titled land but one of two microfinance institutions accept also land without title (land with a village and/or commune certificate) as collateral. Proximity between borrowers and this institution may explain this because it reduces information asymmetries. But, this fact can also have an effect on the manner household choose institution in which they would to borrow, the credit amount they receive and assets they would put as collateral. So, access to loan in this area depends on many factors such as household's assets endowment, risk aversion...On the contrary to the common view in the development economics literature, this access doesn't depend on the amount of owned land.

Credit market is also characterized by imperfections and existence of credit constraints. This imperfections and constraints (lower amount received than requested, too long delay of treatment, and reputation of formal credit institutions...) may increase household's liquidity constraints and then their land tenancy market participation.

3.3.1 Definition

The concept of liquidity constraints may cover several situations for the households. In our analysis, the concept of liquidity constraints refers to the various cases below, and takes into account the fact that a given household is involved or not in credit markets (formal and

informal). The methodology of elicitation of liquidity constraints is adapted from those developed in Boucher et al. (2009):

a) When the household has at least one on going loan during the recall period

We make the following assumptions about these households: they are rational, they request the amount they need and they don't anticipate the fact that they may get a credit amount lower than requested by asking more. So, we define a household as "constrained household" if he gets an amount of credit lower than requested.

b) When the household has not at least one on going loan during the recall period

Because we have a potential problem with observability of credit demand for households not participating in credit markets, we define as liquidity constrained households those who meet either criterion below:

b1) Households have applied for a loan but their applications were rejected and there was no other source of credit.

b2) Households declare they are in need for credit but did not applied for a loan, for several reasons: (i) because they believe that their application would be rejected anyhow, (ii) because they don't want to bear the risk to lose assets (collateral) in case of credit default, and (iii) because they had a previous failed experience with credit (repayment default, repayment delays, distress sale of asset in order to repay for the loan, loss of collateral).

As these definitions show, participating in credit markets does not mean that the household has no liquidity constraints and, conversely, not participating does not mean that there is liquidity constraints.

In addition to the constrained/not constrained dichotomy, we introduce the distinction between "ex ante constraint" and "ex-post constraint". This distinction allows us to take into account the anticipated nature or not of the liquidity constraints. Ex-post constraints (bullets a and b1) refer to households whose constraints derive from credit rationing from the supply side (credit amounts lower than requested and up to outright rejection of credit application). This constraint is not anticipated and we expect that it may have a different effect on household behaviour than ex-ante constraints. Ex-ante constraints (bullet b2) refer to households that self-exclude and do not apply for credit although they declare that they would need it.

On the other side, households with no liquidity constraints are those who participate in credit markets and have their desired amount and those who do not participate and don't need loan.

These definitions allow us to construct three variables: CHH (constrained household dummy), ACHH (ex-ante constrained household dummy) and PCHH (ex-post constrained household dummy). These variables take into account all aspects of liquidity constraints and go beyond the usual variables in the literature: the amount of credit received, the usual dichotomy access/ no access to credit in the literature (Kochar, 1997; Bellemare, 2009; Stephens and Barrett, 2011). We will test the effect of liquidity constraints on household land tenancy market participation using them sequentially: variable CHH first, ACHH and PCHH after.

PCHH is considered to be exogenous because we assume that formal and informal lenders ignore land rental transaction in making their credit allocations. On the other side, there is a potential endogeneity problem with ACHH and CHH: the intuitive justification is that being liquidity constrained may be a choice variable and can be correlated with error terms of the land market participation.

3.3.2 Liquidity constrained households and land tenancy market participation

Table 2 reports the classification of sample household according to our liquidity constraints definition. It illustrates the fact that a given household who do not participate in credit market do not necessarily have liquidity constraints. In the other side, a given household who participate in credit market can have liquidity constraints. So, out of 290 households who participate in credit markets, 116 (40%) are considered as liquidity constrained. On the opposite, out of the 158 households who do not participate in credit markets, 73 (53%) are not considered as liquidity constrained according to our definition.

Table 2: households' participation in credit markets and liquidity constraints (CHH)

	Participation in credit market			Non-participation in credit markets	Total
	Formal	Informal	Total ⁷		
Liquidity constrained households (CHH)	64	64	116 (40%)	73 (47%)	186 (42%)
No liquidity constrained households	141	81	174 (60%)	85 (53%)	262 (58%)
Total	205	145	290 (100%)	158 (100%)	448 (100%)

⁷ Sum of columns is different from total columns because of combination of different sources of credit by household: 60 households combine formal and informal credit contracts.

Within 186 liquidity constrained households, 122 (66%) participate in land tenancy market either as landowner or tenants or both: table 3 summarize this participation.

Households who participate on the demand side (90) represent 74% of household who have liquidity constraint. Moreover, these households prefer sharecropping rather than fixed –rent contract. This can be related to the characteristics of these two contracts: sharecropping and fixed-rent. Indeed, in fixed-rent contracts the rent must be paid ex-ante in cash and it may be difficult for liquidity constrained households to do this. On the other side, in sharecropping contract, the rent is generally paid ex-post with the possibility to share the inputs cost. Then it may be preferable for a household who is liquidity constrained to choose this contract.

