Land rental markets in the process of rural structural transformation: Productivity and equity impacts from China

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Productivity and equity impacts in China

Abstract: While the importance of land rental for overall economic development has long been recognized in theory, empirical evidence on the productivity and equity impact of such markets and the extent to which they realize their potential has been scant. Representative data from China's nine most important agricultural provinces illustrate the impact of rental markets on households' economic strategies, their welfare, and productivity of land use at the plot level. While there are positive impacts in each of these dimensions, transaction costs constrain participation by many producers, thus preventing rental markets from attaining their full potential. Factors that increase transaction costs are identified, together with a rough estimate of the productivity- and equity- impact of removing them.

1. Introduction

In settings where, historically, land and power were distributed in a very unequal fashion, a key role of land rental markets has been to transfer land from large owners to landless workers or small landowners to achieve an outcome more efficient than cultivation based on wage labor. With traditional labor-intensive technology, high levels of risk, and lack of alternative opportunities, the scope for potential renters to bargain was limited especially if population growth led to a decrease in the amount of land available. As the main function of markets was to equalize endowment ratios, land market activity remained low in environments where land was distributed a more equitably.

With widespread availability of off-farm employment opportunities, economic growth that provides a basis for large-scale transfer of labor out of the agricultural sector, and increased importance of new technology and links to supply chains, the importance of rural factor markets, including those for land rental, has increased significantly. In such an environment, mechanisms to allow flexible and low-cost transfer of land to their most productive use will generate opportunities of relevance to the broader transformation of the rural economy and provide a basis for rural welfare to increase over time.

The potential of land rental to contribute to the transformation of rural economies and its advantages compared to transactions in other factor markets, are well recognized (de Janvry *et al.* 2001). For example, and rental can enhance productivity and equity and contribute to structural change by allowing less skilled or old producers to participate in the non-farm economy while still deriving benefits from their land Compared to other options to transfer land, e.g. via sales markets, the fact that rental requires only limited capital outlay and offers ways to overcome market imperfections in labor or credit markets through choice of contractual forms (Otsuka and Hayami 1988) leads to much lower transaction costs and thus greater flexibility. At the same time, it is often not clear to what extent rental markets live up or fall short of their potential, what policy actions might be required to allow better realization of existing opportunities, and what the magnitude of associated productivity- and welfare-gains might be.

In this paper, we use the case of land rental in China to addresses is issue at a conceptual and an empirical level. The conceptual basis for doing so is a model with producers who have idiosyncratic levels of agricultural ability, an exogenous non-agricultural wage rate, and transaction costs in the

land market. This allows us to make predictions on the impact of changed availability of non-agricultural employment opportunities and the level of transaction costs on land markets, occupational choice, agricultural productivity, and the distribution of income. Following the literature on market participation, we use a switching regression of land rental participation to assess factors that increase the cost of participation and thus may reduce the extent of land rental activity and associated benefits. Combining standard household survey information with evidence on the other party involved in land market transactions and productivity of plots before and after having been transferred in the market allows us to make inferences on the benefits from land rental in terms of diversification of income sources, household welfare, and agricultural productivity. Doing so leads to some interesting findings.

First, the impact of land rental on productive efficiency is surprisingly large, with an estimated increase in net revenues by almost 60% even once overall productivity increases are netted out. About one third of these gains accrue to landlords in the form of rental payments while two thirds are received by tenants. Second, in addition to facilitating a significant improvement in tenants' welfare, the fact that tenants normally come from the lower parts of the asset distribution implies that these gains help improve the distribution of income. In our setting, land rental provides a key avenue for the rural population to take on non-agricultural jobs, in most cases via migration. To illustrate the significance of this phenomenon note that, of the landlords in our sample, 57% relied on agriculture as their main source of income before renting out their land but only 17% did so thereafter. In fact, income gains for those renting out are estimated to be even larger than the gains accruing to tenants. Finally, despite the economic benefits from engaging in land rental, local regulations and limited tenure security increase the associated transaction cost, thus constraining participation by some households and the associated welfare gains. Respondents' subjective perceptions and the fact that -despite the significant productivity losses entailed in such *a priori* limitation of the set of possible transaction partners- a large part of them transact exclusively with relatives support this notion.

The paper is structured as follows. Section two provides background on land relations and land rental markets in China, derives predictions from a household model of rental participation and discusses the empirical strategy. Section three discusses data sources and sampling and provides basic descriptive statistics from our data. Section four contains detailed evidence on equity- and productivity-impacts of land rental and results from econometric estimation. Section five concludes by drawing out policy implications for China and other countries.

2. Evolution of land tenure in China and conceptual framework

By tracing the evolution of land tenure and land market activity in this country, we highlight the continuing rapid pace of structural change in China and the steps taken to gradually improve land tenure security so as to improve the potential for decentralized land transfers. We use these elements to develop a model of land market participation in a developing economy with exogenous wage rates

and derive prediction regarding the impact of changes in specific variables on land rental market participation, and discuss strategies to test these empirically.

2.1 Evolution of land tenure and markets in China

Before the communist revolution, most of China's farmers were poor tenants or owners of small plots of land. After taking over, the communist government confiscated large landlords' holdings and distributed land rights to households on an egalitarian basis (Prosterman *et al.* 1990). In the 1950s, a policy of collectivization that required farmers to surrender land to collectives was adopted, with very negative consequences for output and rural welfare (Putterman and Skillman 1993, Yao 1999, Lin and Yang 2000). To increase production, the 1978 Household Responsibility System (HRS) made households residual claimants to output, setting off tremendous increases in output and productivity (McMillan *et al.* 1989, Lin 1992).[1] Structural change since then has been dramatic; agriculture's employment share is estimated to have dropped from more than 70% in 1978 to less than 50% by 2000 (Johnson 2002), in a process of structural change that is expected to continue in the future.

Instead of a big-bang reform, the land tenure system that underpinned these changes has evolved in a gradual way, often in response to needs. In 1978, villages were urged to issue land use contracts for 15 years to farmers. However, these contracts often remained verbal and did not preclude reallocation of land through administrative fiat in a wide range of circumstances (Rozelle *et al.* 2002). Land transfers were expected to occur through administrative reallocation by village leaders (Kung and Liu 1997).[2] This not only jeopardized tenure security but, with an increased volume of potential land transfers, also gave rise to significant productive inefficiency (Benjamin and Brandt 2002). Initially on an informal basis, land transactions started to complement and gradually overtake administrative mechanisms (Yao 2000, Kung 2002). However, renting out of land by a migrant or a person engaging in local off-farm activities could be perceived as a signal that the land was no longer needed and would therefore be available for administrative reallocation (Yang 1997, Brandt *et al.* 2004). Thus, a need to increase tenure security soon emerged as a key precondition for a more active rental market that could in turn foster the evolution of a vibrant off-farm sector.

To respond to this, and encouraged, among others, by results of local land tenure experiments (Kung 2006), legal measures to strengthen tenure security were gradually put in place. Initially, the 1998 Land Management Law put rural land use rights on a firmer legal grounding, requiring that farmers receive written 30-year land use contracts to strengthen their security and restrict the scope for readjustments (Chen and Davis 1998). These provisions were reiterated and tightened by the 2003 rural land contracting law which further constrained the range of situations under which land could be

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[1] In urban areas, land was either allocated by the state or long term leases were acquired by private users upon payment of a fee. Land acquisition provided advantages by giving owners the ability to participate in the secondary land market, use the land as mortgage, and rent it to others. Between 1993 and 1998, the amount transacted annually increased from about 11,000 to almost 1.1 million ha and the amount of land mortgaged rose from about 1,000 to 884,000 ha (Ho and Lin 2003).
[2] Exchanges of land within the village were prohibited before the 1986 Land Management Law legalized them. Transfers to outsiders remained illegal until allowed in 1998, although without clarifying specific modalities to be followed (Li 2003).

redistributed (Schwarzwalder *et al.* 2002). In response to higher levels of tenure security and non-agricultural opportunities, land rental markets, which had been virtually non-existent by the mid-1990s, emerged rapidly, with more than 10% of rural dwellers engaged in land rental transactions in 2001 (Deininger and Jin 2005). Opportunities for migration and non-farm employment motivate an increasing number of households to move out of agriculture (de Brauw *et al.* 2000), with far-reaching social and economic implications (Zhao 2002). China thus provides an ideal setting to explore factors affecting land rental markets and their impact on productivity and household welfare (Liu *et al.* 1998, Zhai and Wang 2002), something that will of particular policy relevance as non-agricultural growth picks up in other countries in the region and beyond.

