Efficiency of Land Allocation through Tenancy Markets:

Evidence from China

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Abstract

Tenancy markets provide an opportunity to trade land between labor-scarce farmers, that is those who engage in off-farm employment, and land-scarce farmers, that is those who want to expand agricultural production. For emerging middle-income countries where rural to urban migration is active, facilitating a well-functioning tenancy markets is important to increase farmer's income and improve agricultural productivity. Although the existing literature argues that high transaction costs are the major source of market failure, the nature of transaction costs is seldom explored. We hypothesize that the search and negotiation costs and the expected loss of land—due to weak property rights—are the major components of the transaction costs in tenancy markets and that they lead to smaller numbers of rental transactions. We also find empirical evidence in support of these hypotheses using farm household data from China.

1. Introduction

In rapidly developing countries, the transfer of land rights from those who move to non-farm sectors, or migrating households, to those who continue farming, or remaining farm households, is critically important for the successful industrialization and the structural transformation of the agriculture sector. If land markets are inefficient, migrating households cannot liquidate their land assets and the remaining farm households cannot expand their farm size to earn an income comparable to the off-farm sector. In post-war Japan a poorly functioning land rental market, which failed to function due to rent controls and other government interventions, was one of the major reasons for the persistence of a large cohort of small-scale, inefficient part-time farmers (Hayami 1988; Otsuka 1992). Thus, the development of well-functioning land markets should be one of the important policy goals that, in addition to other things, can mitigate inter-sectoral income disparity especially in the case of emerging middle income countries.

At the same time it also is known that, if at least one factor market (i.e., the market for labor, land sales or land rental) functions competitively under the assumption of constant returns to scale, an efficient allocation of resources can be achieved (Kevane 1996). However, due to the high cost of monitoring farm work, farm labor markets are almost always thin, confining the use of the hired labor to simple tasks (Hayami and Otsuka 1993). As a consequence, care-intensive activities, such as water management and fertilizer application, are nearly exclusively carried out by family labor. Likewise, land sales markets are not expected to function competitively as a means to facilitate land reallocations across households because of chronic imperfections in credit markets (Binswanger and Rosenzweig 1986). Moreover, because land can be used not only for farming, but also as collateral enabling access to formal

credit markets, the market price of land often is higher than the present value of future agricultural profits that accrue to land, making it difficult to finance the cost of land purchases. Thus, among labor, land sales and land rental factor markets, the land rental market may be one of the most feasible ways of reallocating resources efficiently across farm households in rural villages (Otsuka 2006).

Although the literature on tenancy markets argues that high transaction costs are one of the major reasons why tenancy markets fail (Skoufias 1985), the nature of transaction costs is seldom explored. The theoretical basis of how tenancy market transactions are related with transaction costs and the inefficiency of tenant cultivation is unclear in many existing studies. In this study we construct a theoretical model of the determinants of land rental transactions and use farm household data to identify two of the sources of the failure of land rental markets in China.

In the case of China rapid industrialization has increased the income of the urban non-farm population and, as a result, the income disparity between farmers and non-farmers has increased significantly (e.g., Rozelle e*t al*. 2005). In order to increase farm income in the face of increasing labor costs, the expansion of farm size is necessary to reduce production costs (Hayami and Ruttan 1985). Moreover, given China's limited land endowment, enhancing agricultural productivity so as to allow the agricultural sector to keep up with the nation's growing food demand is indispensable. Several researchers, however, point out that despite more than decades of market reform, factor markets in China still remain underdeveloped (Lin 1988; Bowls and Sicular 2003). Hence, promoting well-functioning tenancy markets is important for facilitating the reduction of the disparity of income between the farm and non-farm population and to raise agricultural productivity.

This paper is organized as follows. Section two presents a theoretical model of the determinants of land rental transactions. The data set is described and descriptive statistics are provided in section three. The methodology and the results of the estimation from the regression analysis are reported in section four. Section five concludes and provides the study's policy implications.

2. Conceptual Framework of Land Rental Transactions

2.1 Existing models

The first attempt to measure the efficiency of the land rental transactions was made by Bliss and Stern (1982), who introduced the concept of the desirable area of cultivated land (*DCA*). *DCA* is defined as the area of land which accords best with the available factor endowments of the household. In particular, Bliss and Stern assume that *DCA* depends on the household's endowments of non-tradable resources such as family labor and draft animals. The actual land rental area is defined to be a fraction of the difference between *DCA* and the household's own cultivated land area. If land rental markets are perfect, households rent in or rent out the area equal to the difference between *DCA* and the household's own land.

Building on this earlier work, Skoufias (1985) explicitly argues that the extent of the adjustment toward *DCA* depends on the transaction costs—both fixed and variable ones—in the land rental market. More specifically, Skoufias asserts that while fixed transaction costs discourage households from participating in land rental markets in the first place, variable transaction costs reduce land rental area once the household had decided to participate in the market. His conceptual model is able to explain the household's non-participation in the land rental market as well as the incomplete adjustments in farm size across households after the

participating decision is made. Unfortunately, despite these important insights, the nature of the fixed and variable transaction costs is not discussed in this study.

Another model of the household's resource adjustment through land rental markets applies the theoretical framework of the agricultural household model. Incorporating factor market imperfections into the agricultural household model, Carter and Yao (2002) find that transaction costs in the land rental markets impede a household's market participation unless the household's land-to-labor ratio exceeds a certain autarky bandwidth. They find that the separability principles of the agricultural household model hold only when the household's land-to-labor ratio is outside the autarky bandwidth. Deininger and Jin (2005) extend this model to highlight the effect of the ability of farmers that engage in their farming activities. They argue that farmers with high abilities to farm are more likely to participate in the land rental market as tenants and those with lesser abilities are more likely to rent out their land.

While useful in explaining many land rental market phenomena, there are several shortcomings. First, the existing models do not explicitly explain why most households in developing countries do not participate in the land rental market. Moreover, the nature of transaction costs in tenancy markets is not clearly specified. To identify the source of the inefficiencies in tenancy markets, we extend the existing models by introducing explicitly a transaction cost function in the household's profit maximization problem.