Table 3: liquidity constraints and tenancy market participation

Type of contract	Demand side			Supply side		
	Sharecropping	Fixed-rent	Total ⁸	Sharecropping	Fixed-rent	Total ⁹
Constrained households	61 (42%)	42 (38%)	90 (41%)	34 (47%)	12 (44%)	43 (44%)
No constrained households	83 (58%)	68 (62%)	132 (59%)	39 (53%)	15 (56%)	54 (56%)
Total	144 (100%)	110 (100%)	222 (100%)	73 (100%)	27 (100%)	97 (100%)

Annex 1 reports a series of comparison on key variables between liquidity constrained and non-liquidity constrained households. Non-constrained household compared to constrained households more paddy field and participate more in formal credit market with higher amount. Liquidity constrained households participate more (land tenancy market) on the supply side than non-constrained households. This suggests that leasing out can be a way to solve liquidity constraints for landowners. On the demand side, liquidity constrained household do not appear to participate more in general, although they participate more under sharecropping contract. For liquidity constrained tenants, share tenancy may be a way to reduce these constraints by resources pooling, cost sharing and ex post payment of the rent.

4 An empirical analysis of the effect of household liquidity constraints on their tenancy market participation

4.1 Qualitative overview

According to our qualitative data, the main contracts are sharecropping and fixed rent contracts. We have more sharecropping contracts (56) than fixed rent (49) contracts and most

⁸ Sum of columns is different from total columns because of combination the two type of contract.

⁹ Sum of columns is different from total columns because of combination the two type of contract.

of these two types of contract concerns paddy fields. 86% of the fixed-rent contracts are characterized by an ex ante cash payment of the rent and all sharecropping contract by a sharing rates of output of 1/2.

These qualitative surveys have enabled us to highlight the main determinants of household participation in the tenancy market. On the supply side, most of landowners argue that liquidity constraints, lacks of labour and productive assets are their main motivations to lease out land. Liquidity constraints in particular, have two effects on the household behavior in the tenancy market: when they are related to the financing of production and hired labour costs, households tend to choose a sharecropping contract; when they are rather linked to an urgent need of liquidity not related to production activities, landowners tend to choose fixed-rent contract with ex ante payment of the rent. As a general pattern, landowners prefer sharecropping contract to fixed-rent contract because sharecropping allows them to get a higher expected rent, and to get an in-kind rent, particularly for rice production, which can be either sold or used for family consumption.

On the demand side, fixed-rent contract appears as a first best but the households who faced liquidity constraints tend to choose sharecropping contract (ex-post payment of the rent) because they do not have enough money to pay for the ex-ante payment of the rent. The lack of productive assets or input (oxen, mechanization, labour...) is also evoked. The resources pooling in these contracts allows the tenant to reduce expense in tradable inputs for the agricultural production. On the other side, the role evoked in the literature by agricultural risk in contractual choice does not appear as a main determinant in our study area. This is in line with another study finding in the same area (Bellemare, 2007).

In our data (qualitative and quantitative), we have more sharecropping contract than fixed-rent contract. Bellemare (2009) relates the predominance of sharecropping contract in reverse tenancy sample to a weak property right effect from only the point of view of landowner. Our qualitative data, which take into account both the point of view of landowners and tenant, suggest otherwise, namely that the predominance of share tenancy contract can be more related to liquidity constraints for either the former or the latter or both. Tenure security is not mentioned as an important determinant of tenancy market participation in the supply side.

So, the main determinant of household participation in the tenancy market in our study area can be related to factor endowments (land, credit, draft animals, mechanization and labour). About Liquidity constraints, it takes the form of leasing contracts with ex-ante payment for the landowners and share tenancy contracts for both landowner and tenant for

whom liquidity constraints is related to the financing of the production costs. On the supply side, the ex-ante payment of the rent in fixed-rent contracts can allow landowners with urgent needs of cash to solve this constraint. On the demand side, on the contrary, ex-ante payment in cash can limit participation of poor household. Thus, liquidity constraints influence participation and contractual choice of households in tenancy market in Lake Alaotra region.

4.2 Econometric analysis

4.2.1 On the supply side

As notified earlier, we have a potential bias of underreporting of fixed-rent contract and this doesn't allow us to have an econometric analysis on the supply side of land tenancy market. This potential bias could reduce the efficiency of the contractual choice estimation on the supply side. However, in our questionnaire, we have questions about household rationales in leasing out. According to these contract level data (table 5), the main motivation in contracts data to lease out is liquidity constraints (60%)¹⁰. Constraints nature influence also contractual choice. Constrained household who have liquidity constraints related to the operation of a given plot choose sharecropping and those who have urgent need of liquidity choose fixed-rent with ex-ante payment of the rent. This type of fixed-rent contract can be called “distress renting”.