2.2 Conceptual framework

The importance of land rental transactions in many settings has given rise to a large literature on contract choice discussing the optimum properties of rental contracts in an environment characterized by multiple market imperfections and (at least implicitly) unequal ownership distribution of land which rental markets help to equalize. Considerable emphasis has been on efforts to reconcile the widespread incidence of sharecropping in many parts of the world with the prediction that this contractual form to be associated with large inefficiencies. Many studies have focused on identifying conditions under which, in an environment characterized by risk and uncertainty, wealth constraints, and moral hazard, sharecropping could be a "second" best choice that will be difficult to improve upon unless key parameters of the environment are modified (Shetty 1988, Basu 1992, Otsuka *et al.* 1992, Laffont and Matoussi 1995, Banerjee *et al.* 2002, Dubois 2002). Empirically, large amounts of evidence have been assembled to quantify the extent to which share contracts will lead to productivity losses (Shaban 1987, Otsuka and Hayami 1988, Otsuka *et al.* 1992, Pender and Fafchamps 2006).

Although some of this literature accounts for factors that affect tenants' and landlords' incentives to enter specific contracts, the main focus is on properties of the rental contract rather than the decision to rent which is often taken as exogenously given. With increased transfer of labor out of the agricultural sector in the context of economic development, the way in which the rural sector responds will itself have repercussions for the economy's productive development and the extent to which rural areas will be able to share in such growth. It will thus be useful to complement analysis of contractual forms with an assessment of factors that affect overall rental market activity, participation by certain types of producers, and the benefits of doing so. This will not only be of conceptual interest but also have great policy relevance for the increasing number of countries affected by such a transition.

To capture factors affecting participation in land rental markets, we use a simple model. Let household i be endowed with fixed amounts of labor $\overline{L}_i$ and land $\overline{A}_i$, and an exogenously given level of agricultural ability α_i (Carter and Yao 2002). Agricultural production follows a production function $f(\alpha_i, l_{ia}, A_i)$ with standard properties, i.e. $f'>0$, $f''<0$ with respect to all arguments and $f_{lA}>0$.

Labor supervision constraints and the egalitarian distribution of land endowments imply limited scope for emergence of agricultural labor markets (Binswanger *et al.* 1995). Households thus allocate their labor between farming on own or leased land $l_{i,a}$ and off-farm employment $l_{i,o}$ at an exogenously given wage w. We abstract from credit market imperfections, noting that these can be overcome through appropriately structured rental contracts.[3] While $f(\alpha_i, l_{i,a}, A_i)$ is subject to constant return to scale (e.g. $f(\alpha_i, l_{i,a}, A_i) = \alpha_i^{1-\beta_1-\beta_2} l_{i,a}^{\beta_1} A_i^{\beta_2}$ in the Cobb-Douglass case) but that, as ability is not tradable, $f(l_{i,a}, A_i) = l_{i,a}^{\beta_1} A_i^{\beta_2}$ is subject to decreasing return to scale in land and labor (Conning and Robinson 2005).

In the above setting, households' decision variables are $l_{i,a}$ and $l_{i,o}$, the amount of labor devoted to farming and wage employment, and the amount of land to be farmed, which implies the amount of land rented in or rented out. Renting of land incurs transaction costs which can be different for renting in (TC^{in}) and for renting out (TC^{out}). In addition to standard factors such as the cost of acquiring information on potential partners as well as negotiating and enforcing contracts, an important element of transaction cost is the risk of land loss, either due to the tenant's failure to vacate the land at the end of the agreed period or because renting of land increases the risk of being affected by redistribution (Rozelle *et al.* 2002). While search and negotiation costs that are expected to be positively related to the size of rental area are the key transaction cost for renting in land, transaction cost associated with the risk of land loss the magnitude of which is proportional to the amount of land transacted and which can be reduced by appropriate institutional arrangements, is of relevance only for renting out, i.e. it will affect only TC^{out} (*S*imilary assumptions in Kimura et al. 2006)[4]. With this, household *i*'s decision problem is to choose A_i, $l_{i,a}$ and $l_{i,o}$ to solve

$$\underset{l_{i,a}, l_{i,o}, A_i}{Max} \; pf(\alpha_i, l_{i,a}, A_i) + wl_{i,o} - I^{in}[(A_i - \overline{A}_i)(r + TC^{in})] + I^{out}[(\overline{A} - A_i)(r - TC^{out})] \qquad (1)$$

$$\text{s.t. } l_{i,a} + l_{i,o} \le \overline{L} \qquad (2)$$

where, in addition to the variables defined earlier, p is the price of agricultural goods, I^{in} is an indicator for renting in (1 for rent-in, and 0 otherwise) and I^{out} is a similarly defined indicator for renting out (1 for rent-out and 0 otherwise). Assuming that (2) holds with equality, the optimal choices, $l_{i,a}^*$ and A_i^* solve the first order conditions (FOCs)

$$pf_{l_{i,a}}(\alpha_i, l_{i,a}, A_i) = w \qquad (3)$$

and for households who rent in ($A^* > \overline{A}_i$), $\qquad pf_{A_i}(\alpha_i, l_{i,a}, A_i) = r + TC^{in} \qquad (4)$

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[3] The notion that households are able to structure rental contracts flexibly to overcome liquidity constraints is supported by the fact that, according to our data, 86% of contracts at the national level, and more than 90% in the poor Southwestern provinces, involve rental payment at harvest time.

[4] While the positive relationship between transaction cost and area of transaction is not necessarily in exact proportion, however, we treat the transaction cost for either side of the markets as variable cost to simplify the derivation of our propositions without loss of generality.

for households who rent out ($A^* < \overline{A_i}$), $\qquad pf_{A_i}(\alpha_i, l_{i,a}, A_i) = r - TC^{out}$ $\qquad$ (5)

and for autarkic households ($A^* = \overline{A_i}$), $\qquad r - TC^{out} < pf_{A_i}(\alpha_i, l_{i,a}, A_i) < r + TC^{in}$ $\qquad$ (6)

Comparative statics based on equations (3)-(6) allow us to derive propositions on the relationship between households' land endowment and their level of agricultural ability and thus the impact of land rental on productivity, the response of land rentals to changes in transaction costs, and their evolution with increases in wage rates that provide the basic hypotheses to be tested empirically with our data. More detailed proofs for each of the propositions below can be found in the appendix.

Proposition 1: The amount of land rented in (out) is strictly increasing (decreasing) in households' agricultural ability, α_i, and strictly decreasing (increasing) in their land endowment $\overline{A_i}$. Land rental will transfer land to efficient, but land-poor producers thereby contributing to higher levels of productivity and more efficient factor use in the economy. For households renting in or out land, this proposition can be derived by totally differentiating both sides of equations (3) and (4) or (3) and (5) with respect to α_i or $\overline{A_i}$. Manipulating terms yields $\partial A_i^*/\partial \alpha_i > 0$ (or $\partial A_i^*/\partial \overline{A} < 0$). Since a_i^{in} or a_i^{out}, the amount rented in or rented out is defined as either $A_i^* - \overline{A_i}$ or $\overline{A_i} - A_i^*$, the result for a_i^{in} and a_i^{out} follows.

Proposition 2: The presence of transaction costs defines two critical levels of ability $\alpha_l(TC^{out}, ..)$ and $\alpha_u(TC^{in}, ..)$ such that households with ability $\alpha_i \in [\alpha_l, \alpha_u]$ will remain in autarky. Any increase in TC^{in} or TC^{out} will expand the autarky range, thus reducing the number of producers participating in rental markets and the number of efficiency-enhancing land transactions. Compared to a situation with no transaction cost, this will decrease productivity and social welfare. To see this, note that the cutoff points α_l and α_u can be obtained from (5) and (4) by setting $A_i^* = \overline{A_i}$ and $l_{i,a} = l_{i,a}^*$ where $l_{i,a}^*$ is autarkic household *i's* optimal amount of labor allocated to agricultural production which can be derived from (3) at $A_i^* = \overline{A_i}$. If we define $f(\alpha_i, l_{i,a}, A) = \alpha_i^{1-\beta_1-\beta_2} l_{i,a}^{\beta_1} A_i^{\beta_2}$ we can solve for α_l and α_u explicitly as

$\alpha_l = \left(\dfrac{r - TC^{out}}{\beta_2 (l_{i,a}^*)^{\beta_1} \overline{A}^{\beta_2 - 1}} \right)^{\frac{1}{1-\beta_1-\beta_2}}$ and $\alpha_u = \left(\dfrac{r + TC^{in}}{\beta_2 (l_{i,a}^*)^{\beta_1} \overline{A}^{\beta_2 - 1}} \right)^{\frac{1}{1-\beta_1-\beta_2}}$. Simple differentiation with respect to the transaction cost variable then yields the result of interest.