2.2. Model of land rental market

For simplicity, we assume that agricultural production depends on two factors, land and labor. The production cost for those that rent in land includes land rental payments and the cost of family labor. Farmers that rent out land receive land rental payments. Since the farm labor

markets are missing or inactive in most cases, hired labor is assumed to be absent in our model.[1] However, we recognize that the development of the off-farm sector provides lucrative employment opportunities for family labor to obtain an income that is higher than can be earned in farming. We also assume that family workers can engage in off-farm employment if they choose not to work on their family farms. Thus, the opportunity cost of family labor is subtracted from our agricultural profit function.

The household's agricultural profit (Π) can be expressed as:

$$\Pi = F(\overline{A} + R, L) - rR - wL \ , \qquad (1)$$

where $\overline{A}$ is the *allocated area of land*, R is the *net area of land rented in*, L is *family's level of labor availability*, r is the *land rent per unit of land area* and w is the *off-farm wage rate*. The household's agricultural profit function is graphically presented as the bold convex curves in Figures 1 and 2, where L is assumed to be fully adjusted to its optimal level of input when $\overline{A} + R$ changes. The household achieves the highest levels of profit of $A^* w$ and $A^* k$ in Figures 1 and 2 when they cultivate A^* of land. We define this area of land as the *desirable area of cultivated land* in the absence of transaction costs (or *DCA*). Figure 1 represents the case when the household's *DCA* is larger than the allocated area of land $\overline{A}$ and the opposite case is represented in Figure 2. If land rental markets were perfect, households would be able to rent in or rent out their land so as to maximize their agricultural profits of A^*. On the other hand, if households do not participate in the land rental market, they cultivate $\overline{A}$ of land and

[1] Although our data show that around 10% of the sample households hired in outside labor, the proportion of hired labor in the household's total labor input is just 2.1 percent on average. In general, the terms of the hired agricultural labor is expected to be short (a few days) and the tasks are simple and observable, such as transplanting (Hayami and Otsuka 1993).

achieve the profit of $\bar{A}z$ and $\bar{A}j$ in Figures 1 and 2. This level of profit can be defined as the household's *reservation profit*.

In our model, we assume that households incur transaction costs when they rent in or rent out land. Moreover, it is further assumed that households face different transaction costs when they are on different sides of the land rental market. In the case of renting in, the household has to find other households that agree to rent out their land and negotiate the terms of rental contracts. In this spirit, we assume that the search and negotiation costs account for a major part of the transaction costs for renting in land. These costs are expected to increase with the land rental area. In particular, in a village where the average farm size is small, the search and negotiation costs to rent in the same area of land will be higher because farm households that want to rent in land have to negotiate with increasingly larger number of households. Hence, we expect that the average size of the farms in a village will have a negative impact on the area of land rented in.

On the other hand, we assume that renting out land is associated with a risk of losing tenure rights to the land unless tenure rights are fully established. In the case of a country, such as China, since the right to allocate land to households belongs to the leaders of the village, land is often reallocated across the households by the village's leadership body (Brandt et al, 2002). With property rights of this sort, it is possible that renting out land may increase the risk of losing tenure rights because village leaders may consider that renting out the land that was originally allocated to the household is the sign of the lack of an intention to continue farming (Yang 1997). The risk of a household losing its tenure right is expected to increase as the household rents out more land. Moreover, the expected loss of a household losing its tenure rights is likely to vary across different villages because of differences in the propensity of

village leadership bodies to administrative reallocate land. Note that in general rented-out land is not reallocated to the rentee, but to other farmers in the village. Thus, weak tenure security increases the transaction cost to rent out land but should not *directly* affect the transaction cost to rent in.[2]

Taking these two transaction costs into account, the net agricultural profit of the household (Π_n) can be redefined as:

$$\Pi_n = F(\bar{A} + R, L) - rR - wL - TN(R) - TO(-R), \quad (2)$$

$$TN(R) = 0 \text{ if } R \leq 0,\ TN(R) > 0 \text{ if } R > 0$$

$$TO(-R) = 0 \text{ if } R \geq 0,\ TO(-R) > 0 \text{ if } R < 0,$$

where *TN(R)* and *TO (-R)* stand for the transaction costs of renting in and renting out land, respectively. It should be noted that *TN* is zero when the household rents out land or does not participate in the land rental market. Similarly, *TO* is zero when the household rents in land or does not participate in the land rental market. The net profit can be graphically shown as the vertical distance between the gross profit function and the transaction cost functions in Figures 1 and 2. To simplify the argument, we assume that the household does not rent in and out simultaneously.[3]

Maximization of Π_n with respect to *R* and *L* in the function in equation (2) leads to outcome in which farmer determines his optimal land rental area and farm labor input. In order

[2] However, while the fear of losing land affects renters, the two sides of the market might be inter-linked in practice. For example, weak tenure security might decrease the area of land rented in if the reduced supply of land to the rental market increases search and negotiation costs as rentees finds in increasingly difficult to find potential renters.

[3] In practice, it is possible that a household could rent out one plot while renting in another plot at the same time. For example, a household could rent out a plot which is located far from its other plots and rent in the plot which is located close to its other plots. Our data, however, shows that only 1.8 percent of the households rent in and rent out the land simultaneously.

to derive an estimable rental area function, we linearly approximate the net profit function by a second-order Taylor series expansion as,

$$\Pi_n = a_0 + a_1(\bar{A}+R) - a_{11}(\bar{A}+R)^2 + a_2 L - a_{22}L^2 + a_{12}(\bar{A}+R)L - rR - wL - \gamma_0 - \gamma_1 R_n - \gamma_2 R_n^2 - \theta_0 - \theta_1 R_o - \theta_2 R_o^2 \quad (3)$$

$$R_n = 0 \text{ if } R \le 0$$

$$R_o = 0 \text{ if } R \ge 0 .$$

Since concavity of the production function is assumed, the first and second derivatives of the production function with respect to each input are positive and negative, respectively (i.e., $a_1, a_{11,} a_2, a_{22,} a_{12,} > 0$). On the other hand, since the marginal increase in the transaction cost is expected to increase as the land rental area increases, the convexity assumption is applied to the transaction cost functions (i.e., $\gamma_1, \gamma_2, \theta_1, \theta_2 > 0$). Since we assume that the transaction cost consists of variable and fixed costs, the fixed cost to rent in and rent out land are added (i.e., $\gamma_0, \theta_0 > 0$). In Figures 1 and 2, γ_0 correspond to $x\bar{A}$ and θ_0 to $i\bar{A}$. The transaction cost of renting in is zero when the household rents out or does not participate in the land rental market (i.e., $\gamma_0 = 0$ if $R \le 0$). Similarly, the transaction cost of renting out is zero when the household rents in or does not participate in the land rental market (i.e., $\theta_0 = 0$ if $R \ge 0$). The optimum R is determined at the point in which the difference between gross profit (Π) and transaction cost curves is maximized.

