THE DEVELOPMENT OF THE LAND LEASE MARKET IN RURAL CHINA

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Abstract

This paper examines the development of the land lease market in rural China. Special attention is paid to productive heterogeneity among farmers and the openness of the labor market in activating the land lease market. A theoretical model is employed to explore the underlying connections. An econometric model is implemented using a two period panel data set gathered in three counties of China's Zhejiang province. The results show that productive heterogeneity and a freer labor market do promote more land leases. The implications for the institutional change literature are discussed.

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I. INTRODUCTION

A basic observation of rural China is the scant incidence of land leases, although land transfers are encouraged by the government. For example, Turner, Brandt and Rozelle (1998) find in a recent survey of eight provinces that only 3 - 4% of the land is leased. The percentage is higher in Zhejiang province, but still only 7 - 8%. Liu, Carter and Yao (1998) find similar evidence in their study of four provinces, some of which overlap those in the former study. These observations lead many authors to ignore the existence of land markets in their theoretical and econometric analyses (e.g., Yang 1994; and Zhao 1997; Turner, Brandt and Rozelle 1998, to name a few). However, the land lease market is regarded as an efficient way to bring about efficient resource allocation (Binswanger and Deininger 1995; Carter, Fletchner and Olinto 1996). The question, then, is why the land lease market has not become a major intermediary for resource allocation in rural China. Besides being interesting from a conceptual point of view, this question is important for policy formation in China.

In the policy arena, China is facing the problem of how to sustain a viable agricultural sector that provides sufficient income to numerous family farms. At present, these family farms are very small; on average, each works on only about half a hectare of land. When China opens its markets to international competition --- this is a mandatory requirement if China joins WTO, many of these small family farms will be forced out of business. The Chinese government is encouraging land consolidation through market intermediaries such as land markets. However, land is legally owned by the village collective, so land selling in the legal sense does not exist. As a result, land leasing is promoted. In light of

the low incidence of land leasing, research is needed to explore the factors that hinder the proliferation of this type of transaction, so further reforms can be effectively carried out.

In the academic arena, the Chinese experience provides an interesting case to further our understanding of institutional changes. The classical induced institutional change hypothesis formulated in the literature states that an institution emerges as a response to the changes of relative factor prices (North and Thomas 1973; Hayami and Kikuchi 1981; Hayami and Ruttan 1985; Hayami 1997). The strong version of this hypothesis is the so-called efficiency hypothesis: institutions that promote efficiency will prevail over other institutions. In the Chinese case, this could lead one to conclude that the land lease market ought to emerge as it promotes efficient resource allocation. The evidence of scant land leases, however, tends to go against this assessment.

There have been many studies addressing the determinants of the activity of the land lease market. These determinants include credit (Jaynes 1982), family labor (Pant 1983), and transaction costs (Skoufias 1995). In the case of China, Lin (1995) tests the link between household participation in rural factor markets with household endowments and technological change. This paper takes a different angle to examine the development of the land lease market in rural China. We move the focus from the demand of individual households to the interaction of households in a general equilibrium framework. The development of the land lease market is measured by the participation rate of the households in a village, which in turn is determined by market equilibrium. In the course of the study, heterogeneity among households is emphasized. Without household heterogeneity, a land market is of little value. Carter and Zimmerman (1994) examine one kind of household heterogeneity, namely, the uneven distribution of initial wealth, in

activating the land market in Sub-Saharan Africa. In this paper, we examine another dimension of household heterogeneity, i.e., the uneven distribution of specific human capital, in activating the land lease market in rural China. Human capital is the most important factor that differentiates Chinese rural households because the accumulation of other assets was prohibited in the collective era and the impact thus created has extended into the current days. With human capital entering the scene, it is also natural for the labor market to be taken into consideration. One approach, therefore, is to study the activity of the land lease market in the context of human capital heterogeneity and labor market imperfections.

The efficiency hypothesis postulated by the classical induced institutional change theory is pursued as an analogy to a producer's cost minimizing behavior (Hayami 1997). The lack of a general equilibrium perspective may lead the theory to incorrect conclusions when it comes to the study of what really comes out of a market equilibrium, especially when the study concerns short-run issues. By taking a general equilibrium approach, this paper will remedy the shortcomings of the classical induced institutional change theory. We consider an economy where the household can allocate its time in both industry and agriculture, with the feature that the industrial sector is characterized by job rationing. Because of rationing, farmers are forced to put more labor into agriculture, raising the marginal productivity of land. As a result, the equilibrium land rent is also raised. In the meantime, increases in the marginal productivity are not homogenous among farmers. The shadow values of the rationing are lower for farmers with higher agricultural productivity, so the marginal productivity of their land is increased less than that of farmers with lower productivity. This heterogeneous movement of the marginal

products of land changes the structure of the land lease market in a way such that compared with the case of a competitive labor market, the decrease of land supply is far stronger than the increase of land demand so that the total amount of land leased is reduced.

Using a two-period panel dataset collected in three counties in China's Zhejiang province, our econometric model tests the hypothesis proposed in the theoretical model regarding the role of heterogeneous population and the labor market. The results confirm the major theoretical hypothesis that a more heterogeneous population and a freer labor market promote more land leases.

The paper is organized as follows. In Section 2, we present a model of land lease market development and propose several testable hypotheses. In Section 3, we implement the econometric model to test these hypotheses. In Section 4, we conclude the paper by a discussion of the implications of our results.

I. A MODEL OF LAND LEASE MARKET DEVELOPMENT

Consider a representative farmer in a semi-industrialized economy where farmers are engaged in both agricultural and industrial employment. The farmer's utility function is $U(y, l)$, where y is income, l is leisure, $U_y > 0$, $U_l > 0$, and U is strictly concave in y and l. The farmer may obtain income from both agriculture and local industry. In agriculture, he uses two inputs, land T and labor L_a, and deploys a concave production function $ef(T, L_a)$ to produce grain, where e is an efficiency indicator. We assume that land and labor are complements, that is, $\partial^2 f / \partial T \partial L_a > 0$. This assumption is confirmed by Lu (1998) using the same data set to be used in this study. It is worth emphasizing, however, that

this assumption does not change the main thrust of this paper, that is, more heterogeneous households and a freer labor market promote the expansion of the land lease market. In fact, it will be clear at the end of this section that compared to the results we will obtain, the results for the case when land and labor are substitutes will be symmetric.