Proposition 3: Increases of the exogenously given wage for off-farm employment will imply that higher amounts of land are transacted in rental markets as households with low agricultural ability who join the off-farm labor market will supply more land. This will lead to a decrease in the equilibrium rental rate which will prompt those with high-ability (who specialize in agricultural production) to rent in more land.

To simplify derivation for this proposition, assume without loss of generality that there are *n* households in the economy who are endowed with identical amounts of land and labor $\overline{A}$ and $\overline{L}$ but

who differ in farming ability α_i which is uniformly distributed between $\underline{\alpha}$ and $\overline{\alpha}$. To be able to derive a closed form solution, we also abstract from transaction costs (i.e. let $TC^{in}=TC^{out}=0$) and use an explicit functional form $f(\alpha_i, l_{i,a}, A) = \alpha_i^{1-\beta_1-\beta_2} l_{i,a}^{\beta_1} A_i^{\beta_2}$. Finally, we assume that, due to fixed setup costs, households will give up agricultural production completely and rent out all their land if the amount of labor to be allocated optimally to agricultural production is less than l_a^c. With an exogenous wage w and normalizing agricultural price at 1, the rental rate r will be determined endogenously, first order conditions then simplify to[5]

$$f'_{l_a} = \alpha^{(1-\beta_1-\beta_2)} \beta_2 A^{\beta_1} l_a^{(\beta_2-1)} = w \qquad (7)$$

and
$$f'_A = \alpha^{(1-\beta_1-\beta_2)} \beta_1 A^{(\beta_1-1)} l_a^{\beta_2} = r \qquad (8)$$

allowing to solve for A^* and l_a^* in terms of α, β, w, and r. As A^* is proportional to households' farming ability α. The market clearing condition ($\int_{\underline{\alpha}}^{\overline{\alpha}} A^* d\alpha = n\overline{A}$) can then be used to solve for A^*, l_a^* and r^* as

$$A^* = \alpha \frac{2n\overline{A}}{(\overline{\alpha}^2 - \underline{\alpha}^2)}, \quad l_a^* = \alpha \left(\frac{\overline{\alpha}^2 - \underline{\alpha}^2}{2n\overline{A}}\right)^{(\frac{\beta_1}{\beta_2-1})} w^{(\frac{1}{\beta_2-1})} \beta_2^{(\frac{1}{1-\beta_2})} \quad \text{and} \quad r^* = \left(\frac{\overline{\alpha}^2 - \underline{\alpha}^2}{2n\overline{A}}\right)^{(\frac{\beta_1+\beta_2-1}{\beta_2-1})} w^{(\frac{1}{\beta_2-1})} \beta_2^{(\frac{1}{1-\beta_2})} \beta_1$$

Setting $l_a^* = l_a^c$ allows to solve for the critical level of ability α_c below which households will rent out all their land endowment. For households who continue farm production, we solve for the new optimal operational land size (A^{**}) and new rental rate (r^{**}) based on (7), (8) and the new market clearing condition ($\int_{\alpha_c}^{\overline{\alpha}} A^{**} d\alpha = n\overline{A}$). Setting $A^{**} = \overline{A}$ allows us to obtain α_{au}, the level of farming ability by households who remain autarkic. Taking derivatives of α_c, A^{**}, α_{au} and r^{**} with respect to w then yields $\partial\alpha_c/\partial w>0$, $\partial A^{**}/\partial w>0$, $\partial\alpha_{au}/\partial w<0$ and $\partial r^{**}/\partial w<0$, suggesting that, as off-farm opportunities increase (i) a larger number of households will give farm production and rent out all their endowment; (ii) the equilibrium rental rate will decrease; (iii) those who remain in agricultural production will cultivate more land; and (iv) a larger number of households will rent in land.

2.3 Estimation strategy

Testing the above predictions quantitatively require measures of agricultural ability and transaction costs. To obtain a measure for the former, we estimate a production function with household fixed effects. Let technology be represented by the Cobb-Douglas production function

$$Q_{ijt} = \exp(\alpha_i + \alpha_j) A_{ijt}^{\theta_1} L_{ijt}^{\theta_2} K_{ijt}^{\theta_3} X_{ijt}^{\theta_4} \exp(\phi t) \qquad (9)$$

where Q_{ijt} is the value of agricultural output produced by household i in village j in year t; A_{ijt}, L_{ijt} and K_{ijt}, X_{ijt} are total cultivated area, labor for crop production, value of agricultural assets, and amounts of chemical fertilizer, organic manure, pesticides, and seeds used in production, θ_1, θ_2, θ_3, and θ_4 are

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[5] To keep notation manageable, we drop the household index i below.

technical coefficients to be estimated, α_j is a time invariant village level efficiency parameter that reflects, among others, access to markets, infrastructure, and other factors that change only slowly such as climate, α_i is the time invariant household fixed effect which serves as our measure of ability, and t is a time dummy so that $exp(\phi t)$ measures productivity changes over time. To estimate (9), we take logarithms of both sides, add an *iid* error term, and let $\alpha_{ij} = \alpha_i + \alpha_j$ to obtain

$$q_{ijt} = \alpha_{ij} + \theta_1 a_{ijt} + \theta_2 l_{ijt} + \theta_3 k_{ijt} + \theta_4 x_{ijt} + \phi t + \varepsilon_{ijt} \qquad (10)$$

where *a*, *l*, and *k* denote the logarithms of *A*, *L*, and *K* with appropriate subscripts. With multiple observations per household, we can subtract the means of relevant variables. Let ~ denote a demeaned variable (i.e. $\widetilde{q}_{ijt} = q_{ijt} - \overline{q}_{ij}$), we have

$$\widetilde{q}_{ijt} = \theta_1 \widetilde{a}_{ijt} + \theta_2 \widetilde{l}_{ijt} + \theta_3 \widetilde{k}_{ijt} + \theta_4 \widetilde{x}_{ijt} + \phi \widetilde{t} + \widetilde{\varepsilon}_{ijt} \qquad (11)^6$$

This allows us to estimate all θs and ϕ and recover an estimate of composite efficiency parameter α_{ij} which includes household's idiosyncratic farming ability and unobserved village characteristics such as infrastructure access. Noting that the village effect can be defined as the average of all household fixed effects in the village, i.e. $\hat{\alpha}_j = (\sum_i \hat{\alpha}_{ij})/n_j$ (Mundlak 1961) allows us to obtain an estimate of ability for each producer in the sample by subtracting $\hat{\alpha}_j$ from $\hat{\alpha}_{ij}$.

A second empirical issue to be addressed is to specify an appropriate econometric framework and to parameterize transaction costs. According to our model, rental market participation will depend on the households' endowments of land ($\overline{A}$) and family labor ($\overline{L}$), their assets (*K*), and opportunities for off-farm employment (*O*). Let $g(\alpha, A, \overline{L}, K, O)$ be a household's net earning function that includes all farm and non-farm earning activities except the net rental income including transaction costs for market participants, and $g'(a, \overline{A}, \overline{L}, K, O)$ be the first derivative of $g(a, A, \overline{L}, K, O)$ with respect to land evaluated at $\overline{A}$. Then, the three market participation regimes can be expressed as:

I. Rent - in regime $(A_i^* > \overline{A}_i)$: $g'(\alpha, \overline{A}, \overline{L}, K, O) + \varepsilon_i > r(TC^{in})$

II. Autarky regime $(A_i^* = \overline{A}_i)$: $r(TC^{out}) \leq g'(\alpha, \overline{A}, \overline{L}, K, O) + \varepsilon_i \leq r(TC^{in})$ (12)

III. Rent - out regime $(A_i^* < \overline{A}_i)$: $g'(\alpha, \overline{A}, \overline{L}, K, O) + \varepsilon_i < r(TC^{out})$

where A_i^* denotes the optimal operational land size. This switching regime model can be estimated using ordered probit with variable upper and lower thresholds. Simple transformation of (12) yields

$pr(A_i^* > \overline{A}_i) = pr\{\varepsilon_i > r(TC^{in}) - g'(\alpha, \overline{A}, \overline{L}, K, O)\}$

$pr(A_i^* = \overline{A}_i) = pr\{\varepsilon_i \geq r(TC^{out}) - g'(\alpha, \overline{A}, \overline{L}, K, O) \cap \varepsilon_i \leq r(TC^{in}) - g'(\alpha, \overline{A}, \overline{L}, K, O)\}$ (13)

$pr(A_i^* < \overline{A}_i) = pr\{\varepsilon_i < r(TC^{out}) - g'(\alpha, \overline{A}, \overline{L}, K, O)\}$

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[6] Note that $\widetilde{\alpha}_{ij}$ disappears as α_{ij} is constant for household *i* in community *j* over time, so $\widetilde{\alpha}_{ij} = 0$.