Table 5: households' motivations to lease out (contract level)

	Motivations	Sharecropping	Fixed-rent	Total
Lease out related to liquidity constraints	Lack of liquidity to finance production cost	27	6	88 (60%)
	Lack of labour and lack of liquidity to finance hired labour	43	5	
	Urgent need of liquidity	--	9	
	To repay credit	--	3	
Lease out non related to liquidity constraints	Lack of productive asset	26		61 (40%)
	Mutual aid arrangement	15		
	Plot too far from house	14		
	Others reasons	8		
Total		121 ¹¹ (100%)	28 ¹² (100%)	149 (100%)

¹⁰ This result comes from our quantitative survey where households who lease were asked about about their motivations to lease out.

¹¹ Some tenant-households have many motivations in sharecropping

¹² Some tenant-households have many motivations in fixed-rent

So, among households who lease out, those who have liquidity constraints related to the financing of the agricultural production of the plot are more likely to lease out land under a share tenancy contract than non-constrained households. However if liquidity constraints is related to an urgent need of liquidity, they may prefer a fixed-rent contract with ex-ante payment. Participation on the supply side is then an alternative to liquidity constraints. This liquidity constraint effect can induce an increase of amount of the rent and then some difficulties for poor tenants to lease in land.

4.2.2 On the demand side

On the demand side, our data allows us to make econometric analysis on the effect of liquidity constraints on household’s tenancy market participation.

4.2.2.1 Model specification and variables

On this side of the tenancy market, credit market (formal and informal) outcomes (credit refusal, lower amount, and denial to participation...) is assumed to have also an effect on household’s decision on tenancy market. These decisions are then treated after the realisation of the credit outcomes as described below:

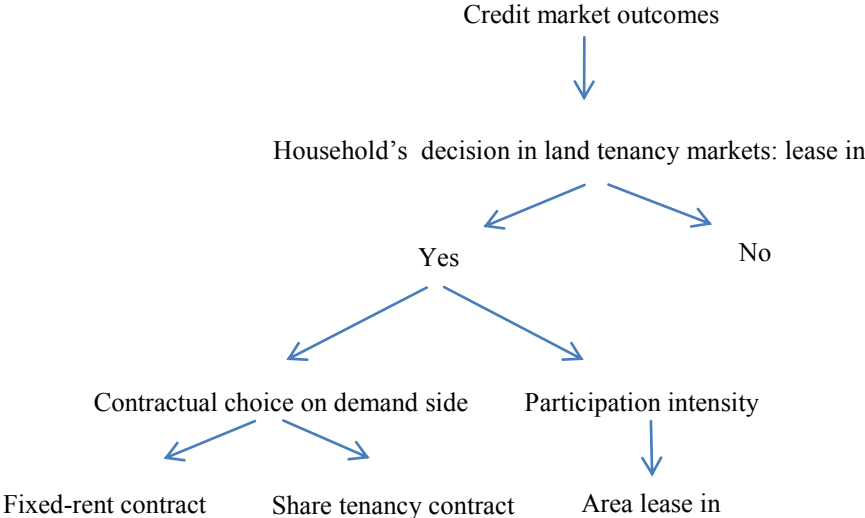


Figure 1: Conceptual framework of the interactions between credit market outcomes and household’s participation in land markets (demand side)

At the beginning of the growing season, after the realisation of the credit market outcomes, we assume that households have a sequential decision process about their participation in the tenancy market: firstly, households decide to rent in or not; secondly, after this first choice, they choose the area to lease in and the contract in which they would lease in: sharecropping or fixed-rent.

The empirical literature (Skoufias, 1995; Kochar, 1997; Deininger et al., 2003; Teklu and Lemi, 2004; Masterson, 2007; Holden et al., 2009) provides us a basis for specifying the equations determining land rental outcomes which are assumed to be mainly a function of the household's resource endowment at the start of the cropping year and hence prior to the land rental decision. These resources include (Annex 2):

– **Human capital and demographic structure of household**

The variables AGE, EDUC and FORM_AGRI measure respectively the age, the duration of schooling (years) and the additional training made in agriculture by the household head. We assume as in other studies that AGE and EDUC may have a nonlinear effect on tenancy market participation. So we also include the squared terms of both variables to test this effect. The additional training made in agriculture can lead the household to prefer fixed-rent contract in order to highlight their skills. We include also household size (HHSIZE) as a proxy of his labor endowment and two dummy variables for female household head (FemHH) and income from off farm activities (OFF_FARM).

– **Land endowment**

We use the proportion of paddy irrigated land in the household land endowment (PADDY_FIELD). This variable is assumed to have a negative effect on the probability to lease in and the area leased in.

– **Other assets endowment**

The stock of agricultural asset is an important determinant of household's participation in land tenancy market in the literature. We used 5 variables to test this effect: dummy variables LAWN_TRACTOR and OXEN which respectively define the fact that a household have at least one LAWN_TRACTOR or one OXEN. NUM_LAWN_TRACTOR and NUM_OXEN define respectively the number of LAWN_TRACTOR and OXEN owned by the household. LOG_ASSET_VALUE takes into account the logarithm of total value of household's agricultural assets.