In Figure 1, the transaction cost of renting in and out are represented by the two concave curves starting from *x* and *v*, respectively. The intercepts *x* and *v* are considered to be the fixed costs of renting in and renting out land, respectively. Similarly, the intercepts *g* and i in Figure

2 correspond to the fixed costs to rent in and rent out the land, respectively. Without participating in the land rental market, households can only achieve profits equal to $\overline{A}z$ and $\overline{A}j$ which is defined as the reservation profit (i.e., $a_0 + a_1\overline{A} - a_{11}\overline{A}^2 + a_2 L - a_{22}L^2 + a_{12}\overline{A}L - wL$). The household does not rent in or rent out land, unless the highest profit that can be achieved by participating in the land rental market exceeds the reservation profit. It is clear that the larger the fixed cost, the more likely farm households do not participate in land rental market. Also note that the household does not rent in land if the allocated area of land is greater than *DCA* (i.e., $\overline{A} > A^*$), whereas the household does not rent out land if *DCA* exceeds the allocated area of land (i.e., $\overline{A} < A^*$).

From the analysis above, it is clear that the household's decision to participate in the land rental market and the optimal land rental area depends on the location and shape of the profit function, and the nature of the transaction cost functions. For example, when the opportunity cost of the household's members increases, the profit function shifts down, which in turn leads to lower agricultural profits and a smaller *DCA*. The reduction in *DCA*, in turn, decreases the optimal rented-in area and increases the optimal rented-out area.[4] In contrast, increases in transaction costs raise the likelihood of non-participation and reduce the size of rented area.

Assuming an interior solution, the optimal land rental area and family labor input can be derived by maximizing profits with respect to the household's choice variables. The first order conditions are:

[4] However, the effect of the increased opportunity cost of labor on the area of land rented in may not be clear in the equilibrium, if excess supply of land to the land rental market may lower the value of the land rent.

$$\frac{\partial \Pi_n}{\partial R_n} = a_1 - 2a_{11}(\overline{A} + R_n) + a_{12}L - r - \gamma_1 - 2\gamma_2 R_n = 0 \quad (4)$$

$$\frac{\partial \Pi_n}{\partial R_o} = a_1 - 2a_{11}(\overline{A} - R_o) + a_{12}L - r - \theta_1 - 2\theta_2 R_o = 0 \quad (5)$$

$$\frac{\partial \Pi_n}{\partial L} = a_2 - 2a_{22}L + a_{12}\left(\overline{A} + R\right) - w = 0\,. \quad (6)$$

From equations (4) to (6), the optimal area of renting in R_n^* and renting out R_o^* can be derived as:

$$R_n^* = \frac{2a_{22}a_1 + (a_{12}^2 - 4a_{11}a_{22})\overline{A} - 2a_{12}a_{22}w - 2a_{22}r - 2a_{22}\gamma_1 + 2a_2a_{12}a_{22}}{4\gamma_2 a_{22} + 4a_{11}a_{22} - a_{12}^2} \quad (7)$$

$$R_o^* = \frac{2a_{22}a_1 + (a_{12}^2 - 4a_{11}a_{22})\overline{A} - 2a_{12}a_{22}w - 2a_{22}r - 2a_{22}\theta_1 + 2a_2a_{12}a_{22}}{4\theta_2 a_{22} + 4a_{11}a_{22} - a_{12}^2}\,. \quad (8)$$

The cultivated area of land which maximizes the household's agricultural profit in the absence of transaction costs, *DCA*, can be derived from the maximization of the profit function in the absence of transaction costs. The combination of the two first-order optimum conditions enables us to express *DCA* in terms of the exogenous variables and parameters:

$$A^* = \frac{2a_{22}a_1 + a_{12}a_2 - a_{12}w - 2a_{22}r}{4a_{22}a_{11} - a_{12}^2}\,. \quad (9)$$

Lastly, the combination of the optimal levels of land rental area and *DCA* yields the following estimable land rental area function for the:

Rent in case $R_n = \tau(A^* - \bar{A}) - \rho$ (10)

where $\tau = \frac{a_{11}}{\gamma_2 + a_{11}}$ and $\rho = \frac{\gamma_1}{2(\gamma_2 + a_{11})}$,

and for the:

Rent out case $R_o = \omega(\bar{A} - A^*) - \psi$, (11)

where $\omega = \frac{a_{11}}{\theta_2 + a_{11}}$ and $\psi = \frac{\theta_1}{2(\theta_2 + a_{11})}$.

It is important (for the empirical analysis) to note that the adjustment coefficients (τ and ω) and constant terms (ρ and ψ) depend on the parameters of both the production and transaction cost functions. If the production and the transaction cost functions are convex and concave, respectively, both coefficients τ and ω are less than one because a_{11}, γ_2 and θ_2 are all positive. If the adjustment coefficients τ and ω are closer to zero, the household's adjustment through the land rental market is inefficient. On the other hand, if τ and ω are unity, and ρ and ψ are zero, the optimum farm size becomes identical to *DCA*. It should also be noted that the factor prices, *w* and *r*, affect *R* only through A^*.

The major difference between our model and the previous models in the literature proposed by Skoufias (1985) and Bliss and Stern (1982) is that the constant term is not included in their models. In fact, the major deficiency of their model is that it cannot explain why so many households do not participate in the land rental market. If our model was constructed without the constant terms, households would participate in the land rental market unless the adjustment coefficient was zero. In our model, if the constant terms are large, the households will choose to not participate in the land rental market. Thus, it is in this way that our model is more general in being able to explain observed land rental market activity.