While similar approaches to market participation have been taken by other studies (Goetz 1992, Key *et al.* 2000, Carter and Yao 2002, Bellemare and Barrett 2006), our approach differs from these in that we treat the thresholds as functions of policy variables, something that allows us to explicitly assess the impact of these variables on demand for and supply of land to the rental market. In terms of our theoretical model, doing so is justified by the fact that these policy variables will affect transaction costs *r(.)* but are unlikely to affect individual producers' marginal product *g'(.)*. At the same time, the fact that information on the amount of land rented was not included in our data before 2005 and is quite noisy even for this year precludes us from modeling the quantity of land transacted conditional on rental market participation.

Under the assumption that $g'(\alpha, \overline{A}, \overline{L}, K, O)$, $r(TC^{in})$ and $r(TC^{out})$ are linear, this can be expressed as

$$g'(\alpha, \overline{A}, \overline{L}, K, O) = \beta_0 + \beta_1\alpha + \beta_2\overline{A} + \beta_3\overline{L} + \beta_4K + \beta_5O \qquad (14)$$

$$r(TC^{in}) = \delta_0 + \delta_1 S_i \qquad (15)$$

$$r(TC^{out}) = \eta_0 + \eta_1 S_o \qquad (16).$$

The switching regression or ordered probit model defined by these equations is estimated by full information maximum likelihood. Households' endowments of land and labor are represented by the total amount of land to which they have use rights, the head's age, and the number of family members 14 to 60 years of age. *K* is represented by the value of assets at the beginning of the year. Village per capita income and the head's level of education are used to approximate *O*.

The upper and lower threshold functions $r(TC^{in})$ and $r(TC^{out})$ will be affected by economic and institutional factors. The former are approximated by the per capita land endowment in the village and the share of adults in the village who on average, had migrated out of the province in the 3-years prior to *t*. Higher levels of out-migration will increase supply of land to rental markets, thereby reducing search costs for those seeking to rent in. Greater endowments with land at the village level are likely to reduce transaction costs for renting-in but increase them for renting-out.

Institutional variables include whether the village allows land to be rented to households from outside the village, whether there is a rule mandating that land that has is left uncultivated for one season is be taken back by local authorities, and whether households have land use certificates to document their land rights. Limitations on renting to outsiders are expected to increase the costs of renting out but, to the extent that they may cause landlords to divert supply to the local leasing market, may reduce the cost of renting in. Rules stipulating the return of non-cultivated land to the village could increase supply of land available for rental and thus reduce the cost of renting in despite the fact that it reduces the level of tenure security. Having a land use certificate is expected to reduce the costs of land loss for landlords renting out, thus increasing their propensity for doing so.

2.4 Productivity impact of rental markets

While coefficients on households' ability, the level of village income, and transaction cost variables allow us to test predictions from on factors affecting rental market participation, quantification of the impact of rental markets on occupational diversification, land use productivity, and household welfare, will require additional evidence. The most direct way to obtain estimates of productivity effects is to compare returns obtained from the same plot before and after it has been rented. Equivalently, impacts on occupational structure and household welfare can be obtained by comparing the main source of income and the amount of income received by households before and after renting land.

One issue that makes it difficult to obtain such information is that in many cases, especially if the landlord has migrated out, it will not be possible to obtain such information form the person actually concerned. In this case, the only practical way of obtaining it is to enquire from those currently in possession of the land. As potential renters or tenants will explore different options before deciding for a specific partner, and as in the local village economy such information is readily available (Lanjouw 1999, DeSilva 2000), we obtain this information from tenants or landlords for their partner.

3. Data sources and descriptive evidence

We test the predictions from our model, using a large panel survey of agricultural producers in China. Standard household and production information is complemented with information on institutional arrangements at the village level and details of rental transactions, characteristics of the other party, and changes in productivity on a given plot.

3.1 Sampling and data collection instruments

Our empirical investigation is based on three sources of data. First, household level information is from a 2002-05 panel survey of almost 8,000 households in slightly less than 800 villages in nine of China's most important agricultural provinces by the Rural Survey Team of China's National Bureau of Statistics (NBS) jointly with the World Bank. Sample households are included in NBS' ongoing consumption survey, implying that a wide range of information on demography, assets, income, expenditure, agricultural production, and land market participation is available. Among others, this allows estimation of a panel production function to derive agricultural ability as discussed above. This is complemented by information on average incomes, endowments, and institutional arrangements (e.g. land use regulations, restrictions on land rental to outsiders, the share of households with land use certificates) at the village level collected in a separate survey administered to local leaders. As much of the relevant information is either available from administrative records or, as in the case of rules and regulations, can be recalled rather easily, it has been collected from 1999 onwards.

Finally, to document the contribution of land rental to structural change, a follow-up survey was administered to those who had actually been involved in land transactions to assess the impact of land rental participation on welfare of participants. This survey collected detailed information on the contractual arrangements for land transfers, the amount of net revenue obtained from the land before it

had been rented, and details of the other party involved in the contract, including his current and past occupation status and income level.

3.2 Descriptive statistics

Descriptive statistics for key variables included in the analysis at the national and regional level,[7] as reported in table 1, point towards differences in income, migration, endowments, and policy variables across regions, in addition to highlighting the increasingly important role of land markets. Households have on average 4 members each, 3 of them in working age, and a head of about 46 years. While primary education is almost universal, 52% and 18% of households have a head with secondary or high school education, respectively. Schooling attainment is lower in the Southwest (46% with secondary and 9% with high school), followed by the Center (45% and 18%, respectively) and the North and Coast regions. The mean per capita land endowment is 1.68 mu[8], a figure that ranges from 1.13 in the Southwest to 2.30 in the Northeast. The amount of non-land assets, about 27,000 Y[9] on average, varies significantly across provinces, from 36,000 in the Coast to 17,000 in the Southwest, the country's poorest region. With a contribution of about 58% to total income, agriculture remains the most important source of income overall, ranging from almost two thirds (63%) in the Southwest to slightly less than half of the income in the Coast.

With a Gini coefficient of 0.41 for "owned" land, within-village variation of endowments is more limited than in other countries, e.g. in India or Brazil where the corresponding coefficients are 0.75 or 0.89, respectively (Deininger and Squire 1998). Still, 13% and 10%, respectively, of households in our sample rented in/out land during 2002-2004, a significant increase from earlier figures (Deininger and Jin 2005). As commonly found in household-based surveys where some landlord households may have migrated, a slightly higher share of households report to rent in land.

While about 60% of those participating in rental markets reported to have a contract, the majority of land transactions remain of an informal nature, as evidenced by the fact that less than 10% of these contracts are written and three quarters are open ended rather than having a pre-specified length (of slightly less than 3 years on average for those with a time frame). Interestingly, almost 40% of renters rent in from a relative, a percentage that is, with almost 60%, particularly high in the Northeast and the Southwest, two regions where an almost equally share level of households rent to relatives (65% in the Southwest and 56% in the Northeast).

Village level data point towards significant differences in the share of households with at least one migrant, about 18% overall, ranging from 25% in the Center to 10% in the Northeast. The share of migrants who crossed provincial boundaries is, with 17%, lowest in the Coast but exceeds two thirds

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[7] The four regions are defined as follows: North and Northeast includes Liaoning and Henan provinces, Coastal Zhejiang and Shandong, the Center Henan and Hubei, and the Southwest Hunan, Sichuan and Guizhou provinces.
[8] One mu equals 1/15th of a hectare.
[9] At the time of the survey, the exchange rate was approximately 8 Y to the US dollar.

in the Center. With participation rates of 21% and 15%, rental is most active in the Central and Southwest regions where levels of overall and inter-provincial migration are also highest, in line with evidence that in many cases migration opportunities trigger rental market participation (Kung 2002).

It is also of interest to note institutional differences across regions. First, although the 1998 land law mandates issuance of land use certificates to everybody, only 82% of households in the sample -less than three fourth in the Northeast but more than 92% in the Southwest- reported to possess such a certificate. Second, about 14% of villages had, in 2001, a policy of prohibiting land rental to non-residents, a share that varied from 26% in the Coast to 5% in the Southwest. Finally, partly reflecting different land availability, about 10% of villages, ranging from 4% in the Southwest to 16% in at the Coast, had a policy allowing the village to take back land left uncultivated for one season.

3.3 Differences by type of land market participation

Splitting the sample by type of rental market participation between those remaining in autarky and those renting in and out, respectively, provides a fist descriptive check of our hypotheses. Results from doing so, reported in table 2, yield three insights. First, in line with proposition 1, and contrary to fears of markets leading to large-scale land concentration, higher land and lower labor endowments increase the propensity to rent out, suggesting that rental markets tend to equalize factor ratios across households similar to what had earlier been intended by administrative reallocation. The mean per capita land endowment for those renting out was 2.1 mu, compared to 1.5 mu for those renting in. The head's age for households who rent out is slightly higher than for those who rent in land.