– **Village and commune effect**

Land rental decision may also reflect levels of agricultural productivity in a given area: village, commune (Kochar, 1997). So, we also included variables at village level and commune level. A village level, we used population size (POPSIZE) as a proxy of the size of the land rental market activity and village dummy (VILLAGE) in order to control at the village level, for the lack of data on plots quality. At commune level, we included the

coefficient of variation of two last rainy seasons 2006/2007 and 2007/2008 (CV_RAIN). This variable allow taking into account agricultural risk in household's decision.

4.2.2.2 Econometric model

– Land market participation

The conceptual framework leads us to use a Heckman selection model to test the effect of liquidity constraints on the probability of participation and the area leased in. The model is as follow:

We have first, the equation of land area leased in:

$$Y_i^* = \alpha_{1i} + \gamma_i LC_i + \beta_i K_i + \pi_i \quad (1)$$

where Y_i^* is the actual level of transaction (*area leased in*) for households who leased in and 0 otherwise. LC_i is the households liquidity constraints dummy (credit market outcome), K_i a vector of regressors evoked above, π_i the error term, and γ_i and β_i the set of parameters to be estimated.

Heckman procedure involves estimation of the probability model for the decision to lease in or not, calculation of the inverse Mill's Ratio (sample selection bias), and incorporation of this variable into the model for the OLS estimation of the area leased in (Y_i^*) in order to correct for the selection bias induced by considering only the sample of tenant.

The model of participation is as follow:

$$lease\ in_i = \alpha_i + \delta_i LC_i + \rho_i X_i + \varepsilon_i \quad (2)$$

where *lease in* is a dichotomous variable indicating the i th farmer's decision of leasing in the land tenancy market, with *lease in* = 1 standing for participation on the demand side, and *lease in* = 0 for otherwise. X_i is a vector of regressors, ε_i the error term, and δ_i and ρ_i the set of parameters to be estimated.

For this equation, the inverse Mill's Ratio is: $\varphi = \frac{\theta(\delta_i LC_i + \rho_i X_i)}{\Phi(\delta_i LC_i + \rho_i X_i)}$

Where θ and Φ are density and cumulative density functions, respectively. This ratio is included as an additional regressor in the land intensity regression conditional on *lease in* = 1.

$$Y_i^* = \alpha_{1i} + \gamma_i LC_i + \beta_i K_i + w_i \varphi_i + \pi_i \quad (3)$$

where the variables in K_i are allowed to differ from those in X_i .

The testable assumptions are as follows: on the demand side, liquidity constrained households are less likely to lease in land than non-constrained households (expected sign of γ_i is negative) and among households who lease in, those who have liquidity constraints lease in less land than non-constrained households (expected sign of γ_i is negative). Estimations are presented in annex 3.

Seeing that CHH and ACHH are dummy variables and are common on the selection and censored equations, the model named “Endogenous Switching Type II-Tobit” would give better estimations (Kim, 2006). This model is “a hybrid of Heckman (1978)’s “multivariate probit model with structural shift” and a type II-tobit model and provide a simple two step estimator which is easy to implement and robust compared to other alternative estimators” (Kim, 2006: 281). This model is being built and IV results will be presented in a forthcoming version of this paper.

– Contractual choice in the land market

Household who decide to lease in have to choose between a sharecropping contract and a fixed-rent contract. This choice is represented by the variable *Sharecropping* which take the value 1 if it is a sharecropping which is chosen and 0 if it is a fixed rent contract. The expected methodology might be similar to that developed earlier for the area leased in but in the second stage we used a probit model rather than OLS because of the nature of our variable (dummy). However, the Wald test of independence (annex 4) equations is not conclusive about this methodology. So, we turn to a probit model to test our hypothesis. We expected here that γ_i will be positive. Indeed, among households who lease in, those who have liquidity constraints are more likely to lease in land under a share tenancy contract than non-constrained households ($\gamma_i \geq 0$). This is due to the fact that share tenancy delays the payment at the end of the crop season (quasi-loan) on the contrary of fixed-rent contract where the payment of the rent is ex-ante. Also, share-tenancy contracts may include some cost-sharing features which can be interpreted of as a way to solve liquidity constraints.

Seeing that the endogenous regressors and the outcome variable (sharecropping) are dummy variables, the usual instrumental variable estimators are not consistent. So, to avoid potential endogeneity with ACHH and CHH, we rely on methodology which combines impact analysis methodology when the treatment effect is endogenous (definition of a treatment effect equation) and a bivariate probit model. Results are presented in annex 6.

4.2.2.3 Results and discussion

– **On the effect of Liquidity constraints and tenancy market participation (Annexe 3)**

The fact to be liquidity constrained (all three variables) seems to do not have any significant effect on household's land tenancy market participation. This result however should be taken with caution because of the potential endogeneity of this variable.