The amount of operational land T is the sum of a farmer's own land T_0 and the land he rents in T_r, minus the land he rents out T_u. Similarly, the amount of labor L_a is the sum of his own labor used in agriculture L_f and the net hired-in labor L_h which he pays a wage of w_a. The land rent is r, and every unit of transacted land has to incur an extra cost of transaction. While the cost may be caused by many factors, here we summarize them by a single indicator M that indicates the extent to which land is traded without incurring any costs. Let $c(M)$ denote the amount of costs associated with M. Naturally, the cost is decreasing in M. Because of the transaction costs, land rent is not symmetric for the owner and the tenant. For the owner, the net gain of renting out one unit of his land is $r - c(M)$; and for the tenant, the net cost of renting one unit of land is $r + c(M)$. Finally, the farmer earns an industrial wage of w_n which is greater than w_a. We assume that the labor market is cleared by quantity rationing in order to fill the wage gap. While there are several theories explaining why firms use quantity rationing instead of price rationing to clear the labor market (for example, the efficiency wage theory proposed by Akerlof and Yellen 1986; the moral hazard model proposed by Shapiro and Stiglitz 1984), Yao (forthcoming) links quantity rationing in rural China with the ownership structure of the indigenous industry. Using 1993 data, he shows that industrial employment is characterized by time rationing in one of the counties this paper is about to study. Time rationing is defined as the kind of rationing that limits the length of time that a person can

work in the industrial sector so that more people can have a share of the limited industrial jobs. This form of rationing is likely to be taken by publicly owned firms that are used by local leaders as an instrument for equal income distribution in villages where industrial jobs are limited but paid higher than agricultural jobs. Resting on the results of Yao (forthcoming), here we assume that the quantity rationing takes the form of imposing a ceiling, L_n^0, to the farmer's working time in industry L_n. Notice that L_n^0 can be different for a different farmer depending on his specific human capital.

The typical farmer's utility maximization problem can be characterized by

$$\begin{aligned}
&\text{Max} \quad U(y,l) \\
&T_r, T_u, L_h, \\
&L_f, L_n, l \\
\text{s.t. } & y = ef(T, L_a) + w_n L_n - w_a L_h - [r + c(M)]T_r + [r - c(M)]T_u \\
& T = T_0 + T_r - T_u \\
& L_a = L_f + L_h \\
& L_0 = L_f + L_n + l \\
& L_n \le L_n^0
\end{aligned} \qquad [1]$$

In the problem, L_0 is the farmer's time endowment, and all the prices are expressed in terms of the price of grain. To proceed, it is useful to divide the problem into two parts. In what follows, we will first study how the imperfections in the labor market affect the farmer's agricultural labor allocation when the land lease market is held inactive, and then move on to relax the assumption and study how the land lease market works under the imperfect labor market.

Agricultural Labor Allocation in the Absence of the Land Market

Substituting for L_n by L_f and l via the time endowment constraint, the farmer's decision of agricultural labor allocation can be characterized by the following two first-order conditions

$$L_f\text{: } ef_L - w_n + \lambda / U_y \le 0, \quad [2]$$

$$L_h\text{: } ef_L - w_a \le 0, \quad [3]$$

in which ef_L is the marginal product of labor, and l is the Lagrange multiplier for the constraint on L_n. Let $w_s = w_n$ - l /U_y be the shadow wage for family labor that is equivalent to the competitive industrial wage that would have induced the farmer to put the same amount of time in agriculture as he does when his industrial employment is rationed. It is noteworthy that w_s is equal to w_n if the industrial employment constraint is not binding (so l is equal to zero), and is smaller than w_n if the constraint is binding (so l is positive). In other words, a farmer with a smaller valuation of the industrial employment has a larger shadow wage for family labor. By substituting the definition of the shadow wage, [2] becomes

$$ef_L - w_s \le 0. \quad [4]$$

Comparing [4] and [3], we find that the farmer will not use both family and outside labor simultaneously unless his labor endowment constraint is reached or his shadow wage for family labor is the same as the agricultural wage, a case in which he is indifferent between the two kinds of labor. When the gap between the industrial wage w_n and the agricultural wage w_a is small, it is likely that w_s will be smaller than w_a when the industrial employment constraint is binding for the farmer. Consistent with empirical observations that most farmers in China do use at least parts of their family labor in

agricultural production, we assume that w_s is less than w_a for a binding farmer so that he will not hire outside labor. Also, we make the assumption that w_s is strictly positive. With these two assumptions, L_a has an interior solution and the equality in [4] holds.

Figure 1 depicts the farmer's labor allocation graphically. In the figure, we denote w_s as a function of L_a conditioned on the efficiency factor e to reflect the fact that w_s is not parametrically given. We draw two sets of curves for the marginal labor product and shadow wage corresponding to two levels of efficiency e and $e¢$ Let us ignore the set associated with $e¢$for a moment and concentrate on the set associated with e. It is easy to show that $w_s(L_a; e)$ is nondecreasing in L_a. That is

$$\frac{\partial w_s}{\partial L_a} = \frac{\lambda}{U_y{}^2} U_{yy}(ef_L - w_n) \geq 0. \qquad [5]$$

This is because U_{yy} is negative by assumption and ef_L - w_n is nonpositive as shown by the first-order condition [4] when L_a has an interior solution. The maximum value of w_s is w_n, a case only happens when l is equal to zero, that is, when the farmer is not constrained by rationing. Therefore, the farmer will apply more labor in agriculture when he is constrained than when he is not because $ef_L(L_a)$ is decreasing in L_a by our assumption on the production function. In Figure 1, $L_a{}^c$ and $L_a{}^r$ are the solutions to L_a under perfect and imperfect labor markets. The result is illustrated by $L_a{}^r$'s lying to the right of $L_a{}^c$. The following lemma is a natural extension.

Lemma 1. When the land lease market is absent, the marginal product of labor under the rationed labor market is not higher than that under the perfect labor market, but the marginal product of land is at least as high for every farmer.

The first part of the lemma is an immediate consequence of our assumption of a concave production function. The second part is the consequence of the complementarity of land

and labor in agriculture: as more labor is applied, the marginal productivity of land is raised.[1]

Now, Let us turn to the comparison of the two situations under e and e¢ We assume that e¢is greater than e. In Figure 1, L_a^c¢and L_a^r¢are the solutions to L_a corresponding to e¢ under perfect and imperfect labor markets, separately. The following lemma will prove useful later.

Lemma 2. $L_a^r - L_a^c > L_a^r$¢$- L_a^c$¢

That is, the increase of labor input of a more able farmer is less than the increase of a less able farmer as the labor market turns from competitive to rationed. To prove the lemma, it suffices to show that with a higher e, a farmer's marginal labor product curve moves to the right and becomes steeper, and his w_s curve moves upward. These two claims are shown graphically in Figure 1. The first claim holds obviously as e¢f_L is greater than ef_L and e¢f_{LL} is less than ef_{LL} for every L_a. The second claim says that the shadow wage of a more able farmer is higher than that of a less able. In other words, the marginal value of industrial employment of a more able farmer is less than that of a less able. This claim can be established by studying the following derivative

$$\frac{\partial w_s}{\partial e} = -\frac{1}{U_y}\left(\frac{\partial \lambda}{\partial e} - \frac{\lambda}{U_y} U_{yy} f\right). \qquad [6]$$

Using the fact that l = $\partial U/\partial L_n^0$, the above derivative becomes

$$\frac{\partial w_s}{\partial e} = -\frac{U_{yy} f}{U_y}\left(w_n - \frac{\lambda}{U_y}\right) = -\frac{U_{yy} f}{U_y} w_s > 0. \qquad [7]$$

Lemma 2 is remarkable because it holds when we are not certain about the relative magnitudes of L_a^r and L_a^r¢ In a perfect labor market, we know that a more able farmer

will definitely put more labor in his land because an increase in efficiency only has a substitution effect, as shown in Figure 1 by the gap between L_a^c¢and L_a^c. Under the rationed labor market, however, an increase in efficiency has both a substitution and an income effect as it not only raises the marginal labor product, but also bids up the farmer's shadow wage.