Second, those better endowed with human and physical capital are more likely to supply land to the rental market. In fact the mean asset endowment of households renting out is about one third higher than that of households renting in, in addition to those renting out having slightly higher levels of tertiary education. Although income levels for those renting in are still significantly below those for rent-out household, the difference is less pronounced than for assets, suggesting that land rental provides an opportunity for the poor to catch up. Finally, there is evidence that rental markets contribute to higher levels of occupational diversification. Although the share of household income from agriculture remains, with 53%, high even for those renting out land, it is significantly lower than for those renting in who derive almost two thirds (65%) of their income from agricultural activity. This is also reflected in the fact that those renting out receive significantly higher shares of income than those renting in from migration and transfers (24% vs. 19%), wages (12% vs. 7%), and non-farm self-employment (11% vs. 9%) with all of the differences being statistically significant at the 1% level.

4. Empirical evidence

Comparing changes in productivity for rented to autarkic plots points towards large productivity gains. These in turn translate into a very positive impact of rental on household welfare, diversification of livelihoods, and productivity of land use. About 30% of sampled tenants increased their income, 69%

remained in the same bracket, and only 1% moved down with corresponding figures for "landlords" of 45%, 54% and 1%, respectively. Econometric evidence points towards a number of factors that tend to limit participation in land rental markets and thus should be of interest for policy makers.

4.1 Impact on productivity, welfare, and occupational diversification

Data on net revenues excluding family labor from a plot before and after it had been transferred through rental markets in table 3 support the hypotheses of significant improvements in productivity through land rental. With a gain of 267 or 283 Y/mu amounting to an increase in net revenues of 84% or 83%,[10] figures obtained form tenants and landlords, respectively, are surprisingly consistent.[11] With rents, including taxes, of some 90 Y/mu, about two thirds of the surplus from land rental accrues to tenants and one third to those renting out. With a mean of 3 mu per land transaction, the increase in net income for the tenant due to rental market participation would amount to about 550 Y.

While the simple difference used above eliminates unobservable plot-level effects such as soil quality, the estimated productivity impact of land rental will suffer from upward bias if productivity increased over time in an independent manner as well. To adjust for this, we pool data for changes in net income as reported by rental market participants with the difference in net revenue between 2001 and 2004 (Δy) for the 6100 households who remained in autarky throughout the period.[12] Using the 7,968 households in the pooled sample to run a regression of the form $\Delta y = \alpha_0 + \alpha_1 R^{in} + \alpha_2 R^{out} + \beta D$ where D denotes regional dummies allows us to recover the increase in productivity for rented plots compared to those that remained in self cultivation while holding constant for regional effects. Doing so indeed points towards slightly smaller productivity increase of 186 Y/mu for rented in and 180 Y/mu for rented out plots, i.e. an increase in productivity of slightly below 60%.[13]

To assess the extent to which land rental can help diversify income sources and develop the non-farm economy, we compare information on changes in the main income source for landlords and income brackets for both parties involved in rental transactions before and after land had been transferred. The sample used consists of the 1106 households who actually had participated in land rentals and their partners. Evidence on changes in the main income source for households renting out land as presented in table 4 supports the notion that such markets help to promote a considerable occupational shift. Before renting out land, the vast majority (57%) in this group relied on agriculture, followed by local non-farm employment (23%) and migration (20%). The ability to engage in land rental completely

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[10] If both apply equivalent amounts of family labor, the change in net revenue is equivalent to an increase in productivity. As, with 81 versus 91 days per mu, renters actually spend slightly less time on agricultural activities than autarkic cultivators, this assumption seems justified.

[11] Recall that, in cases where the landlord migrated out, asking the tenant is the only feasible way of obtaining such information. As we are using brackets and broad job categories, information obtained from both partners in the pre-test for cases where doing so was feasible was internally very consistent.

[12] If higher managerial ability by rent-in households imply a systematic difference in the *rate*, rather than just the *level* of productivity growth, this estimate may still be biased. As information on agricultural inputs is available only at the household level, it was not possible to conduct the more appropriate comparison between changes in net revenue for owned and rented in plots by the same household.

[13] The regression has high predictive power (R^2 of 0.56) and we are unable to reject equality of the two coefficients. Use of region dummies is supported by significant differences in estimated net gains from rental across regions, the magnitude of which is quite consistent between assessments by tenants and landlords.

changed this; after renting out land, the share of households deriving their main income from migration had increased by 35 points to 55%, followed by 29% in local off-farm employment, and only 17% who remain in agricultural production, i.e., a total of 40 points less than before land rental who remained in agricultural production. Inspection of the transition matrix highlights that virtually all of the change was due to households shifting out of full-time agricultural production into migration (33 points) and local non-farm employment (8 points), complemented by a modest shift from non-farm employment to migration (3%).

To obtain a better understanding of welfare effects from land rental, we present levels of net per capita income in broad categories before and after land rental for households renting out (table 5) and those renting in (table 6). For the former, we note that rental participation was associated with significant income gains. 45% moved up by at least one category, 54% remained in the same category, and less than 1% moved down. While the need to rely on ranges rather than exact figures makes it impossible to compute the impact on average incomes, we note that the share of landlord households with a per capita income of less than 1,500 Y dropped by 20 points, from 30% to 10%, consistent with evidence that it is those with the lowest asset endowments who engage in migration (Deininger and Jin 2006). The level of upward mobility is also illustrated by the fact that the share of households with incomes above 3,000 Y increased from 26% to 47% of the total.

While recognizing that those renting out are likely to gain, policy makers in China have often been concerned that greater reliance on impersonal market forces may negatively affect equity as those renting in will need to pay for it, contrary to administrative reallocation where land was available "for free". The earlier evidence on productivity impacts of land rental suggests that the requirement to pay for land may actually facilitate productivity increases that would be difficult to accomplish under a system relying purely on administrative reallocation. Indeed, the transition matrix of tenants' income before and after renting in land points towards considerable improvements; although some two thirds remained in the same income bracket, about one third moved up and only about 1% moved down.[14] With the majority of impacts concentrated at the bottom of the distribution, these changes had a positive distributional impact: the share of households in the poorest group (< 1,500 Y) declined from 21% to 10%, another 5 point decrease is observed in the share of households in the 1,500-3,000 Y bracket, and the share of those obtaining more than 3,000 Y increased from 27% to 42%.

While this illustrates that rental markets can provide significant benefits, it is unclear whether they capitalized fully on existing potential or fell short of realizing it. To provide descriptive evidence on this, households were asked whether they ever had wanted to rent out (or in) more than they could obtain in the market and whether they feel confident that in the future they will be able to use rental to

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[14] The fact that these households had been included in our sample before also allows us to cross-check the information provided by the other party (in this case landlords) with historical data from a high quality household survey. Doing so points towards high levels of consistency, with a slightly lower share (52%) whose income had stayed in the same bracket, an almost equal share (31%) who had moved up by at least one bracket, and a somewhat higher share whose income bracket had decreased (17%).

fully adjust to their desired level of operational land holding. Responses, in the bottom panel of table 3, suggest friction on demand and supply sides. Almost 40% indicate that they had been demand-constrained at some point in the past while 12% wanted to supply more land than the market could absorb. More than 80% indicated that the 2003 rural land contracting law (RLCL) has made transfers of land through the market easier, although it did not fully eliminate constraints to participation. In fact, the share of households who are "not confident" about being able to rent in their desired amount is, with 45%, slightly above the share of those who experienced rationing in the past and 23% report concerns about not being able to rent out the most desirable amount of land in the future.

A common assumption in the literature is that, if tenure is insecure, households will rent land only to close relations (Macours *et al.* 2004) to reduce the potential for of enforcement problems due to, for example, the tenant failing to return the land upon expiration of the contract.[15] The finding that despite legal provisions to the contrary, land reallocations by village leaders continued at surprisingly high rates suggests that, at least in some cases, such concerns about tenure security may indeed continue to be of relevance (Deininger *et al.* 2006). To assess whether this may be an issue, we compare the net increase in productivity due to the land transfer between those renting to relatives and those transacting with non-relatives.[16] Results, displayed in table 7, suggest significant and large differences, with net gains from renting to non-relatives almost 80% higher than for transactions with relatives. While part of the gap could be explained by imperfect information or altruistic motives, the size of the figures points towards high levels of unrealized potential.