3. Data and descriptive analysis

To test our theory, we draw on a set of household data that was designed explicitly to examine rental and other land-related activities and institutions. The data set was collected in 2000 by a team of researchers from the Center for Chinese Agricultural Policy Research (CCAP) in Beijing, the University of Toronto and the University of California, Davis. One of our coauthors was part of the team that designed the survey and collected the data. The data set covers 60 randomly selected villages that were chosen from six representative provinces (Hebei, Liaoning, Shanxi, Zhejiang, Hubei and Sichuan). In each village, there were 20 sample households, making a total of 1,200 households. Since the survey was designed to analyze land tenancy issues in China, the data set has rich information on land rental transactions as well as family labor endowments. The community-level part of the data set also has several questions on particular issues such as changes to land allocations in earlier years. This information is used to construct a variable to indicate tenure insecurity. With our data, we can construct variables that can be used empirically analyze the development of renting in and renting out.

Family workers

The characteristics of the sample households are presented in Table 1. The typical household is endowed with 2.7 family members that are in the labor force (henceforce, *family workers*).[5] Average school attainment is 7.2 years. More than half of family workers completed primary education; about a quarter completed secondary education. However, school attainment varies across the sample provinces. For example, the proportion of family workers that completed both primary and secondary education is the highest in Shanxi province (75%

[5] *Family workers* are defined as any family member that reported to be engaged in any on-farm or off-farm activities in 2000. The definition of each variable is presented in the Appendix.

and 40%, respectively) and the lowest in Hubei province (47% and 24%, respectively). The age composition of family workers is also shown in Table 1. Around 8 percent of family workers are more than 65 years of age; about a quarter of them are below 30 years old.

Land reallocation and rental transaction

Land management practices, while different in different villages, in general, were typical of China. In all villages individual use rights were awarded to each household as a result of the introduction of the Household Responsibility System (HRS). Although the de facto ownership of the land belongs to the local village (of more formally, the *collective*), a number of measures has been taken by the central government to strengthen individual tenure rights, such as promulgating regulations restricting the administrative land reallocation by the village authorities. Moreover, the rapid development of off-farm labor markets in rural China accelerated land tenure transactions because farmers that take off-farm jobs often want to rent out their land (Kung 1995).

Because land was given to almost all families in our sample (99.8 percent of families have their own land), the average farm size of our sample households is small—only 0.57 ha. However, differences in local endowments mean that land size varies across the sample. For example, while the typical household in Hebei and Shanxi provinces cultivate 14.0 mu (0.94 ha), households in Hubei and Zhejiang provinces cultivate between 0.28 and 0.38 hectares.

While the incidence of the land rental transactions across households in villages is still fairly small, as found in Rozelle et al. (2005), it has been increasing. According to a survey reported in Brandt et al. (2002), less than 1 percent of land was rented in; rental transactions were participated in by only 2 percent of households across China in 1988. In our data the proportion of the households that reported any land rental transactions is around 29 percent.

However, the proportion of land rented is only 5.7 percent of the total farmland. Among the sample provinces, Zhejiang province is found to have the most active land rental market. Indeed, more than 60 percent of the sample households either rent in or rent out land and about 14 percent of the total farmland was actually rented. On the other hand, in Hubei province, only 15 percent of household participated in land rental market and only 1.4 percent of the land is rented.

In the case of China it is often argued that weaknesses in individual land rights are caused by administrative land reallocations (Li, Rozelle and Brandt 1998; Brandt et al. 2002; Deininger and Jin 2003). Rooted in the collective farming system before the introduction of HRS, local village leadership bodies have a decisive power to reallocate land periodically across households in the village. In our sample, for example, administrative reallocations that affect the land holdings of more than half of the households in the village was conducted 1.2 times on average since the introduction of HRS. Thus, it may be reasonable to approximate the extent of the tenure security by the frequency of the administrative reallocations conducted since the introduction of HRS.[6] This strategy has been used in other papers in the literature (e.g., Benjamin and Brandt 2002; Kung 2000). In our paper, we leave this as a hypothesis to be tested, recognizing that the frequency of reallocations may or may not empirically affect land rental activity.

However, like many other indicators of institutions in China's villages, according to our data, the frequency of the administrative land reallocation differs sharply across sample villages. While 40 percent of the villages conducted the administrative reallocations once or

[6] The size of the reallocation varies across different time and villages. To capture the administrative reallocations which might have a greater likelihood of reducing tenure security, we only count the frequency of the administrative reallocations involving more than half of the households in the village.

twice, 44 percent of the villages reported no major administrative reallocations. 17 percent of villages conducted three or more. These differences, according to our data, also seem to differ across provinces. Although the sample villages in Hebei, Shanxi and Zhejiang province have reported frequent and large administrative adjustments, almost all the villages in Liaoning, Hubei and Sichuan province reported nearly no such reallocations

Off-farm employment

Although more than 80 percent of family workers in our sample households are engaged in some type of farm work—either full-time or part-time, the emergence of the non-farm labor market offers relatively lucrative employment opportunities outside the farms of families living in most villages. Indeed, 38 percent of the family workers are found to have some form of off-farm employments; a quarter of them migrated to locations outside the immediate vicinity of the village to engage in off-farm employments.[7] Among the sample provinces, Zhejiang province has by far the highest rate of the participation in the off-farm labor market (50 percent), followed by Sichuan province (39 percent). Although Hubei province has the lowest off-farm employment rate, 33 percent of the household labor force still worked off the farm.

Compared to those that are engaged in farming, we find that off-farm employment provides 3.4 times higher the daily earnings on average. Although family farm workers earn 7.9 yuan per day on average, the off-farm employment provides 27.0 yuan per day on average.[8] In Sichuan and Liaoning province, the off-farm daily wage rates are 7.2 times and 4.5 times higher than the daily farm earnings per worker, respectively. Among the sample provinces, Zhejiang province has the highest off-farm wage rate (33.6 yuan per day), followed by Shanxi

[7] In this study, a family worker is considered to have migrated if he or she worked (and lived) away home for more than 6 months in the sample year.
[8] We estimate daily farm earning per family worker from the total household income divided by total days of family labor input.

province (32.0 yuan per day). In these two provinces, daily farm earnings are also the highest among sample provinces (5.2 and 5.7 yuan per day).