The Activity of the Land Lease Market

When the land lease market is introduced, we notice first that the farmer will not rent in and rent out land simultaneously. This is shown by the following first-order conditions for T_r and T_u

$$T_r: \ ef_T - [r + c(M)] \le 0, \qquad [8]$$

$$T_u: \ ef_T - [r - c(M)] \le 0, \qquad [9]$$

where the two equalities can not hold simultaneously (ef_T is the marginal product of land). In fact, the above two first-order conditions define three regimes for the farmer regarding his decision of land market participation. Depending on the magnitude of his marginal product of land, he will rent out land, stay in autarky, or rent in land according to the following rule

Rent-out: $ef_T < r - c(M)$;

Autarky: $r - c(M) \le ef_T \le r + c(M)$;

Rent-in: $ef_T > r + c(M)$. [10]

To determine the activity of the land market, we need first to study the determination of the land rent *r*. This requires us to leave the representative farmer and study all the farmers in the village.

It is evident that heterogeneity among the farmers in a village is a precondition for a land market to exist: if all of them possessed the same endowments, employed the same technology, and were equally productive, there would be no demand for land transactions. Here we assume that farmers in the village are differentiated by their total factor productivity e as well as their initial land endowment T_0. We assume that e has a distribution $\mathrm{j}(e)$. Let $F_{T0} = ef_T[T_0, L_a(e)]$ denote the marginal productivity of land of a farmer with efficiency e and land endowment T_0 when he has not engaged in any land transaction. The relationship of F_{T0} and e is shown by the following derivative

$$\frac{\partial F_{T0}}{\partial e} = f_T + ef_{TL}\frac{\partial L_a}{\partial e}, \qquad [11]$$

whose sign depends on how L_a behaves as e is increased. As we noted earlier, the effect of an increase in e depends on the relative magnitudes of the substitution and income effects. Here we assume that the substitution effect is larger than the income effect so that L_a is increasing in e. So F_{T0} is also increasing in e. Then, the distribution of F_{T0} can be derived from $\mathrm{j}(e)$ in the usual way. To study the influence of the imperfect labor market, the key is to note that the distributions of F_{T0} are different under imperfect and perfect labor markets.

Let $g_c(F_{T0})$ and $G_c(F_{T0})$ denote, respectively, the density and cumulative distribution functions for the F_{T0}'s under the perfect labor market. It is noteworthy that the distribution is conditioned on the land endowment T_0. Let us assume that every farmer who participates in the land market rents in or rents out only one unit of land. Therefore, the supply of land is equal to $G_c[r - c(M)]$, and the demand for land is equal to $1 - G_c[r + c(M)]$. The land rent, denoted in this case by r_c, is determined by equating supply with demand

$$G_c[r_c - c(M)] = 1 - G_c[r_c + c(M)]. \quad [12]$$

Then, the number of farmers falling in autarky is

$$N_c = G_c[r_c + c(M)] - G_c[r_c - c(M)]. \quad [13]$$

Let $g_r(F_{T0})$ and $G_r(F_{T0})$ denote the density and cumulative distribution functions for the F_{T0}'s under the rationed labor market. Similarly, the land rent in this case, denoted by r_r, and the number of farmers falling into autarky are determined by the following two equations

$$G_r[r_r - c(M)] = 1 - G_r[r_r + c(M)], \quad [14]$$

$$N_r = G_r[r_r + c(M)] - G_r[r_r - c(M)]. \quad [15]$$

Lemma 1 shows that a farmer's marginal land productivity under a rationed labor market is at least as large as that under a competitive labor market. Therefore, we have $G_c(F_{T0}) \geq G_r(F_{T0})$ for every value of F_{T0}. With this result, we have the following proposition.

Proposition. The land rent under the imperfect labor market is larger than the land rent under the perfect labor market.

This is so because if r_r were less or equal to r_c, we would have $G_r[r_r - c(M)] < G_c[r_c - c(M)] = 1 - G_c[r_c + c(M)] < 1 - G_r[r_r + c(M)]$, which means that r_r could not be the equilibrium land rent under imperfect labor market. In addition to the relative magnitudes of the land rents, we have the following result about the shapes of the distributions.

Lemma 3. Compared with $g_c(.)$, $g_r(.)$ is skewed toward the higher end of the distribution.

Figure 2 shows an example in which $g_c(.)$ is a normal distribution with a standard deviation of 5, and $g_r(.)$ is a mirror image of a gamma distribution with a mean of 20 and standard deviation of $10\sqrt{2}$. Compared with $g_c(.)$, $g_r(.)$ is skewed toward and relatively

concentrated on the higher end of the distribution. In essence, the lemma says that the marginal land productivity of a more productive farmer is not likely to be increased, or increased less by rationing than that of a less productive farmer. To arrive at this conclusion, we rearrange the conclusion in Lemma 2 to get $L_a^c(e\Phi) - L_a^c(e) > L_a^r(e\Phi) - L_a^r(e)$, so

$$f_T[T_0, L_a^c(e')] - f_T[T_0, L_a^c(e)] > f_T[T_0, L_a^r(e')] - f_T[T_0, L_a^r(e)]. \quad [16]$$

As $e\Phi$ is greater than e, the following is an immediate consequence of the above inequality

$$e' f_T[T_0, L_a^c(e')] - e f_T[T_0, L_a^c(e)] > e' f_T[T_0, L_a^r(e')] - e f_T[T_0, L_a^r(e)]. \quad [17]$$

Therefore, we have

$$F_{T0}[T_0, L_a^r(e)] - F_{T0}[T_0, L_a^c(e)] > F_{T0}[T_0, L_a^r(e')] - F_{T0}[T_0, L_a^c(e)], \quad [18]$$

which is the result we want to prove.[2]

The skewness of $g_r(.)$ toward the higher end of the distribution possesses a potentially important implication for land market participation under the imperfect labor market. Depending on the degree of skewness and concentration of $g_r(.)$, the number of farmers participating in the land market will be smaller under an imperfect than under a perfect labor market. Take for example the case shown in Figure 2. Suppose that the transaction costs $c(M)$ is unit. Under a perfect labor market, the land rent is the mean of $g_c(.)$ because of the symmetric property of the normal distribution. So the percentage of farmers participating in the land market is $\Phi(-1/5) = 42\%$. Under an imperfect labor market, the percentage of participating farmers can be determined by the equilibrium condition [14] in which $G_r(.)$ now is the cumulative distribution function of the gamma distribution. It is about 39%, less than the percentage under the perfect labor market. However, the validity of this result depends on our assumptions about the two distributions. For example, if the

standard deviation of $g_c(.)$ were not 5, but 2, the percentage of participating farmers would be the same for the two cases. General conditions under which the result in the example holds are not likely to be obtained analytically unless we make strong assumptions about the farmers' technology and the distribution of their total productivity. Here we express the result as a conjecture, and will test it empirically in the next section.