About other variables, *human capital and demographic* structure variables have various effects on household's participation in land tenancy market. HHSIZE is a proxy of the availability of labour in the household. This variable has a significant positive effect on the area leased in and this means that the availability of family labor allows the leasing (in) of more land instead of the using of this liquidity to take hired labour. Age does not have an effect on the area leased in and household who have off farm activities don't lease more land than the others. EDUC and EDUCsquare measure the management capacity of the household. So, household who have a certain level of education (EDUCsquare) may have another financing source and then, they can lease more land. However, household who have off farm activities seems to do not lease more land. This is closely related to the fact that off farm activities are their main income source.

We also notice that *assets* (NUM_OXEN and NUM_LAWN_TRACTOR) have significant positive effects on the area leased in. This asset endowment is essential in the study area and allow household to undertake agricultural production regardless constraints which can exist in these assets markets (renting).

On the probability of participation in tenancy market, AGE has a negative impact on renting in and can be related to an experience effect if we consider that experience increase with the age. This is supported by the fact that AGESquare has a positive effect on the probability to participate to the land tenancy market. FORM_AGRI which is another managerial capacity indicator has also a positive effect on the leasing in probability.

Our *village and commune* variable (POPSIZE and CV_RAIN) have positive effect on the probability of leasing in. Indeed, the size of the village is an indicator of the size of the local land market; the fact that a village has many people may induce a pressure on land and so a demand for land. Between household who lease in, those who are in the first quintile of income lease in less land (quint1).

– **On the effect of liquidity constraints and contractual choice on tenancy market (annex 5 & 6)**

The fact to be liquidity constrained has a significant effect on household's probability to choose sharecropping only in our IV estimations (Annex 6). However the Hausman specification test (annex 7) doesn't allow us to tell which estimator is the best.

In annex 5, *human capital and demographic* structure and *assets* variables don't have significant effect on the probability to contract under sharecropping contract. Village and commune level variables increase however the probability to choose sharecropping.

CV_RAIN is a proxy of agricultural production risk. When CV_RAIN increases, the risk of flooding may increase also. So household may choose sharecropping in order to mitigate this risk.

Off farm activities increase household's probability to contract under fixed-rent. Indeed, off farm activities is an income source and can allow them to pay for the rent. Household who has also more paddy field prefer contract under fixed-rent contract. The holding of (lot of) paddy fields in this area may be an indicator of wealth, so the sign of OFF_FARM may mean that richer household prefer fixed-rent contract and other sharecropping contract. However, the first income quintile variable (quint1) indicate, that those who earns the less can choose a fixed rent contract. This is a surprising result but it can be explained by the fact that it exist several types of land in the tenancy market. While paddy fields are the most common type of land, there exists other which is lower quality. We have here an adjustment effect which mean that household who are constrained can choose a fixed-rent contract but with a lower land quality or lower areas.

Annex 6 provides us a joint estimation of the probability to choose sharecropping and the probability to be constrained. These results show an effect of the fact to be constrained on contract choice. Household who are liquidity constrained prefer sharecropping rather than fixed-rent contract. Cost sharing and the fact that fixed rent must be paid ex ante are the main motivations as shown above. As in annex 5 we have also the same effect for OFF-FARM, PADDY_FIELD and quint1.

These estimations allow us also to undertake an exploration of the determinants of being constrained or not. The results show that the time taken to go to the nearest formal institution (TIMECREDIT), the fact to have less income (quint1), the have land without formal document (INFORMAL_DOC_Land) and off-farm activities (OFF_FARM) increase

the probability to be constrained. Informal land documents do not prevent household to take formal credit because it is possible in this area to put as collateral informal land document (document with village or commune stamp). However they may have a lower amount than household who can give as collateral formal land document (FORMAL DOC_Land).

5 Conclusion

Households' tenancy market participation is related to their liquidity constraints. These constraints (form and nature) have different effect on households' participation. On the supply side, they increase the probability to lease out land and have effects on household's contractual choice. On the demand side, liquidity constraints do not have significant effect on the probability to lease in land but they are one the main determinants on contractual choice between sharecropping and fixed-rent. Tenancy market allows households to overcome credit markets imperfections. In this, share tenancy is compromise for both the tenant and the landowner. So public policies must not be targeted to a particular sector (land or credit market) but must take into account the interactions of land and financial needs in household's strategies.

Bellemare (2009) connect reverse share tenancy to the question of tenure security in the Lac Alaotra from only landowner point of view. Our results show that the importance of share tenancy is more related to liquidity constraints faced for both the tenant and the landowner. Moreover, in our qualitative survey, tenure security is not the main determinant of tenancy market participation. The interesting questions which emerges are how tenant and landowner meet each other and what are the terms of the arrangements (cost sharing or not). These issues will be our future research. .