4. Regression analysis

4.1 Estimation strategy

To estimate our model empirically, it is necessary to replace *DCA* with an estimable function. Since *DCA* can be derived from the maximization of the household's profit function in the absence of transaction costs, it seems reasonable to assume that *DCA* is a function of the household's resource endowments, such as the number of family workers, their gender and age and school attainment levels as well as the opportunity cost of the family workers. To operationalize this assumption, we can express *DCA*, A^*, as:

$$A^* = a_0 + a_1 NL + a_2 FE + a_3 GE + a_4 ED + a_5 OC \tag{12}$$

where NL is the *number of family workers*, FE is the *gender composition of family workers*, GE is the *age composition of the family workers*, ED is the *educational attainment of family workers* and OC is the *opportunity cost of family workers*.

By replacing *DCA*, or A^*, in the land rental functions (12) and (13) with the above function, two estimable equations can be derived, one for the determinants of renting in and one for the determinants of renting out:

$$\text{Rent in:} \quad R_n = \mathsf{t}(a_0 + a_1 NL + a_2 FE + a_3 GE + a_4 ED + a_5 OC) - \mathsf{t}\bar{A} - \mathsf{r} \tag{13}$$

$$\text{Rent out:} \quad R_o = \mathsf{w}\bar{A} - \mathsf{w}(a_0 + a_1 NL + a_2 FE + a_3 GE + a_4 ED + a_5 OC) - \mathsf{y} \ . \tag{14}$$

In these equations, the estimated coefficients of the allocated area of land $\bar{A}$ are the direct estimates of the coefficients t and w in our land rental market model.

Transaction costs and land rental markets

In our model search and negotiation costs are assumed to be an important determinant of the efficiency of rent-in side of the market. To test this hypothesis, we include the average farm size of the village in our regression model as a proxy for this transaction cost. If the average farm size of the village is small, the transaction cost to rent in the same size of land is expected to be high because the households that want to rent in the land have to find and negotiate with a larger number of households. Thus, a negative relationship is expected between the average farm size of the village and the area of land rented in. The critical assumption we adopt here is that such transaction costs affect r in equation 13.

On the other hand, as discussed above, weak tenure security would discourage households from renting out their land by increasing the expected loss of losing tenure rights in the future. An important assumption we adopt here is that such transaction costs affect y in equation 14.[9] To test this hypothesis, we include the frequency of administrative reallocations as a proxy for the extent of the tenure security in the village. We expect the area of land rented out to be negatively affected by the frequency of the administrative reallocations in the village. Note that our formal model focuses separately on the behavior of rentees and rentors. Thus, for example, tenure security is assumed to affect renting-out decision, but not renting-in. But changes in renting-out decision will affect opportunities to rent in at the land rental market. Similarly, farm size may affect not only renting-in decisions but also renting-out decisions, if the land rental market responds to changes in the renting-in decisions. For these reasons, we include farm size and land tenure security variables in both the rent-in and rent-out regression functions.

[9] r and y are also determined by the parameter of the transaction cost function. The values of g_1 and q_1 in equation 11 and 12 primarily affect r and y, respectively.

Off-farm labor market and land rental markets

The development of off-farm labor markets is also considered to be a significant determinant of the farm size adjustment through land rental markets (Kung 1995; Deininger and Jin 2005). The opportunity cost of family workers is expected to rise as the difference between the returns to the family farming and the off-farm wage rate increases. Our model predicts that as the opportunity cost of family workers (*OC* in equations 13 and 14) rises there will be a negative impact on the area of land rented in and a positive impact on the area rented out (R_n and R_o in equations 13 and 14, respectively).[10] To test this hypothesis, we add the off-farm wage rate in the village to the explanatory variables.

4.2 Regression model

Several characteristics of land rental markets have to be considered when we specify an appropriate estimation approach. First, due to the existence of transaction costs in land rental markets, our land rental market conceptual model predicts that some of the farm households will choose not to participate in rental markets, even though their *DCA* is different from the allocated area of land. Therefore, the dependent variables in our regression are censored below zero. For this reason, a Tobit model is an appropriate non-linear regression approach. Second, we hypothesize that tenure insecurity caused by frequent administrative reallocations will have a negative impact on the area of land being rented out. This hypothesis, however, is based on the assumption that the frequency of administrative reallocations is exogenous to the area of land being rented. Unfortunately, it is possible that this assumption may not hold and that the frequency of administrative reallocations might be endogenous. This would be the case, for

[10] Since an increase in opportunity cost reduces DCA, the coefficient a_5 in equation 12 and 13 is predicted to be negative.

example, if administrative reallocations are more frequently conducted in villages in which land rental activity is stagnant (and that the frequency of administrative reallocations and the absence of land rental activity are both influenced by some third, unobserved/unmeasured factor). Because of this, we propose an alternative econometric approach to address this problem. In addition, to the Tobit model, we also use a Two-Stage Least Square (2SLS) model, treating frequency of administrative reallocations as an endogenous variable.

Tobit Estimator

For estimating our model of land rental market, the dependent variables should be censored below zero. Given that y_{in}^{*} is the desirable area of land rented in and y_{in} is the observed area of land rented in, zero is observed when y_{in}^{*} is less than zero. On the other hand, y_{in}^{*} should be observed when y_{in}^{*} is larger than zero. Given that the households cannot rent out more than allocated area of land, the dependent variables should be censored below zero and above the allocated area of land. Therefore, a two-limit Tobit model is used to estimate the renting out regressions,

$$y_{io}^{*} = \beta_{o}' x_i + \varepsilon_i \qquad (15)$$

$$y_{io} = 0 \qquad if\ y_{io}^{*} < 0$$

$$y_{io} = y_{io}^{*} \qquad if\ 0 < y_{io}^{*} < c_i$$

$$y_{io} = c_i \qquad if\ y_{io}^{*} > c_i\ ,$$

where c_i and zero are the upper and lower censoring point, respectively. In this case, the upper

limit is equivalent to the allocated area of land for each farm household. [11]

Two Stage Least Squares Estimator

Since we treat the variable that measures the frequency of administrative reallocations as endogenous, the key step in executing this approach is finding a set of instrumental variables (IV) that can identify the effect of reallocations on rental activity. A good IV is one that is correlated with the frequency of administrative reallocations, but is not correlated with the extent of land rental activity in the village except through its effect on administrative reallocations.