Conjecture. The percentage of farmers participating in the land lease market is higher under the perfect labor market than under the imperfect labor market.

The intuition behind the conjecture is as follows. When the labor market is rationed, farmers are forced to put more labor into agricultural production, raising their marginal land products. To clear the land market, the equilibrium land rent has to increase to accommodate the higher values of land attached to by individual farmers. However, individual marginal land productivity is not raised in a uniform fashion. A farmer who is more productive in agriculture puts a smaller value on the restriction in industrial employment, so his marginal land productivity is raised less or not raised at all. The heterogeneous movement of the marginal land products causes their distribution to skew and concentrate to the higher end. As the new equilibrium land rent ought to be close to the mode of the distribution (as does the land rent under the competitive distribution), the number of farmers falling in autarky (that is, falling in the range of the rent minus $c(M)$ and the rent plus $c(M)$) ought to be increased. The key element here is the productive heterogeneity among the farmers. Without this heterogeneity, the new distribution would be only a parallel move of the old distribution to the right. Although the land rent would still be raised, the number of farmers falling in autarky would remain the same.

The above results make a dichotomous distinction between perfect and imperfect labor markets. They still hold when we consider gradual changes of the competitiveness of the labor market, as we can conduct the comparison consecutively for any two adjacent states. A freer labor market means either that more people are allowed to choose their industrial employment freely according to price signals, or that the rations allotted to some or all households are raised. In either case, the shadow wages for individual households are raised.

III. EMPIRICAL TESTS

In this section, we will empirically test the hypothesis that a more heterogeneous population and a freer labor market promote the deepening of the land lease market in rural China. The test uses a two period panel data set collected in three counties in China's Zhejiang province. In the test, we define land market participation as a dichotomous decision of either participating or not participating and will employ the logit model to capture this decision. The logit model will be first estimated by pooling the two period data together. Then, the panel method proposed by Chamberlain (1980) will be used to re-estimate the model to get more robust results.

The Econometric Model and Data

The logit model for land market participation is

$$p_{it} = X_{it}\gamma_1 + X_{jt}\gamma_2 + u_i + u_j + u_{it}\,. \qquad [19]$$

In the equation, p_{it} is a dichotomous variable indicating the *i*th farmer's decision of participating the land lease market in period *t*, with p_{it} = 1 standing for participation, and

$p_{it} = 0$ standing for no participation. X_{it} is a set of family variables describing the ith family's total factor productivity e_i and its initial land endowment. X_{jt} is a set of village variables that describe the freedom of land transaction and the competitiveness of the labor market in the jth village where the ith family resides; and γ_1 and γ_2 are two sets of parameters to be estimated. In terms of our theory, the family variables account for a family's position on the distribution of the marginal productivity of land; the village variables characterize the land rent and the size of the autarky region in the village (we do not have data on land rents). Finally, u_i and u_j are, respectively, a household specific effect and a village specific effect that are not observed by the researcher, and u_{it} is an i.i.d. random variable that has a mean of zero and is mean-independent of the regressors. If one wants to model u_i and u_j as fixed effects, applying the ordinary logit or probit model to estimate equation [19] will generate inconsistent estimates for the γ's in a short panel (Hsiao 1986). Chamberlain (1980) proposes a conditional logit approach to estimate such a model. By this approach, only the cases with $p_{i1} + p_{i2} = 1$, that is, those households whose statuses of land market participation were changed over the two periods, are of interests. Let $w_i = 1$ if $(p_{i1}, p_{i2}) = (0, 1)$, and $w_i = 0$ if $(p_{i1}, p_{i2}) = (1, 0)$. Then, the log-likelihood function conditioned on $p_{i1} + p_{i2} = 1$ is

$$L = \sum_{i \in I_1} \{ w_i \ln F[(Z_{ij2} - Z_{ij1})\gamma] + (1 - w_i) \ln F[-(Z_{ij2} - Z_{ij1})\gamma], \qquad [20]$$

where $I_1 = \{i | \, p_{i1} + p_{i2} = 1\}$, $Z_{ijt} = (X_{it}, X_{jt})$, $\gamma = (\gamma_1, \gamma_2)$, and $F(.)$ is the cumulative distribution function of the logit distribution.

The data we are going to use come from two household and village surveys conducted in 1988 and 1993 in Shaoxin, Ning, and Yueqin counties of Zhejiang province in China. Zhejiang, located on the southeast coast of China, is a relatively developed province. Its

rural economy is characterized by the mixture of local industry and small-scale farming. As shown in the first row of Table 1, the average farm size per household in the three counties was only between 0.12 to 0.2 hectares in 1988 and 1993, far below the national average of about half a hectare. Partly because of the tight land endowment, Zhejiang was among the few provinces that started rural industry in the 1970's. Up to 1993, local industry hired more than two thirds of the total labor force in all the three counties (row 2, Table 1). The performance of the land lease market, however, was quite different among the three counties. In Yueqin county, the participation rates were over 60% in both 1988 and 1993, while the highest rate for the other two counties in both years was only 31%. As our theory has suggested, the performance of the land market is linked to the openness of the labor market. We have listed in Table 1 two indicators that may describe the situation of the labor market in a village. They are the percentage of outside workers working in the village and that of private firms in the total number of firms. The first indicator directly measures the tightness of the local labor market. It is conceivable that a firm would first look for workers in the village before it begins to hire people from outside (Wang and Yao, 1996). The fact that there are outside workers working in a village shows that the local labor supply begins to be exhausted and the labor market becomes more competitive. The second indicator reflects the different incentive structures underlying the decision-making of firms with different types of ownership. From 1988 to 1993, the rate of land market participation had increased in Shaoxin and Ning counties, but decreased in Yueqin county. The increases of the rate in Shaoxin and Ning were accompanied by the increases of outside workers and private firms in those two counties. In Yueqin, although the participation rates were negatively correlated with

the two indicators over the two years, they were much larger than those in the other two counties. While Yueqin did not have more outside workers, it had overwhelmingly more private firms than the other two counties, showing that the correlation between the number of private firms and the rate of land market participation was strong. Shaoxin and Ning counties are located close to the affluent Yangtze delta where rural industry was early developed in the form of collective ownership. In contrast, Yueqin is located in the south part of Zhejiang province where there has been a tradition of private commerce and light industry. As Yao (forthcoming) shows by using the data of 1993, industrial job entry is characterized by time rationing in Ning county. One of the consequences of time rationing is the creation of many part-time farmers who work involuntarily for more hours in agriculture, so the land values are concentrated on the higher end of the distribution, reducing the potential for trade. In contrast, time rationing is not likely to be taken by a private firm even if rationing is necessary because time rationing renders the firm more administrative and training costs. The strong correlation between the percentage of private firms and the land market participation rate may well show that more private firms do indicate a freer labor market. In what follows, we will explore the causality between the participation rate and the two labor market indicators by estimating the logit model presented in [19].