4.2 Econometric results

To complement the descriptive evidence, provide a more direct test of the hypotheses noted earlier, and identify the extent to which institutional factors systematically increase transaction costs and thus can explain the rather high levels of rationing, we estimate the ordered probit model discussed earlier using pooled data. Table 8 reports results from the marginal product equation in the top panel, and from the lower and upper bounds between leasing out and autarky and autarky and leasing in, respectively in the middle and bottom panel

The marginal product equation provides a number of insights. First, the large and significant coefficients on households' land (negative) and labor (positive) endowments suggest that land rental helps to equalize factor ratios by transferring this factor from land-abundant and labor poor households to those with little land and large amounts of labor. There is thus little basis for the argument that land rental would lead to concentration of land. Second, the negative coefficient on per capita village income, our proxy for local wage rates, highlights that availability of other economic opportunities increase land rental supply. This increases households' propensity to rent out and makes

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[15] Alternatively, in the Chinese context, reliance on transfers within the family could reduce the likelihood of the land being expropriated by village leaders.

[16] As neither of these issues is a concern for tenants, tenure security would be expected to be an issue only for landlords wanting to rent out.

them less likely to rent in, thereby allowing those who participate to obtain increased amounts of land. The negative and weakly significant coefficient on a dummy of the head having high school education provides some support for the notion that households with greater off-farm opportunities may be more likely to rent out. Although not directly related to our model, the negative and highly significant coefficient on households' initial asset endowment suggests that it is the poor with high levels of agricultural ability who are able to obtain land through the rental markets. Furthermore, as predicted by our model, those with higher levels of agricultural ability are more likely to rent in land (col. 2).[17] To interpret the coefficient, we note that, compared to the least efficient household, the most efficient household in the sample is 33% more likely to rent in or 5% less likely to rent out. The negative coefficient on age squared also suggests that, by shifting land to younger producers, land rental helps to redistribute land across generations.

Lower and upper bound equations support the hypotheses that migration helps to stimulate land rental markets, that greater tenure security will increase supply of land to rental markets but not demand, and that local regulations affecting the cost of transferring land will affect producers' entry into rental markets. As it reduces the amount of labor available, higher village level migration is estimated to increase supply of land to rental and the demand for such land.[18] As expected, greater availability of land in the village reduces the propensity to rent-out and makes it easier to rent-in. The significance of having a land certificate for renting out is consistent with the notion that limited levels of tenure security continue to constrain households from supplying their land to rental markets and that issuance of an 'official' document to codify their ownership makes them more confident in doing so.

As to the impact of village-level regulations, rules that put limits on rental to outsiders are estimated to be a significant factor reducing households' propensity to supply land to rental markets although they have no discernible impact on participation on the demand side. Somewhat surprisingly, land use regulations that allow village leaders to confiscate land that has not been utilized for one season are estimated to have a very significant impact on the propensity for rental market participation on either the supply or the demand sides. The size of the coefficient -much larger than that for possession of a land use certificate and equivalent to migration of about one third of workers in the village- highlights that, especially after abolition of land taxes eliminated financial incentives for effective land use, local regulations against speculation may actually help activate land markets.

5. Conclusion and policy implications

By complementing the focus on the productive performance of different types of rental contracts with an emphasis on the determinants of rental market participation in a growing economy as well as the

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[17] As there are about 1,000 observations for whom we can not estimate ability due to lack of production activity, we report specifications with and without ability. As we lack information on inputs and outputs for rented plots separately, systematically lower productivity on rented plots would lead to a downward bias on our the coefficient on ability, implying that the estimate constitutes a lower bound.
[18] This is consistent with the notion that cash constraints that could be alleviated through remittances are not a key factor affecting rental market participation.

impact of such arrangements, this paper provides analytical and an empirical insights. Analytically, we show that, in the situation at hand, higher non-agricultural wages will create a pathway for development that can complement agricultural intensification and land-related investment considered by traditional models. To make most effective use of such opportunities, security against eviction to provide incentives for an optimum level of land-related investment will need to be combined with a level of tenure security and transfer rights to allow at least temporary transfers of land use to others.

Our empirical evidence suggests that the gains in allocative efficiency and productivity of land use that can be realized through rental markets in a growing economy can be large, with productivity increases of some 60%. In our case, these translate into improvements in tenants' welfare of some 25%, and even larger increases in landlords' income. The magnitude of these impacts significantly exceeds those commonly estimated to arise from altering the bargaining power within a given contract, thus suggesting that studying determinants of rental market participation may usefully complement the large literature on contract choice. This is of particular interest as our data point towards a positive distributional impact, consistent with evidence that in many situations it is the poor who are more likely to participate in rental markets as well as migration.

Although this points towards a very positive impact of land rental markets, we find that the level of rental market activity in our study area remains considerably below optimum. If concerns about tenure security prompt households to refrain from participating in land rental or to limit rental transactions to relatives, the productivity and equity benefits from land rental will be reduced or entirely forgone. While successive reforms increased security of land use rights and improve land market functioning, tenure insecurity remains an important concern voiced by survey respondents, many of whom consider their level of land market participation to be constrained. Additional efforts to increase tenure security, by clarifying the legal situation, improving enforcement, and possibly formalizing local systems of land registration may thus have a beneficial impact on land markets. Such measures may be particularly important as a secular decline in the economic importance of the agricultural sector is likely to increase the potential for efficiency-enhancing land transactions.

While our data show that operation of land rental markets will provide significant direct benefits and that policies to increase tenure security have great potential to further enhance these, they do not allow us to make inferences on the precise ways through which such an impact comes about. (e.g. under-utilization of productive land by migrant households). By linking functioning of land rental markets explicitly to migration decisions, follow-up work could help to probe more specifically into this issue, identify some of the indirect impacts of both phenomena, and distinguish more clearly between the contribution of land markets and that of other policy factors. As these issues will have far-reaching implications for the transfer of labor from the agricultural sector and the development of rural areas far beyond China, they are of high priority for future research.

Table 1: Descriptive statistics

	Entire	By Regions			
	Sample	**N&NE**	**Coastal**	**Centre**	**SW**
Household characteristics & rental participation					
Household size	3.94	3.89	3.69	4.14	4.03
Members aged 15-60 years	2.99	2.97	2.88	3.15	2.93
Head's age	46.56	46.85	46.34	46.59	46.25
Head with secondary education (%)	52.12	58.98	55.31	45.12	45.84
Head with high school education (%)	18.30	21.02	23.74	17.62	9.41
Households renting in (%)	13.49	10.72	8.43	20.50	14.55
Households renting out (%)	9.81	6.15	10.76	13.68	10.53
Assets and income					
Total owned land (mu)	6.24	8.41	5.29	5.51	4.31
Owned land per capita (mu)	1.68	2.30	1.49	1.42	1.13
Value of total assets (Y)	27166	29992	36183	24244	17404
Per capita income	2983	3022	4184	2677	2158
of which from agri. (%)	58.38	60.91	49.42	57.59	63.43
of which from wage (%)	15.00	18.32	22.88	7.96	10.43
of which from migration (%)	11.21	6.42	9.98	16.77	13.85
of which from non-farm self emp.(%)	10.92	10.8	13.11	12.03	7.73
of which from transfer (%)	4.49	3.55	4.61	5.65	4.57
Renting in					
Renting in from relative (%)	39.32	58.59	25.86	35.08	54.43
Share with contract, incl. oral ones (%)	59.44	37.84	57.08	66.50	55.70
Share of contracts, written	7.78	18.46	24.44	1.67	3.41
Share with fixed term (%)	24.15	30.61	29.20	21.08	22.78
if yes, length of term (years)	2.71	3.82	3.80	2.11	1.57
Renting out					
Renting out to relative (%)	31.04	55.81	24.29	23.18	64.58
Share with contract, incl. oral ones (%)	59.29	22.73	50.00	75.00	47.92
Share of contracts, written	8.63	0.00	13.89	6.55	13.04
Share with fixed term (%)	26.61	34.09	22.14	28.77	22.92
if yes, length of term (years)	2.92	1.60	3.06	3.19	2.73
Village characteristics & land policy					
Village per capita land endow. (mu)	1.33	1.84	1.30	1.02	0.88
Villager per capita income (Y)	2256.26	2306.15	3229.46	1930.47	1649.44
Share of members migrating (%)	17.83	10.05	17.07	24.85	22.03
Of which, % migrating out of province	39.61	27.27	17.60	61.08	51.03
Have land certificate (%)	81.16	73.92	83.05	81.33	92.02
Renting to outsiders not allowed (%)	13.53	16.60	25.74	6.90	4.83
Uncultivated land taken away (%)	9.74	9.08	15.72	10.22	4.09
No of observations	19570	6622	3533	5187	4228