In selecting our IV for the Two Stage Least Squares estimator, we employ same strategy as Benjamin and Bandt (2002). Our general strategy relies on a set of variables that measures preferences of village leaders (those individuals most directly responsible for initiating and implementing administrative reallocations) and which are correlated with the costs of undertaking administrative reallocations. Specifically, as in Benjamin and Brandt (2002), we propose to use as IVs the number of households in the village and as well as the educational attainment and age of the village leader. The number of households in a village is expected to have a negative impact on the frequency of the administrative reallocations since it raises the cost of reallocation by village leaders. The more households there are, ceteris paribus, the more time and effort is needed to reallocate administratively. We also expect that

[11] the likelihood function of the two-limit Tobit model can be expressed as

$$L = \prod_{0}\left[\Phi\left(\frac{-\beta_o' x_i}{\sigma}\right)\right] \times \prod_{n}\frac{1}{\sigma} f\left(\frac{y_{io} - \beta_o' x_i}{\sigma}\right) \times \prod_{c}\left[1 - \Phi\left(\frac{c_i - \beta_o'}{\sigma}\right)\right],$$

where the first term represents the product of all the observations taking zero and the second term is the product of all the observation taking more than zero but less than c_i. The product of all the observations renting out all the allocated land is expressed in the third term.

the human capital of the village leader—his educational attainment and age—will help define the leader's preferences and these will affect the way in which he manages land in the village, including administrative allocations. In addition to passing the logic test, our test of over-indentification restrictions support our choice (and the choice of Benjamin and Brandt) of IVs.

4.3. Estimation results

Efficiency of the land rental markets

The results from the Tobit and 2SLS estimators are presented in Tables 2 and 3. Both sets of estimated parameters from the Tobit and 2SLS approaches indicate that the coefficients of the allocated area of land (t and w in equations 13 and 14) are not significantly different from zero on either side of the markets. Such a findings implies that the adjustment coefficients, t and w, are not significantly different from zero. This means, according to our results, that the household's farm-size adjustment through land rental markets is either inefficient or incomplete or both.

Number of family workers

The findings that relate the family's labor endowment to its land rental decisions are as expected. The results of both the Tobit and 2SLS models show that the coefficients of the number of family workers variable in renting out side of the market ($-wa_1$ in equation 14) is negative and significant. One interpretation of this finding is that when households are endowed with greater number of family workers, they rent out less land. On the other hand, the estimated coefficient of the number of family workers variable in renting in side of the market (ta_1 in equation 13) from Tobit model shows that the number of workers has positive effect on the area of land rented in. Such findings are reasonable, since they imply that labor abundant

households rent in more land and labor scarce households rent out less land. The estimated coefficient of the number of family workers in the rent-out side of the 2SLS model is also significant and negative. However, the coefficient in the renting-in equation is not significant, implying that it might be the case that in some labor abundant households with the excess family workers there is a tendency to participate in off-farm labor markets rather than expand their farm size by renting in land.

The schooling of family workers also is found to be a significant determinant of the area of land rented out. Our results from the Tobit model indicate that the proportion of family workers that completed secondary education has a positive effect on the area of land rented out. Since the returns to education are likely to be higher in the off-farm employment sector than in family farming (deBrauw 2001), the results, as expected, show that when education levels are higher, family members tend to be involved in off-farm employment and have less interest in renting in land.

The Transaction Cost Variables

Average farm size. *In bo*th the Tobit and 2SLS models, we find positive and significant coefficients of the average farm size variable in the rent in side of the estimation. This result supports our hypothesis that when farm sizes are smaller, there is an impediment in the village that is keeping households from renting in land because small farm sizes raise the search and negotiation costs of those wanting to rent land in. In contrast, no significant relationship can be found between the average farm size and the area of land rented out. According to our formal model, transaction costs that affect renting out land does not directly depend on the average farm size; the search and negotiation costs fall on the shoulders of those

renting in not out. This is true because in our data, typically farmers rent out their land (or part of their land) to only a single tenant.

Tenure security. Consistent with the prediction of our model, a significant relationship is found between the extent of tenure security and the area of land rented out. The estimation results of both models—when we use the Tobit and 2SLS models—indicate that the area of land rented out tends to be smaller in the villages with more frequent reallocations. Since the frequency of administrative reallocations is expected to be a proxy for the extent of the tenure insecurity in the village, these results may suggest that the weak tenure security impedes households to rent out their land by raising the expected loss of renting out their land.

On the other hand, the Tobit model estimation finds a negative impact of the tenure insecurity on the area of land rented in, which is not predicted from our model. This relationship, however, is not supported by the results of the 2SLS model which finds no significant relationship between tenure security and renting-in area. One possible explanation for the finding in the Tobit model could be that when there are more frequent reallocations, farmers tend to rent in less not only because it harms tenure security, but also partly because of a simultaneity problem. It could be that reallocations are conducted more frequently in villages in which land rental activity is stagnant. If this were the case, the coefficient on the administrative reallocation variable would be biased. In fact, when we seek to account for the simultaneity, the results from the 2SLS model find no significant relationship between tenure security and renting-in area. In other words, the results from our 2SLS model, which arguably produces the best estimates, supports our hypotheses.

The opportunity cost of family workers

The results from two models also show that the area of land rented in increases as the average male wage rate in the village increases. Since our formal model predicts that the increased opportunity cost reduces the household's *DCA*, and has a negative impact on the rent in area (equation 13), this result is inconsistent with the expectation of our model. However, this might be the case if there was an increased supply in the land rental market which lowered the rent. A lower rent, of course, would create more demand to rent in land. Hence, although our model did not capture the relationship, these results perhaps suggest that higher wage rates are stimulating the development of land rental markets.