Estimations

The family variables used in equation [19] are the absolute values of the differences between household average age, average formal schooling years, and land endowment/labor endowment ratio and their corresponding village averages. Subsequently, these three variables will be denoted by DAGE, DEDU, and DLAND_LABOR, respectively. The individual-village differences instead of the individual values themselves are used because they represent the degree of household heterogeneity in a village. The first two variables control for household heterogeneity in the efficiency of rice production and specific human capital for industrial employment. We do not have further information to separate these two kinds of heterogeneity. While average schooling years capture a household's human capital potential, average age captures the experience a household has accumulated. Land/labor endowment controls for household heterogeneity in initial land endowment. Since it is those households on the two ends of the distribution that are more likely to participate in the land market, we expect that the three variables will have positive effects on a household's probability of participating in the land market.

Unlike the work of Skoufias (1995) and Carter, Fletchner and Olinto (1996), both of whom employ an unobserved endogenous switch model to infer transaction costs, we parameterize them in an explicit way by considering only the costs associated with the local government's interventions of the land markets. Liu, Carter and Yao (1998), using 1993 data, discuss in detail how those restrictions were correlated with the local factor endowments and the stake the central government held in local agricultural production. Using both 1988 and 1993 data, Carter and Yao (1999) analyze the allocative

implications of these interventions. In their analysis, Liu, Carter and Yao (1998) extract an index indicating the freedom of land transactions by the principle component method of factor analysis from the village cadre's answers to three questions about the village's restrictions on the transfer of land use rights, land leasing, and land entrusting. We adopt the same approach to form an index for M_j in our theory and will denote it by MKT_FREEDOM from now on. As $c(M_j)$ defines the size of the autarky region, we expect that as the freedom of land transactions is increased, farmers in the village are more likely to participate in the land market. Besides the freedom of land transactions, the number of land adjustments made in the past also alter the size of the autarky region. These adjustments were almost always made in response to demographic changes in some or most of the households in the village, and might serve as a substitute for land transactions made through the market. In other words, more land adjustments in the past may reduce a farmer's probability of participating in the land market in the current year.

The two labor market indicators, the percentage of outside labor working in the village (OUTS_LABOR), and that of the number of private firms in the village (PRIV_FIRMS) enter the regression to capture the change of the distribution of the marginal productivity of land as well as to simulate the land rent in a village. In addition, four interaction terms between the two labor market indicators and DAGE and DEDU, labeled OUTS_DAGE, OUTS_DEDU, PRIV_DAGE, and PRIV_DEDU, respectively, are added to allow for the possibility that the effects of a freer labor market on the households at the two ends of the distribution are smaller than on the households in the middle of the distribution. This possibility exists because the households at the two ends are more likely to participate in the land market even when the labor market is restricted.

Finally, a year dummy (YEAR) is added to account for the difference between 1993 and 1988 with YEAR = 1 indicating 1993.

One problem with the village variables is that they may be endogenously determined rather than deterministically given. For example, Liu, Carter and Yao (1998) show that the institutional arrangements at the village level are endogenously determined by the interaction of the state, village cadre, and farm households whose stakes in the arrangements were functions of the village characteristics. Therefore, the two institutional variables we use in the regression, the freedom of land transactions and the number of land adjustments, may well be correlated with the village specific effect u_j. In addition, the other two variables describing the local labor market may also be endogenous and correlated with u_j. Therefore, an ordinary logit model will provide inconsistent estimates. However, the endogeneity can be taken care of by the conditional logit approach that takes the difference between the two periods. Therefore, we expect that the conditional logit will perform better than the ordinary logit.

Table 2 shows two sets of results for estimation of equation [19]. The first column of the table lists the results of an ordinary logit model estimated by simply pooling the two period data. There are 428 cases in the pooled dataset, with 128 households, or 30%, participating in the land lease market. The second column reports the results of the conditional logit model. Since only the households whose statuses of land market participation changed over the two periods are relevant in this model, the number of cases is reduced to 49, with 30 of them changing from not participating to participating, and the rest doing the opposite.

In the pooled logit model, the signs of the coefficients of DAGE and DLAND_LABOR conform with our expectation while that of DEDU shows the opposite. In addition, the coefficient of DAGE is highly significant. The coefficients of the two labor market indicators, OUTS_LABOR and PRIV_FIRMS, are both significantly positive, consistent with the prediction of our theory. In addition, the two interaction terms associated with OUTS_LABOR, although not significant, have the expected negative sign. That is, the effect of a freer labor market as revealed by more outside workers in the village is indeed weaker for the households at the tails of the distribution of land values. In contrast, only one of the interaction terms associated with PRIV_FIRMS, i.e., PRIV_AGE, has the expected negative (but insignificant) sign, and the other is shown to be significantly positive. In addition, the freedom of land transactions is shown to be insignificant, if not negative. Lastly, contrary to expectation, the number of past adjustments (NUM_ADJ) is shown to have a significantly positive impact on a household's probability of participation; in addition, the freedom of land transactions (MKT_FREEDOM) is shown to be insignificant, if not negative.

In the conditional logit model, the effect of past land adjustments is no longer significant (albeit still positive) and the sign of market freedom turns positive (not significant). The results concerning the openness of the labor market have not changed qualitatively. That is, a freer labor market as revealed by more outside workers and more private firms increase a household's probability of participating in the land lease market. Because of the smaller sample size, the significance of the two estimates is lower compared with the pooled logit model. For the same reason, the tail effects (revealed by the four interaction terms) are even weaker. As for the household variables, the

coefficient of DAGE is still significantly positive, but the signs of DEDU and DLAND_LABOR have changed. Now, DEDU is shown to have a positive effect, and DLAND_LABOR is shown to have a negative effect, but neither is significant. Another change happens with the year dummy that turns from insignificantly negative in the pooled logit model to significantly negative in the conditional logit model. An implication of both the pooled logit and conditional logit models is that average age is a better indicator than average schooling years in defining household heterogeneity of human capital, an assessment that is shown by their coefficients and those of the interaction terms. Average age directly captures the experience a household has accumulated. In contrast, formal schooling years only measure the human capital potential of a household. Elementary or junior high school education obtained by most of the people in our sample are not human capital themselves as they do not provide specific technical skills for any type of job. Rather, they provide people with the ability to obtain skills. Therefore, the effect of DEDU is mixed in our results.

The effects of a freer labor market as revealed by the percentages of outside labor and private firms are shown graphically in Figure 3 and 4 based on the results of the conditional logit model. Two sets of curves are drawn in each of the figures. One is the average probability of land market participation and its two point moving average polynomial trendline when the labor market is reasonably open when both OUTS_LABOR and PRIV_FIRMS are equal to 15% (their averages are 21% and 37%, respectively); the other is the curves when the labor market is most restricted as characterized by OUTS_LABOR = 0 and PRIV_FIRMS = 0. The curves are drawn against average ages in Figure 3 and against average schooling years in Figure 4. As both

figures have shown, the trendline for a reasonable labor market in both figures is almost flat, not varying across age and schooling years, but the trendline for the most restrictive labor market has the U shape with the bottoms being at the middle of ages and schooling years. This contrast reflects perfectly our verbal discussion of the results, that is, the effects of a freer labor market are stronger for the households in the middle of the efficiency distribution, and weaker for those at the two tails of the distribution.