Annex 1: Constrained and non-constrained household (total sample)

Variable	Total sample (448)		No constrained household (262)		Constrained household (186)		Test
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
AGE: Household head	44,38	12,31	44,73	12,35	43,89	12,27	
OFF_FARM: dummy equal to one if off-farm activities	0,52	0,50	0,50	0,50	0,55	0,50	
PADDY_FIELD: proportion of paddy field in land holding	0,29	0,29	0,31	0,28	0,27	0,30	+**
FORMAL CREDIT: equal to one if household has a formal credit	0,55	0,50	0,60	0,49	0,47	0,50	+***
INFORMAL CREDI : equal to one if household has an informal credit	0,30	0,46	0,28	0,45	0,32	0,47	
Credit amount obtain formal sector (Ariary ¹³)	584001,00	1220590,00	679831,90	1385090,00	451468,90	934725,00	+**
Credit amount obtain in informal sector (Ariary)	41305,38	128541,80	41709,85	133650,10	40746,01	121473,30	
Lease out dummy	0,23	0,42	0,20	0,40	0,27	0,44	--*
Lease in dummy	0,50	0,50	0,49	0,50	0,51	0,50	
Fixed-rent dummy (lease out)	0,05	0,22	0,04	0,20	0,06	0,25	
Fixed-rent dummy (lease in)	0,29	0,45	0,31	0,46	0,26	0,44	
Sharecropping dummy (lease out)	0,19	0,39	0,17	0,37	0,21	0,41	
Sharecropping dummy (lease in)	0,29	0,46	0,27	0,44	0,33	0,47	--*
OXEN : equal to 1 if household has an oxen	0,48	0,50	0,50	0,50	0,44	0,50	

The last column contains t-tests /proportion test of the difference of the mean from the non-constrained and constrained household samples for each variable. As such, a plus (minus) sign indicates that the mean of the variable is significantly higher (lower) in non-constrained sample than constrained sample. *10%, **5% and ***1%.

¹³ 1euro≈2500Ar

Annex 2: Tenants sample

Variable		Obs	Mean	Std.Dev.
Area_leased	Area leased in by the household	224	1,31	1,33
Fixed_rent contract	Equal to 1 if household has a fixed-rent contract	224	0,58	0,50
Sharecropping	Equal to 1 if household has a sharecropping contract	224	0,59	0,49
CHH	Equal to 1 if household is liquidity constrained	224	0,43	0,50
PCHH	Equal to 1 if household is “ex post” liquidity constrained	224	0,28	0,45
ACHH	Equal to 1 if household is “ex ante” liquidity constrained	224	0,17	0,38
AGE	Age of the household	223	42,05	11,22
FemHH	Equal to 1 if household head is female	224	0,05	0,23
HHSIZE	Household size	224	6,86	2,61
EDUC	Time spend in school (years)	216	6,59	3,29
OFF_FARM	Equal to 1 if household has off farm activities	224	0,53	0,50
FORM_AGRI	Equal to one if household head received an additional training in agriculture	224	0,21	0,41
PADDY_FIELD	Proportion of paddy irrigated land in the household land endowment	184	0,25	0,28
OXEN	Equal to 1 if household has at least one oxen	224	0,54	0,50
NUM_OXEN	Number of oxen of the household	224	2,00	2,33
LAWN_TRACTOR	Equal to 1 if household has at least one lawn tractor	224	0,12	0,33
NUM_LAWN_TRACTOR	Number of lawn tractor of the household	224	0,15	0,45
LOG_ASSET_VALUE	Logarithm of the total value of agricultural assets	220	14,45	2,43
ASSETLOOSE	Equal to 1 if household loose an assets in the last twelve months and could not replace it	224	0,33	0,47
TIMECREDIT	Time taken (minute by bicycle) to go to the nearest formal credit institution	224	52,16	25,22
POPSIZE	Village population size	224	2720,76	1306,78
CV_RAIN	Coefficient of variation of the two last rainy seasons 2006/2007 and 2007/2008	224	-21,62	6,10