Source: Own computation from NBS/World Bank land market survey

Table 2: Household and village characteristics by rental status

| | Type of household | | |
	Rent-in	**Autarkic**	**Rent-out**
Household characteristics			
Owned land (mu)	5.60***	6.18	7.65***
Owned land per capita (mu)	1.47***	1.67	2.10***
Household size	4.02*	3.94	3.87*
Members 15-60 years old	3.06*	2.99	2.90*
Head's age	45.82**	46.62	47.11**
Head with secondary education. (%)	50.09**	52.88	48.62***
Head with high school education. (%)	16.47*	18.74	17.21***
Assets and income			
Value of total assets (Y)	24,039***	27,417	29,467***
Per capital net income (Y)	2734.14***	3003.06	3168.60***
Share of income from agriculture (%)	64.73***	61.00	53.06***
Share of inc. from wage (%)	7.31***	11.85	12.29***
Share of inc. from migration (%)	18.78*	17.98	23.65***
Share of inc. non-farm self emp.(%)	9.17	9.17	11.01**
Agricultural Ability	0.049	-0.016	-0.007

Source: Own computation from NBS/World Bank land market survey

T-Test was conducted to compare the group mean of the tested group versus the mean of autarkic group;

*, **, *** significantly different from the sample mean at 10%, 5% and 1% respectively

Table 3: Productivity gains from land rental

	Total Sample	N&NE	Coast	Central	SW
Tenants' assessment					
Profit before transfer (Y/mu)	317.65	257.07	430.00	302.31	274.95
Profit after transfer (Y/mu)	584.74	710.8	793.29	530.29	399.01
Productivity gain through rental (Y/mu)	267.09	453.73	363.29	227.98	124.06
Productivity gain through rental (%)	84.08	176.51	84.49	75.41	45.12
of which to tenant (%)	65.33	71.76	57.23	68.75	54.85
of which to owner (%)	34.67	28.24	42.58	31.25	45.15
Land owners' assessment					
Profit generated by owner before transfer (Y/mu)	340.93	184.31	434.03	324.59	285.81
Profit after transfer (Y/mu)	623.9	593.55	770.21	566.87	486.4
Productivity increase through rental (Y/mu)	282.97	409.24	336.18	242.28	200.59
Productivity gain through rental (%)	83.00	222.04	77.46	74.64	70.18
of which to tenant (%)	65.46	76.46	58.28	69.22	59.58
of which to owner (%)	34.47	24.12	41.42	30.64	40.42
Actual & perceived constraints to rental					
Tenants rationed in the past (%)	39.02	51.32	36.20	35.92	33.67
Tenants thinking RLCL improved market functioning	81.34	83.96	91.93	75.38	76.25
Owners rationed in the past (%)	12.24	8.33	7.33	15.63	15.24
Owners thinking RLCL improved market functioning	81.44	89.74	96.43	61.06	92.59
Tenants having doubts about future (%)	44.54	65.79	36.20	40.99	35.71
Owners having doubts about future (%)	22.98	20.72	19.73	24.74	25.00

Source: Own calculation based on NBS/World Bank survey

Table 4: Main income source of lease-out households before and after transfer

	Before			
After	Agric. production	Local non-farm	Migration	Total
Agric. production	15.91%	0.63%	0.18%	16.73%
Local non-farm	8.32%	19.80%	0.45%	28.57%
Migration	32.91%	2.62%	19.17%	54.70%
Total	57.14%	23.06%	19.80%	100.00%

Source: Own calculation based on NBS/World Bank survey (tenants' assessment for 1106 land rental contracts)

Table 5: Per capita net income of lease-out households before and after transfer

	Before				
After	<1500 Y	1500-3000 Y	3000-5000 Y	>5000 Y	Total
<1500 Y	9.84%	0.63%	0.09%	0.00%	10.56%
1500-3000 Y	17.42%	24.82%	0.09%	0.00%	42.33%
3000-5000 Y	1.81%	15.97%	12.82%	0.09%	30.69%
>5000 Y	1.08%	1.99%	6.95%	6.41%	16.43%
Total	30.14%	43.41%	19.95%	6.50%	100.00%

Source: Own calculation based on NBS/World Bank survey (land owners' assessment for 462 rental contracts)

Table 6: Per capita net income of lease-in households before and after transfer

	Before				
After	<1500 Y	1500-3000 Y	3000-5000 Y	>5000 Y	Total
<1500 Y	10.57%	0.00%	0.00%	0.00%	10.57%
1500-3000 Y	10.34%	36.78%	0.69%	0.00%	47.82%
3000-5000 Y	0.00%	15.17%	17.01%	0.69%	32.87%
>5000 Y	0.00%	0.00%	4.60%	4.14%	8.74%
Total	20.92%	51.95%	22.30%	4.83%	100.00%

Source: Own calculation based on NBS/World Bank survey (tenants' assessment for 1106 land rental contracts)

Table 7: Gains from land rental by transaction partner

	Renting out to	
	Relative	**Non-relative**
Profit after transfer (Y/mu)	512.08	685.99
Profit before transfer (Y/mu)	326.25	347.60
Net gain (Y/mu)	185.83	339.99
Net gain to tenants (Y/mu)	128.27	223.99
Net gain to owners (Y/mu)	57.56	115.53
% of benefit to tenants	69.03	65.88
% of benefit to owners	30.97	34.12

Source: Own calculation based on NBS/World Bank survey

Table 8: Determinants of land rental market participation

	Specification	
	Without ability	**With ability**
Agricultural ability		0.402***
		(8.89)
Household land endowment (log)	-0.199***	-0.311***
	(24.24)	(27.44)
Number of members aged 15-60 (log)	0.071***	0.062***
	(8.23)	(6.87)
Value of total assets (log)	-0.056***	-0.035**
	(4.27)	(2.58)
Head's age (log)	1.777**	0.934
	(2.31)	(1.60)
Head's age squared	-0.262**	-0.152*
	(2.56)	(1.95)
Head completed secondary education	-0.010	0.001
	(0.42)	(0.05)
Head completed higher education	-0.050*	-0.043
	(1.71)	(1.40)
Village per capita income	-0.144***	-0.139***
	(5.50)	(5.20)
Lower bound equation (lease out to autarky)		
Share of village workers migrating out of province	0.367***	0.407***
	(8.52)	(9.03)
Own land certificate	0.070**	0.079**
	(1.98)	(2.11)
Rule: Renting to outsiders not allowed	-0.076**	-0.083**
	(1.96)	(2.06)
Rule: Village takes back non-cultivated land	0.261***	0.253***
	(6.91)	(6.39)
Village per capita land	-0.044**	-0.049**
	(2.15)	(2.29)
Upper bound equation (autarky to lease-in)		
Share of village workers migrating out of province	-0.420***	-0.385***
	(10.49)	(9.34)
Own land certificate	-0.033	-0.011
	(1.06)	(0.35)
Rule: Renting to outsiders not allowed	-0.014	-0.030
	(1.96)	(0.80)
Rule: Village takes back non-cultivated land	-0.131***	-0.137***
	(3.58)	(3.63)
Village per capita land	-0.095***	-0.117***
	(5.27)	(6.29)
Log-likelihood	-13032.05	-12070.83
No. of observations	19,570	18,390

Note: Time dummies and constants included but not reported.

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

Annex 1: Proofs for main propositions

Proposition 1: The amount of land rented in (out) is strictly increasing (decreasing) in households' agricultural ability, α_i, and strictly decreasing (increasing) in the land endowment $\overline{A}_i$. Rental markets will transfer land to efficient, but land-poor producers, thereby contributing to higher levels of productivity and more efficient factor use in the overall economy.

Totally differentiating both sides of (2) with respect to α (ignoring the subscript to keep notation simple), yields:

$$pf_{l_a\alpha}(\alpha,l_a,A)+p(f_{l_al_a}\frac{\partial l_a}{\partial\alpha}+f_{l_aA}\frac{\partial A}{\partial\alpha})=0 \tag{A1}$$

Total differentiation of both sides of (3) or (4) with respect to α, yields:

$$pf_{A\alpha}(\alpha,l_a,A)+p(f_{AA}\frac{\partial A}{\partial\alpha}+f_{Al_a}\frac{\partial l_a}{\partial\alpha})=0 \tag{A2}$$

From (A1), we obtain $\partial l_a \big/ \partial\alpha$; substituting this into the (A2), with some manipulation of terms, gives:

$$\frac{\partial A^*}{\partial\alpha}=\frac{f_{Al_a}f_{l_a\alpha}-f_Af_{l_al_a}}{(f_{AA}f_{l_al_a}-f_{Al_a}f_{l_aA})}=\frac{f_{Al_a}f_{l_a\alpha}-f_{A\alpha}f_{l_al_a}}{[f_{AA}f_{l_al_a}-(f_{Al_a})^2]}>0 \tag{A3}$$

Thus, for all households participating in rental markets (on either side), area operated increases with ability. The amount of land rented in (or out) is the difference between operational land size and the land endowment, i.e.

$$a^{in}=A^*-\overline{A} \text{ and } a^{out}=\overline{A}-A^* \tag{A4}$$

Total differentiation of both sides of (A4) with respect to α, yields $\frac{\partial a^{in}}{\partial\alpha}=\frac{\partial A^*}{\partial\alpha}>0$ and $\frac{\partial a^{out}}{\partial\alpha}=-\frac{\partial A^*}{\partial\alpha}<0$, implying that amount of land rented in (or out) is increasing (deceasing) in agricultural ability.