IV. CONCLUSION

Our results are pertinent to the current debate on China's land policy. Nearly twenty years after the first land tenure reform, China now is at the crossroad of another round of reforms. The key question is whether the current small family farming system is supportive of a viable agricultural sector. Tenure reform has created numerous small farms that many people regard as either inefficient or unsustainable as an independent production unit. In semi-industrialized regions like the one this paper studies, it is common to observe that agricultural income only consists of a minimal percentage of a household's total income, yet only a few households have given up farming. This phenomenon is often taken as the evidence showing the inefficiency of the land lease market. By linking the inactiveness of the land lease market and the imperfections of the labor market, this paper suggests that explanations are to be found in the imperfections of other related factor markets. In terms of the next step reforms, our results suggest that market reforms in other factor markets are as important as further tenure reforms in bringing about an active and efficient land lease market.

Our results also have implications for the institutional change literature. The finding that individual heterogeneity matters to the development of an institution suggests that more attention be paid to the interaction of the actors carrying out the institutional change. The major problem of the induced institutional change hypothesis comes from the application of price theory in a partial equilibrium setting where every agent takes prices as given; what is missing is the feedback effect arising from general equilibrium considerations. This paper is an attempt to put the development of the land lease market into a general equilibrium framework and study the implications of such an exercise. Further work can be done to study general institutional changes in general equilibrium or game theoretical framework.

REFERENCES

Akerlof, G. and J. Yellen. 1986. Efficiency Wage Models of the Labor Market. New York: Cambridge University Press.

Binswanger, H. and K. Deininger. 1995. "World Bank Land Policy: Evolution and Current Challenges." In Agriculture in Liberalizing Economies: Changing Roles for Governments: Proceedings of the Fourteenth Agricultural Sector Symposium, ed. D. Umali-Deininger and C. Maguire. Washington: The World Bank.

Carter, M. and F. Zimmerman. 1994. "The Microeconomics of Induced Institutional Innovation." Mimeo. Department of Agricultural and Applied Economics, University of Wisconsin-Madison.

Carter, M., D. Fletchner, and P. Olinto. 1996. "Does Land Titling Activate a Productivity-Promoting Land Market? Econometric Evidence from Rural Paraguay." Mimeo. Department of Agricultural and Applied Economics, University of Wisconsin-Madison.

Carter, M. and Y. Yao. 1999. "Specialization without Regret: Transfer Rights, Agricultural Productivity and Investment in an Industrializing Economy." Mimeo. Department of Agricultural and Applied Economics, University of Wisconsin-Madison.

Chamberlain, G. 1980. "Analysis of Covariance with Qualitative Data." Review of Economic Studies, XLVII: 225-238.

Feder, G., L. Lau, J. Lin, and X. Luo. 1992. "The Determinants of Farm Investment and Residential Construction in Post-reform China." Economic Development and Cultural Change, 41(1): 1-26.

Hayami, Y. and M. Kikuchi. 1981. Asian Village Economy at the Crossroads: An Economic Approach to Institutional Change. Baltimore: Johns Hopkins University Press.

Hayami, Y. and V. W. Ruttan. 1985. Agricultural Development: An International Perspective. Baltimore: Johns Hopkins University Press.

Hayami, Y. 1997. Development Economics: From the Poverty to the Wealth of Nations. Oxford: Clarendon Press.

Hsiao, C. 1986. Analysis of Panel Data. New York: Cambridge University Press.

Jaynes, G. 1982. “Production and Distribution in Agrarian Economies.” Oxford Economic Papers, 34: 346-67.

Lin, J. 1995. " Endowments, Technology, and Factor Markets - A Natural Experiment of Induced Institutional Innovation from China Rural Reform." American Journal of Agricultural Economics, 77(2): 231-242.

Liu, S., M. Carter, and Y. Yao. 1998. “Dimensions and Diversity of Property Rights in Rural China: Dilemmas on the Road to Future Reform.” World Development, 26(10): 1789-1806.

Lu, G. 1998. "A Study on the Scale Economy of Rice Production in Southern China." Master thesis, Guanghua School of Management, Beijing University.

North, D. and R. Thomas (1973). The Rise of the Western World. London: Cambridge University Press.

Pant, C. 1983. “Tenancy and Family Resources: A Model and Some Empirical Analysis.” Journal of Development Economics, 12(1-2): 27-39.

Skoufias, E. 1995. "Household Resources, Transaction Costs, and Adjustment through Land Tenancy." Land Economics, 71(1): 42-56.

Shapiro, C., and J. Stiglitz. 1984. "Equilibrium Unemployment as a Worker Discipline Device." American Economic Review, 74: 433-444.

The Statistical Bureau of China. 1994. China Statistical Yearbook. Beijing: China Statistical Publishing House.

Turner, M., L. Brandt and S. Rozelle. 1998. "Property Rights Formation and the Organization of Exchange and Production in Rural China." Mimeo. Department of Economics, University of Toronto.

Wang, X., J. Zhang, M. Yao. 1996. Zhongguo Cunzhuang de Jinji Zengzhang yu Shehui Zhuanxing (Economic Growth and Social Transformation in the Chinese Village), Tayuan: Shanxi Jinji Press.

Yang, D. 1994. "Knowledge Spillovers and Labor Assignments of the Farm Household." Ph.D. Diss., University of Chicago.

Yao, Y. forthcoming. "Rural Industry and Labor Market Integration in Eastern China." Journal of Development Economics.

Zhao, Y. 1997. " Labor Migration and Returns to Rural Education in China." American Journal of Agricultural Economics, 79(4): 1278-1287.

FOOTNOTES

[1] When substitution instead of complementarity is assumed, the result is just symmetric. This symmetry will carry over to the other major results we are about to obtain.

[2] If land and labor are substitutes instead of complements, the distribution of land value will skew toward the lower end of the distribution. But the skewness is the only requirement to reach our conjecture soon to be revealed.

TABLE 1

CHARACTERISTICS OF THE THREE COUNTIES

County	Shaoxin		Ning		Yueqin	
	1988	1993	1988	1993	1988	1993
Land/hh (mu)[a]	2.76	2.39	2.79	2.47	2.15	1.89
Perc. of Non-farm labor (%)	54.1	61.2	73.4	73.7	54.1	65.5
Perc. of outside labor in village (%)	21.9	46.4	7.2	13.6	9.87	26.8
Perc. of private firms (%)	0.0	8.0	6.0	35.0	89.0	100.0
Land market participation rate (%)	1.0	8.0	5.0	31.0	72.0	64.0

a. One mu = one fifteenth of a hectare.