Annex 3: Heckman estimation of household's participation and area leased in

VARIABLES	Estimation with CHH		Estimation with ACHH and PCHH	
	Area leased in	Lease in	Area leased in	Lease in
CHH	0.0558 (0.185)	0.140 (0.148)		
ACHH			0.225 (0.282)	0.0668 (0.215)
PCHH			-0.00597 (0.202)	0.124 (0.166)
HHSIZE	0.103* (0.0587)	0.0817** (0.0349)	0.106* (0.0591)	0.0821** (0.0349)
AGE	0.0147 (0.0677)	-0.113*** (0.0412)	0.0181 (0.0679)	-0.114*** (0.0414)
AGEsquare	-0.000620 (0.000620)	0.000816** (0.000413)	-0.000659 (0.000622)	0.000829** (0.000415)
EDUC	-0.200* (0.112)	0.0574 (0.0737)	-0.185 (0.113)	0.0575 (0.0737)
EDUCsquare	0.0179** (0.00766)	-0.00176 (0.00555)	0.0171** (0.00771)	-0.00177 (0.00554)
OFF_FARM	-0.619*** (0.199)	-0.173 (0.157)	-0.625*** (0.199)	-0.171 (0.158)
PADDY_FIELD	-0.455 (0.372)	-0.449* (0.271)	-0.413 (0.374)	-0.454* (0.272)
OXEN		0.361 (0.276)		0.353 (0.277)
LAWN_TRACTOR		-0.0945 (0.259)		-0.104 (0.259)
FORM_AGRI		0.340* (0.189)		0.335* (0.190)
LOG_ASSET_VALUE		0.0359 (0.0636)		0.0373 (0.0637)
POPSIZE		0.00144** (0.000690)		0.00141** (0.000698)
CV_RAIN	-0.0188 (0.0254)	0.161* (0.0973)	-0.0182 (0.0253)	0.158 (0.0984)
NUM_OXEN	0.119** (0.0494)		0.120** (0.0494)	
NUM_LAWN_TRACTOR	0.947*** (0.214)		0.943*** (0.213)	
quint1	-1.080*** (0.378)	-0.390 (0.273)	-1.106*** (0.378)	-0.378 (0.278)
quint2	-0.582* (0.300)	-0.118 (0.243)	-0.563* (0.299)	-0.114 (0.243)
quint3	-0.235 (0.274)	-0.137 (0.229)	-0.223 (0.273)	-0.132 (0.229)
quint4	-0.0577 (0.263)	-0.0397 (0.220)	-0.0595 (0.262)	-0.0357 (0.220)
Mills (lambda)	0.729 (0.670)		0.712 (0.676)	
Constant	1.277 (1.341)	-0.701 (1.418)	1.146 (1.343)	-0.656 (1.424)
Observations	370	370	370	370

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Village dummy are includes but not reported

Annex 4: Heckprob estimation of the contractual choice

VARIABLES	Estimation with CHH		Estimation with ACHH and PCHH	
	Sharecropping	Lease in	Sharecropping	Lease in
CHH	0.220 (0.324)	0.106 (0.166)		
ACHH			-0.00404 (0.366)	0.100 (0.151)
PCHH			0.237 (0.305)	0.0407 (0.192)
HHSIZE	-0.0568 (0.286)	0.0657* (0.0384)	-0.0566 (0.171)	0.0661* (0.0390)
AGE	0.0563 (0.318)	-0.144** (0.0630)	0.0441 (0.190)	-0.142** (0.0562)
AGEsquare	-0.000632 (0.00284)	0.00119* (0.000655)	-0.000509 (0.00171)	0.00117* (0.000603)
EDUC	-0.0332 (0.352)	0.126 (0.124)	-0.0426 (0.209)	0.126 (0.125)
EDUCsquare	-0.000526 (0.0213)	-0.00773 (0.0101)	2.87e-05 (0.0139)	-0.00764 (0.00997)
OFF_FARM	-0.506 (0.336)	-0.210 (0.276)	-0.483** (0.243)	-0.208 (0.257)
PADDY_FIELD	-0.858 (0.717)	-0.527 (0.397)	-0.908* (0.519)	-0.532 (0.328)
OXEN		0.0973 (0.247)		0.0956 (0.243)
LAWN_TRACTOR		-0.195 (0.537)		-0.198 (0.467)
FORM_AGRI		0.540 (0.439)		0.536* (0.289)
LOG_ASSET_VALUE		0.114* (0.0603)		0.114* (0.0588)
POPSIZE		0.00162*** (0.000258)		0.00165*** (0.000254)
CV_RAIN	-0.00870 (0.0373)	0.205*** (0.0439)	-0.0106 (0.0242)	0.209*** (0.0373)
NUM_OXEN	-0.0220 (0.213)		-0.0189 (0.134)	
NUM_LAWN_TRACTOR	-0.153 (0.171)		-0.139 (0.175)	
quint1	-1.109** (0.546)	-0.566** (0.266)	-1.070** (0.439)	-0.574** (0.264)
quint2	-0.488 (0.512)	-0.200 (0.295)	-0.507 (0.475)	-0.203 (0.282)
quint3	-0.588** (0.272)	-0.389** (0.191)	-0.597** (0.254)	-0.387** (0.154)
quint4	-0.881 (0.978)	-0.202 (0.193)	-0.848 (0.632)	-0.205 (0.183)
Constant	0.292 (3.177)	-0.812 (1.501)	0.539 (2.445)	-0.879 (1.278)
athrho	1.161 (4.119)		1.257 (2.413)	
Observations	370	370	370	370

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Village dummy are included but not reported

Wald test of indep. eqns. (rho = 0): chi2(1) = 0.08 Prob > chi2 = 0.7781 (CHH estimation)

Wald test of indep. eqns. (rho = 0): chi2(1) = 0.27 Prob > chi2 = 0.6025 (ACHH and PCHH estimation)