On the other hand, the estimated coefficients from the Tobit model indicate that the average male and female off-farm wage rates in the village have positive effects on the area of land that is being rented out. As the development of non-farm sectors increases the opportunity cost of the family workers, the household allocates more workers to off-farm employment than to farming. As a result, the household's *DCA* decreases. Consistent with the expectation of our formal model, the increased opportunity cost reduces the household's *DCA*, and hence has a positive impact on the rent out area (equation 14).

5. Summary and Conclusion

Considering that neither farm labor nor land sales markets are expected to function effectively, in many developing countries the land rental market is likely to be the only means to achieve an efficient land allocation across households. When functioning, land rental markets provide benefits for both the farmers that want to dispose their land to move to non-farm sectors and those that wish to expand their farm size. Thus, the development of well-

functioning land rental markets is critically important for facilitating the structural transformation of the economy from an agricultural-based to the industrialized economy.

In this paper, we propose a theoretical model of the determinants of land rental transactions. Our basic hypothesis is that at least one of the sources of the failures of land rental market is high transaction costs. Transaction costs not only can impede the household's farm size adjustment toward an optimal size (which would be optimal in the absence of transaction costs), but also discourages households from participating in land rental markets in the first place. The predictions of our conceptual model are empirically tested by using household survey data from China. We find that the small size of farms in villages and tenure insecurity at the village level have negative impacts on land rental transactions. In addition, the development of off-farm labor markets is found to activate the land rental market, most likely because an increase in the opportunity cost of family farm workers creates the incentive for households to rent out land.

In order to remove the impediments of the land tenure transactions in China, further strengthening of individual land rights as well as their protection and enforcement of the current rights by local governments is necessary. Under the current administrative land reallocation system, individual land use rights can be taken away and appears to be thwarting incentives for farmers, including relatively unproductive part-time farmers who cultivate tiny plots of land, to rent out their land. Hence, according to our results, granting and protecting individual land rights on farmland is one of the major remaining institutional reforms that must be implemented in China in order to sustain China's rapid economic transformation.

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Table 1 Description of household labor and land resources

	All	Hebei	Liaoning	Shanxi	Zhejinag	Hubei	Sichuan
Household labor resources							
Number of family workers	2.69	2.6	2.7	2.5	2.8	2.8	2.8
Proportion of female workers	0.56	0.577	0.56	0.56	0.59	0.52	0.55
Proportion of workers completing primary education	0.55	0.5	0.56	0.72	0.54	0.44	0.56
Proportion of workers completing secondary education	0.24	0.19	0.24	0.37	0.24	0.18	0.29
Proportion of workers between 30 and 50 years of age	0.39	0.33	0.42	0.45	0.38	0.35	0.42
Proportion of workers between 51 and 65 years of age	0.24	0.29	0.23	0.27	0.22	0.22	0.23
Proportion of workers more than 65 years of age	0.078	0.083	0.089	0.071	0.092	0.07	0.065
Proportion of off-farm workers	0.38	0.36	0.35	0.34	0.50	0.33	0.39
Proportion of migrated workers	0.26	0.26	0.28	0.22	0.29	0.23	0.26
Daily off-farm wage rate (yuan)	27.0	24.6	21.9	32.0	33.6	21.0	29.9
Daily farm earnings per worker (yuan)	7.9	8.1	4.9	13.7	10.3	6.2	4.4
Household land resources							
Average farm size (mu)	8.5	13.9	5.4	12.7	5.7	4.3	6.0
Proportion of land rented	0.057	0.049	0.023	0.075	0.14	0.014	0.045
Proportion of households participating in land rental markets	0.29	0.29	0.17	0.33	0.61	0.15	0.19
Frequency of the large administrative reallocations since HRS	1.15	2.3	0.20	2.2	1.91	0.10	0.20

Table 2 Determinants of the land rental area (Tobit model)

Explanatory Variables	Rent in	Rent out
Allocated area of land	-0.048	-0.0042
	(-0.74)	(-0.14)
Family labor resources		
Number of family workers	0.93*	-0.74***
	(1.78)	(-2.74)
Proportion of female workers	-1.17	0.97
	(-0.41)	(0.82)
Proportion of age group (30-50) among family workers	3.41	-0.44
	(1.48)	(-0.46)
Proportion of age group (51-65) among family workers	3.73	-0.33
	(1.36)	(-0.29)
Proportion of age group (65<) among family workers	-0.15	2.03
	(-0.04)	(1.36)
Proportion of labor force completing primary education	0.12	-1.02
	(0.07)	(-1.31)
Proportion of labor force completing secondary education	-1.55	2.23***
	(-0.84)	(2.64)
The value of agricultural production assets	0.0013	0.00013
	(1.43)	(0.29)
Village level characteristics		
Average male off-farm wage rate	0.0051**	0.0027**
	(2.56)	(3.05)
Average female off-farm wage rate	-0.0020	0.002**
	(-0.70)	(1.96)
Average farm size in the village	0.24**	0.061
	(2.03)	(1.04)
Frequency of large administrative reallocations	-1.07*	-.0.54*
	(-1.83)	(-1.75)
Provincial dummies		
Heibei	6.06**	1.21
	(2.46)	(1.06)
Shaanxi	5.09**	1.67
	(2.13)	(1.58)
Liaoning	2.39	0.21
	(1.20)	(0.24)
Sichuan	2.48	-0.76
	(1.26)	(-0.84)
Zhejiang	11.05***	2.40**
	(4.83)	(2.34)
Constant	-22.01***	-7.05***
	(-5.22)	(-3.84)

*** significant at 1 % level ** significant at 5 % level * significant at 10% level. T-stats are in parenthesis.
Dependent variables in both equations are measured in mu.