TABLE 2

RESULTS OF THE LOGIT MODELS[a]

Variables	Model (1) (428 cases)	Model (2) (49 cases)
Constant	-3.24** (0.71)	
YEAR	-0.38 (0.36)	-1.93* (1.06)
DAGE	0.15** (0.07)	0.25* (0.14)
DEDUC	-0.75 (0.53)	0.48 (0.98)
DLAND_LABOR	0.04 (0.07)	-0.45 (0.40)
MKT_FREEDOM	-0.17 (0.16)	0.18 (0.35)
NUM_ADJ	0.47** (0.20)	1.41 (1.01)
OUTS_LABOR	0.03** (0.008)	0.11* (0.065)
OUTS_AGE	-1.83×10^{-3} (1.22×10^{-3})	-9.65×10^{-3} (6.63×10^{-3})
OUTS_EDUC	-2.80×10^{-3} (6.70×10^{-3})	5.64×10^{-2} (5.16×10^{-2})
PRIV_FIRMS	0.033** (0.007)	0.055* (0.031)
PRIV_AGE	-7.29×10^{-4} (9.29×10^{-4})	-6.34×10^{-4} (2.07×10^{-3})
PRIV_EDUC	1.28×10^{-2} ** (5.90×10^{-3})	1.69×10^{-2} (1.23×10^{-2})
Perc. of right prediction	85.0%	36.0%

a. Standard errors obtained by the inverse Hessian are reported in the parentheses.

* Significant at the 10% significance level. ** Significant at the 5% significance level.