Annex 5: Probit estimation of contractual choice

VARIABLES	Estimation with CHH Sharecropping	Estimation with ACHH and PCHH Sharecropping
CHH	0.248 (0.238)	
ACHH		0.132 (0.231)
PCHH		0.207 (0.250)
HHSIZE	0.00632 (0.0492)	0.00726 (0.0485)
AGE	-0.0564 (0.0423)	-0.0579 (0.0425)
AGEsquare	0.000426 (0.000465)	0.000445 (0.000462)
EDUC	0.0482 (0.116)	0.0503 (0.117)
EDUCsquare	-0.00393 (0.00862)	-0.00410 (0.00858)
OFF_FARM	-0.434** (0.202)	-0.427** (0.202)
PADDY_FIELD	-0.671* (0.347)	-0.686** (0.331)
OXEN	-0.00123 (0.504)	-0.0257 (0.507)
LAWN_TRACTOR	-0.200 (0.469)	-0.212 (0.473)
FORM_AGRI	0.339 (0.215)	0.330 (0.231)
LOG_ASSET_VALUE	0.0215 (0.118)	0.0258 (0.118)
POPSIZE	0.000785** (0.000355)	0.000741** (0.000342)
CV_RAIN	0.0862* (0.0480)	0.0799* (0.0469)
FemHH	-0.301 (0.531)	-0.310 (0.517)
quint1	-1.005*** (0.351)	-0.992*** (0.354)
quint2	-0.357 (0.373)	-0.349 (0.367)
quint3	-0.520*** (0.151)	-0.513*** (0.150)
quint4	-0.620** (0.314)	-0.615** (0.308)
Constant	0.0825 (1.618)	0.136 (1.630)
Observations	370	370

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Village dummy are includes but not reported

Annex 6: estimation of contractual choice (IV estimator)

VARIABLES	IV estimation of CHH		IV estimation of ACHH	
	Sharecropping	CHH	Sharecropping	ACHH
CHH	1.360** (0.568)			
PCHH			0.182 (0.173)	
ACHH			0.116 (1.080)	
HHSIZE	0.0256 (0.0368)	0.0284 (0.0341)	0.0460 (0.0378)	-0.00367 (0.0455)
AGE	-0.0249 (0.0414)	0.0133 (0.0385)	-0.0285 (0.0465)	-0.0338 (0.0484)
AGEsquare	4.49e-05 (0.000416)	-0.000167 (0.000384)	1.81e-05 (0.000469)	0.000417 (0.000484)
EDUC	-0.00745 (0.0746)	-0.0522 (0.0733)	-0.0314 (0.0791)	-0.0312 (0.101)
EDUCsquare	0.000949 (0.00546)	0.00209 (0.00557)	0.00181 (0.00590)	-0.000621 (0.00823)
OFF_FARM	-0.398** (0.163)	0.180 (0.158)	-0.386* (0.203)	0.589*** (0.224)
PADDY_FIELD	-0.297 (0.341)	-0.397 (0.260)	-0.580* (0.305)	-0.492 (0.363)
OXEN	0.105 (0.245)		0.0903 (0.302)	
LAWN_TRACTOR	0.0755 (0.254)		-0.0188 (0.281)	
FORM_AGRI	0.147 (0.194)		0.234 (0.204)	
LOG_ASSET_VALUE	0.00524 (0.0562)		0.00338 (0.0682)	
POPSIZE	0.000482 (0.000701)		0.000617 (0.000858)	
CV_RAIN	0.0397 (0.0960)	-0.0778 (0.0805)	0.0423 (0.121)	-0.214* (0.113)
FemHH	-0.0383 (0.280)		-0.0178 (0.333)	
ASSETLOOSE		0.109 (0.152)		-0.0879 (0.210)
TIMECREDIT		0.0116 (0.0181)		0.0485** (0.0243)
NUM_OXEN		-0.0258 (0.0304)		-0.00851 (0.0418)
NUM_LAWN_TRACTOR		-0.221 (0.179)		-0.313 (0.321)
FORMAL DOC_LAnd		-0.359* (0.202)		-0.203 (0.317)
INFORMAL DOC_LAnd		0.406*** (0.139)		-0.285 (0.197)
quint1	-0.608** (0.274)	0.425 (0.260)	-0.523 (0.418)	1.161*** (0.367)
quint2	-0.114 (0.237)	0.166 (0.242)	-0.0699 (0.280)	0.490 (0.351)
quint3	-0.257 (0.222)	0.313 (0.232)	-0.175 (0.256)	0.362 (0.348)
quint4	-0.293 (0.218)	0.114 (0.225)	-0.267 (0.245)	0.400 (0.339)
Constant	-0.943 (1.366)	-2.722 (2.740)	-0.709 (1.713)	-7.153* (3.743)
Observations	370	370	370	370

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Annex 7: Hausman test of specification (CHH estimation)

Test: Ho: difference in coefficients not systematic

$$\chi^2(24) = (b-B)'[(V_b-V_B)^{-1}](b-B) = 10.58$$

$$\text{Prob} > \chi^2 = 0.9917$$

($V_b - V_B$ is not positive definite)

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