Total differentiation of both sides of (A4) with respect to $\overline{A}$, yields $\frac{\partial a^{in}}{\partial\overline{A}}=-1<0$ and $\frac{\partial a^{out}}{\partial\overline{A}}=1>0$, implying the amount of land rented in (or out) is strictly decreasing (or increasing) in land endowment.

Proposition 2: The presence of transaction costs defines two critical ability levels $\alpha_l(TC^{out}, ..)$ and $\alpha_u(TC^{in}, ..)$ such that households with ability $\alpha_i \in [\alpha_l, \alpha_u]$ will remain in autarky. Any increase in TC^{in} or TC^{out} will expand the autarky range, thus reducing the number of producers participating in rental markets and thus the number of efficiency-enhancing land transactions. Compared to a situation with no transaction cost, this will decrease productivity and social welfare.

Using the functional form $f(\alpha,l_a,A)=\alpha^{1-\beta_1-\beta_2}l_a^{\beta_1}A^{\beta_2}$ for the production function, FOC (2-4) can be rewritten as:

$$p\beta_1\alpha^{1-\beta_1-\beta_2}l_a^{\beta_1-1}A^{\beta_2}=w \tag{A5}$$

and for households who rented in: $p\beta_2\alpha^{1-\beta_1-\beta_2}l_a^{\beta_1}A^{\beta_2-1}=r+TC^{in}$ \hfill (A6)

for households who rented out: $\qquad p\beta_2\alpha^{1-\beta_1-\beta_2}l_a^{\beta_1}A^{\beta_2-1} = r - TC^{in}$ (A7)

Plugging $A = \overline{A}$ into (A5) allows us to obtain $l_a^* = (\dfrac{w}{p\beta_1\alpha^{1-\beta_1-\beta_2}\overline{A}^{\beta_2-1}})^{\frac{1}{\beta_1-1}}$ (A8)

Plugging $l_a = l_a^*$ and $A = \overline{A}$ into (A7) allow us to derive $\alpha_l = \left(\dfrac{r - TC^{out}}{\beta_2(l_a^*)^{\beta_1}\overline{A}^{\beta_2-1}}\right)^{\frac{1}{1-\beta_1-\beta_2}}$ (A9)

Similarly, plugging $l_a = l_a^*$ and $A = \overline{A}$ into (A6) yields $\alpha_u = \left(\dfrac{r + TC^{in}}{\beta_2(l_a^*)^{\beta_1}\overline{A}^{\beta_2-1}}\right)^{\frac{1}{1-\beta_1-\beta_2}}$ (A10)

This allows to show that $\partial\alpha_l/\partial TC^{out}<0$ and $\partial\alpha_u/\partial TC^{in}>0$, suggesting that increase in transaction costs reduces the number of producers participating in rental markets.

Proposition 3: Increases of the exogenously given wage for off-farm employment will increase the amount of land transacted in rental markets by increasing the amount rented out by households with low agricultural ability (who will join the off-farm labor force) and the amount rented in by those with high-ability (who specialize in agricultural production). This will be associated with a decrease in the equilibrium rental rate which, in a risk-free environment, will make everybody better off.

First, we consider the case where there is no minimum labor (l_a^c) below which households quit farming.

Obtaining $l_a = r^{(\frac{1}{\beta_2})}\beta_1^{(-\frac{1}{\beta_2})}\alpha^{(\frac{1-\beta_1-\beta_2}{-\beta_2})}A^{(\frac{1-\beta_1}{\beta_2})}$ from (7) and substituting it into (6), with some manipulation, yields:

$A^* = \alpha w^{(\frac{\beta_2}{\beta_1+\beta_2-1})}\beta_2^{(\frac{\beta_2}{1-\beta_1-\beta_2})}\beta_1^{(\frac{\beta_2-1}{\beta_1+\beta_2-1})}r^{(\frac{1-\beta_2}{\beta_1+\beta_2-1})}$ (A11),

suggesting that optimal operational land size is proportional to farming ability. Denoting by Δ all the right hand side terms except α, we can rewrite: $\qquad A^* = \alpha\Delta$ (A12)

With total land in the economy being $n\overline{A}$, the land market clearing condition is $\int_{\underline{\alpha}}^{\overline{\alpha}}\alpha\Delta d\alpha = n\overline{A}$. This allows us to

solve for $\Delta = \dfrac{2n\overline{A}}{\overline{\alpha}^2 - \underline{\alpha}^2}$. Substituting this into (A12) allows to solve for A^*, and consequently for l_a^*, and r^*.

Specifically, $A^* = \alpha\dfrac{2n\overline{A}}{(\overline{\alpha}^2 - \underline{\alpha}^2)}$, $l_a^* = \alpha\left(\dfrac{\overline{\alpha}^2 - \underline{\alpha}^2}{2n\overline{A}}\right)^{(\frac{\beta_1}{\beta_2-1})}w^{(\frac{1}{\beta_2-1})}\beta_2^{(\frac{1}{1-\beta_2})}$ and $r^* = \left(\dfrac{\overline{\alpha}^2 - \underline{\alpha}^2}{2n\overline{A}}\right)^{(\frac{\beta_1+\beta_2-1}{\beta_2-1})}w^{(\frac{1}{\beta_2-1})}\beta_2^{(\frac{1}{1-\beta_2})}\beta_1$.

The assumption of a minimum level of farm labor (l_a^c) implies that households who would optimally supply less than l_a^c to agriculture will move out of farming and rent out all their land. The key to solve this problem, is to find the critical farming ability (α_c), i.e., any households with $\alpha < \alpha_c$ will have $l_a^*<l_a^c$ (for $\partial l_a^*/\partial\alpha >0$) and therefore rent out all their land. Setting $l_a^*=l_a^c$ allows us to solve for α_c, With some manipulation, we obtain:

$\alpha_c = \left(\dfrac{\overline{\alpha}^2 - \underline{\alpha}^2}{2n\overline{A}}\right)^{(\frac{\beta_1}{1-\beta_2})}w^{(\frac{1}{1-\beta_2})}\beta_2^{(\frac{1}{\beta_2-1})}l_a^c$ (A13)

Since now only households with $\alpha \in [\alpha_c, \overline{\alpha}]$ will cultivate, the new market clearing condition is $\int_{\alpha_c}^{\overline{\alpha}} \alpha \Delta d\alpha = n\overline{A}$, plugging a_c from (A13) into the market clearing condition allows us to obtain new Δ and consequently new optimal operational land size A^{**}:

$$A^{**} = \alpha \frac{2n\overline{A}}{\overline{\alpha}^2 - \left(\frac{\overline{\alpha}^2 - \underline{\alpha}^2}{2n\overline{A}}\right)^{(\frac{2\beta_1}{1-\beta_2})} w^{(\frac{2}{1-\beta_2})} \beta_2^{(\frac{2}{\beta_2-1})} l_a^c} \tag{A14}$$

Setting $A^{**} = \overline{A}$ also allows us to solve for another critical farming ability α_{au}, which divides households between rent-in (for $\alpha_i > \alpha_{au}$) and rent-out ($\alpha_i < \alpha_{au}$), specifically, we can have:

$$\alpha_{au} = \frac{\overline{\alpha}^2 - \left(\frac{\overline{\alpha}^2 - \underline{\alpha}^2}{2n\overline{A}}\right)^{(\frac{2\beta_1}{1-\beta_2})} w^{(\frac{2}{1-\beta_2})} \beta_2^{(\frac{2}{\beta_2-1})} l_a^c}{2n} \tag{A15}$$

Finally, equalizing both the right hand sides of equation (A11) and (A14) allow us to solve for the new equilibrium rental rate r^{**}. With some manipulations, we can obtain an explicit solution for r^{**} (not reported).

We can also show that $\frac{\partial A^{**}}{\partial w} > 0$, $\frac{\partial \alpha_{au}}{\partial w} < 0$, $\frac{\partial \alpha_c}{\partial w} > 0$ and $\frac{\partial r^{**}}{\partial w} < 0$, which suggests that, as off-farm opportunities increase a larger number of households will drop farm production and rent out all their endowment, the equilibrium rental rate will decrease, households who remain in agricultural production cultivate more land, and more households will rent in land.

$$A^{**} = \alpha \frac{2n\overline{A}}{}$$

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