Table 3. Determinants of the land rental area (Two Stage Least Square (2SLS) model)

Explanatory Variable	Rent in	Rent out
Allocated area of land	0.004	0.0005
	(0.25)	(0.16)
Family labor resources		
Number of family workers	0.20	-0.06***
	(1.23)	(-2.7 •)
Proportion of female workers	0.26	0.36*
	(0.62	(1.69)
Proportion of age group (30-50) among family workers	0.38	-0.10
	(1.31)	(-0.85)
Proportion of age group (51-65) among family workers	0.34	-0.21*
	(1.09)	(-1.73)
Proportion of age group (65-) among family workers	-0.51	0.42
	(-1.31)	(1.06)
Proportion of labor force completing more than primary education	0.31	-0.15*
	(0.67)	(-1.81)
Proportion of labor force completing more than secondary education	-0.29	0.14
	(-1.36)	(1.36)
The value of agricultural production assets	0.0002	-7.63e-07
	(0.71)	(-0.02)
Village level characteristics		
Average male off-farm wage rate	0.002*	0.0002
	(1.72)	(1.43)
Average female off-farm wage rate	0.0004	0.0001
	(0.84)	(1.32)
Average farm size of the village	0.09*	0.02
	(1.79)	(1.06)
Frequency of larger administrative reallocation	-0.39	-0.24**
	(-1.57)	(-2.14)
Provincial dummies		
Heibei	0.47	0.48*
	(0.96)	(1.83)
Shaanxi	0.004	0.44**
	(0.01)	(2.00)
Liaoning	-0.23	0.003
	(-1.02)	(0.05)
Sichuan	-0.30	-0.01
	(-0.96)	(-0.17)
Zhejiang	1.13*	0.52**
	(1.82)	(2.15)
Constant	-2.28	-0.09
	(-1.36)	(-0.53)

*** significant at 1 % level ** significant at 5 % level * significant at 10% level. T-stats from robust standard errors are in parenthesis. Dependent variables in both equations are measured in mu. The overidentification test stats are 0.26 and 1.12 in the rent-in and rent-out sides of the equations, respectively.

Figure 1 The profit function and the transaction cost functions in the case of renting in

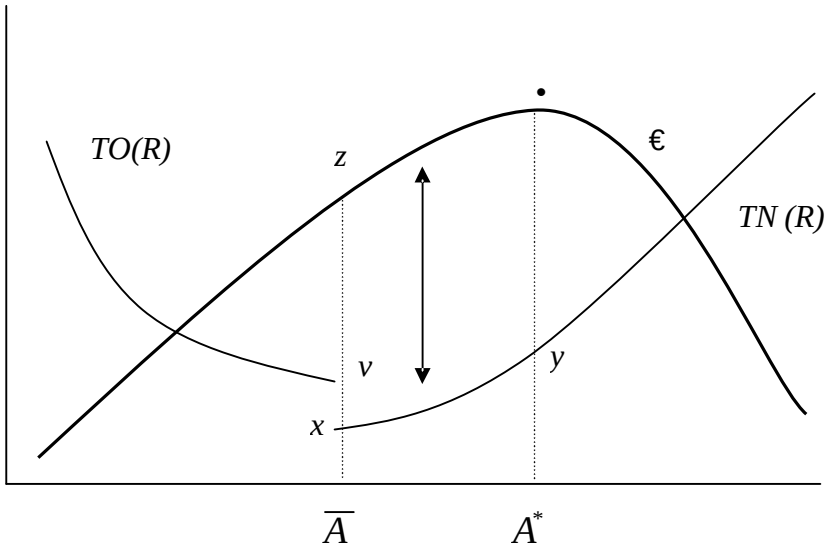
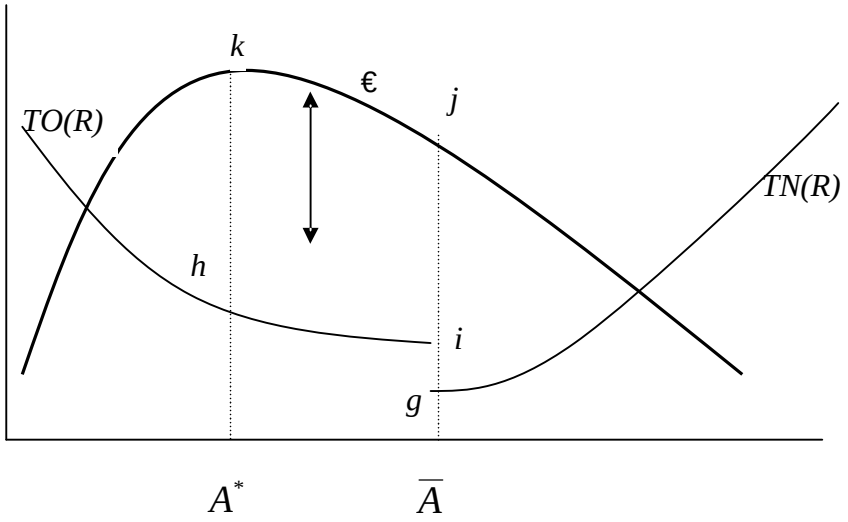


Figure 2 The profit function and the transaction cost functions in the case of renting out



Appendix. The definition of the variables

Variables	Definition of the variables
Family labor resources	
Number of family workers	Number of family member that reported on-farm or off-farm work in 2000
Proportion of female workers	Proportion of female among family workers
Proportion of age group (30-50) in the family workers	Proportion of family workers between 30 and 50 years of age
Proportion of age group (51-65) in the family workers	Proportion of family workers between 51 and 65 years of age
Proportion of age group (65-) in the family workers	Proportion of family workers more than 65 years of age
Proportion of family workers completed primary education	Proportion of females among family workers that completed more than 6 years of education
Proportion of labor force completed secondary education	Proportion of family workers that completed more than 9 years of education
Proportion of family workers completed high education	Proportion of family workers that completed more than 12 years of education
The value of agricultural production asset	Value of agricultural production assets (yuan)
Allocated area of land	The area of farmland that village leaders allocated household in 2002 (mu)
Village level characteristic	
Average male off-farm wage rate	The average wage of male workers from off-farm employment per month
Average female off-farm wage rate	The average wage of female workers from off-farm employment per month
Frequency of administrative reallocations	Frequency of administrative reallocation of land involves more than half of the total village land since the introduction of the Household Responsibility System in the village
Average farm size in the village	Cultivated area of land per household in the village (mu)