FIGURE 1

AGRICULTURAL LABOR INPUT UNDER PERFECT AND IMPERFECT LABOR MARKETS

FIGURE 2

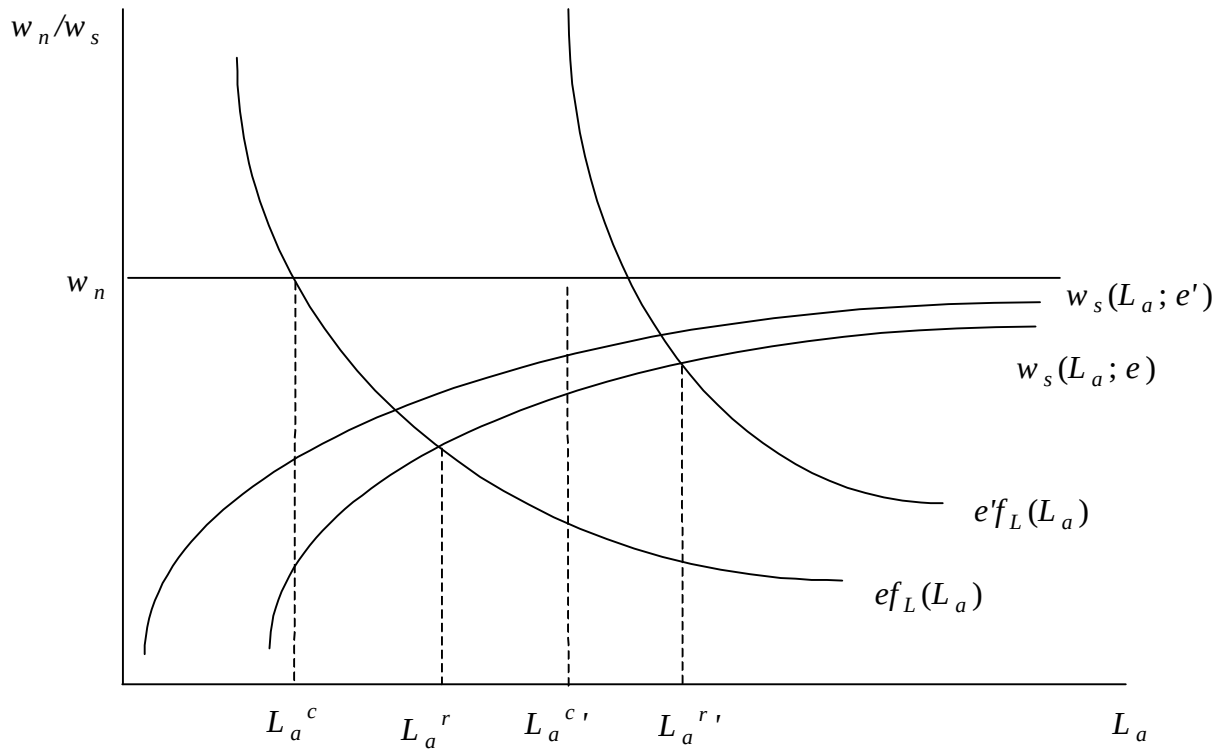
DISTRIBUTION OF THE MARGINAL PRODUCTIVITY OF LAND

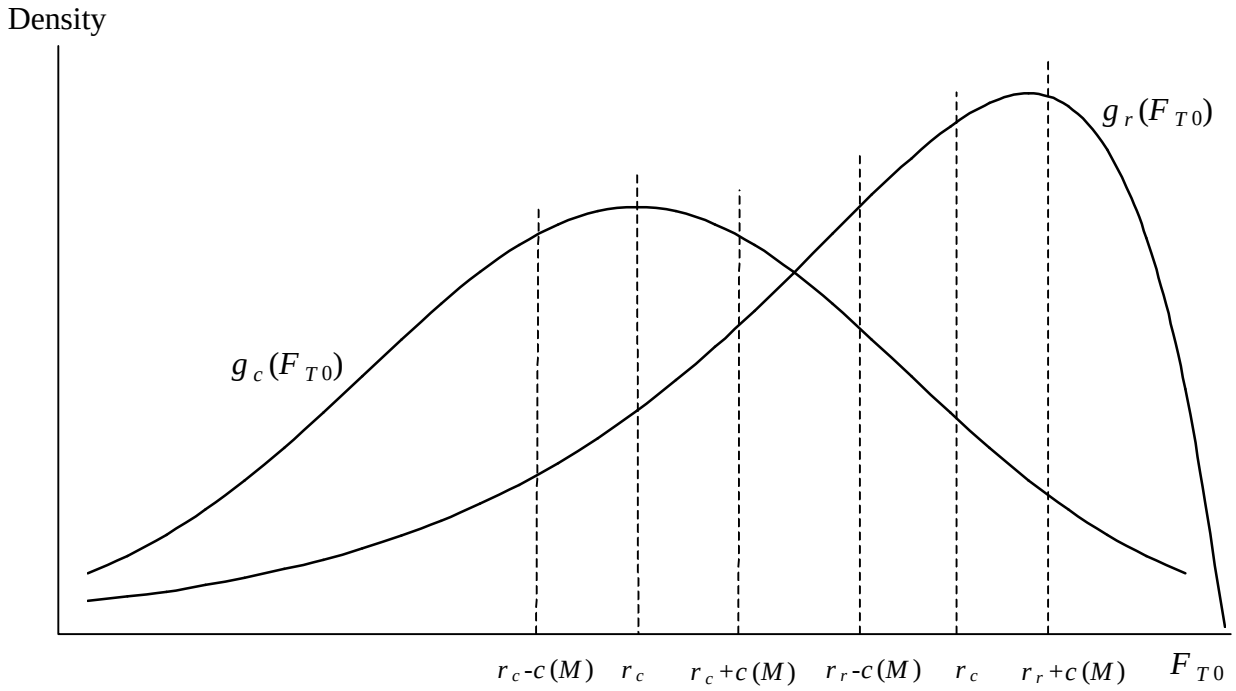
FIGURE 3

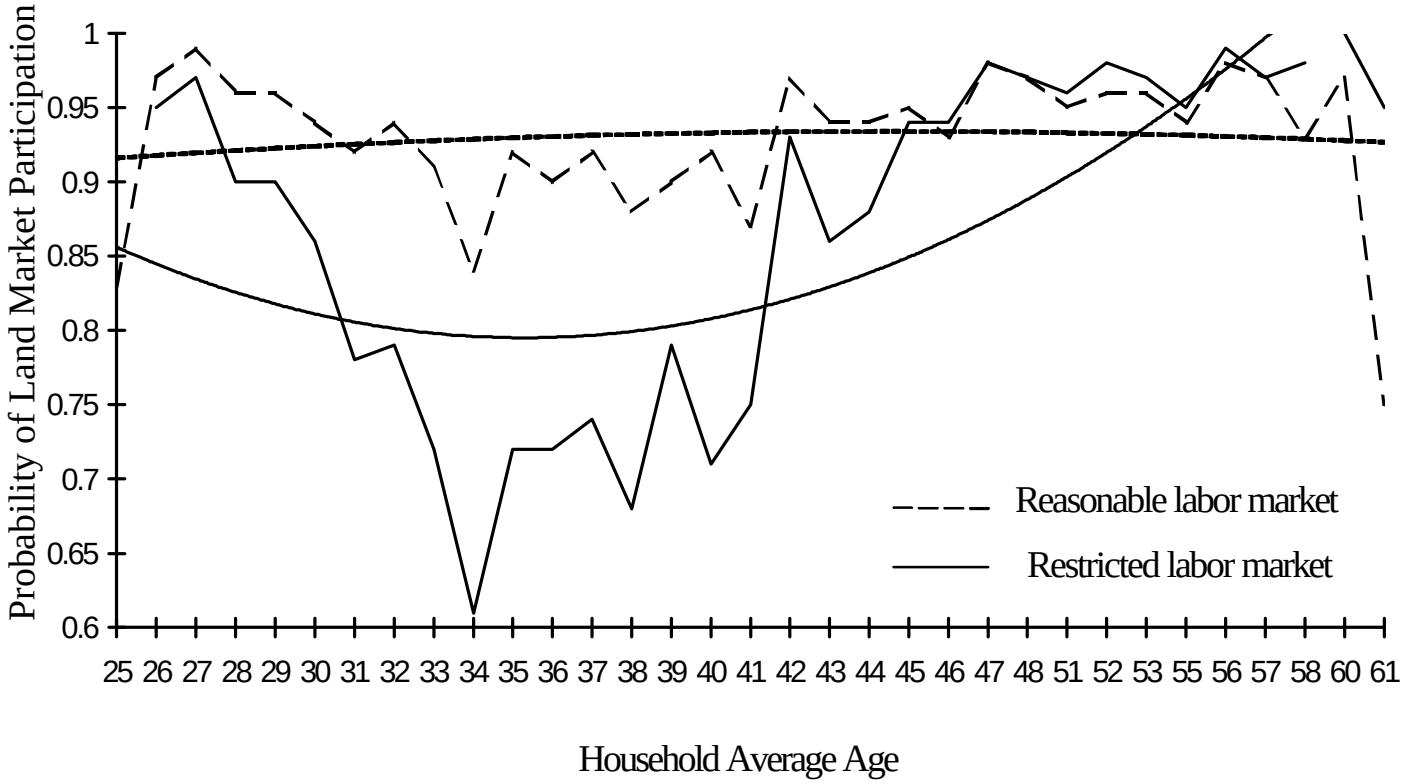
HOUSEHOLD AGE AND LAND MARKET PARTICIPATION

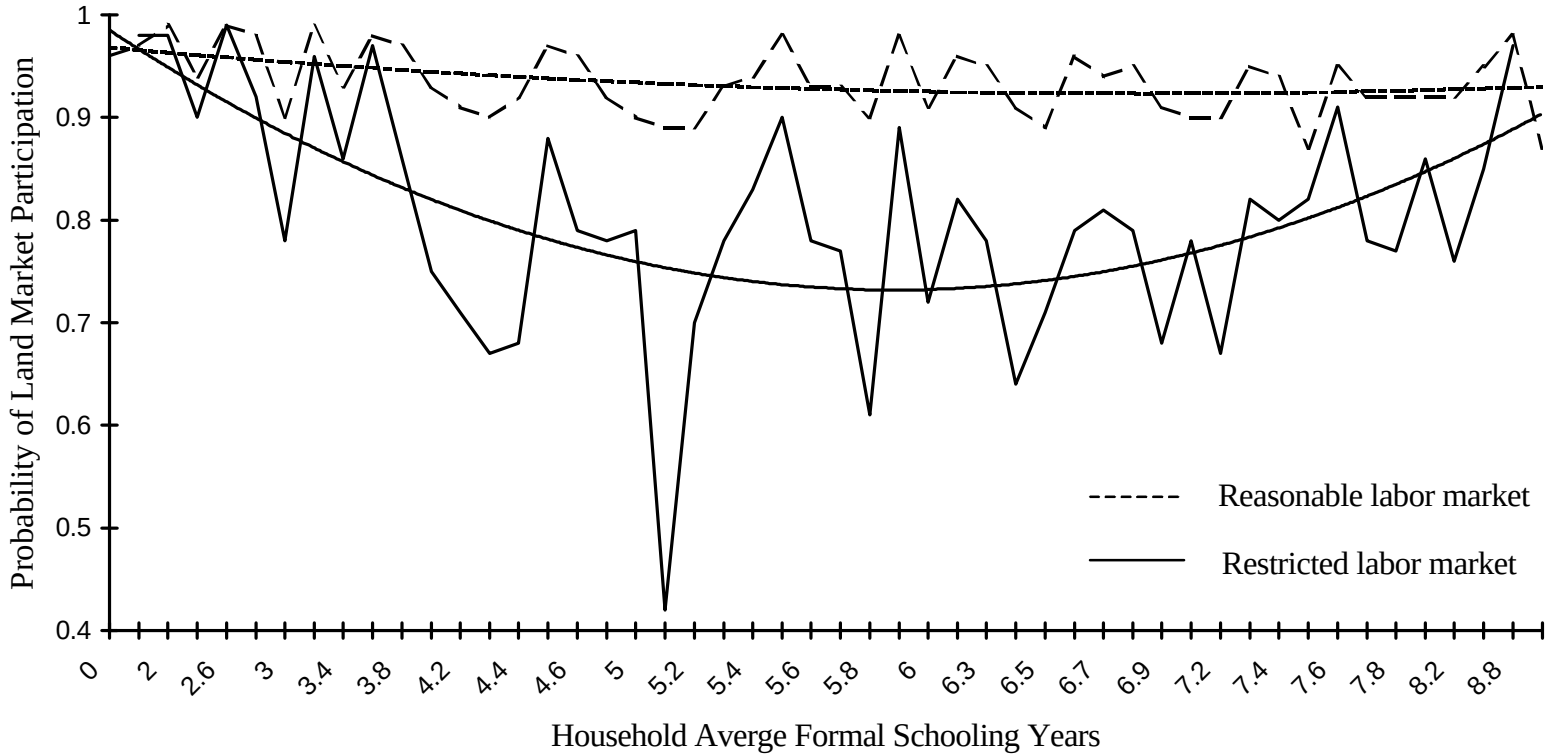
FIGURE 4

HOUSEHOLD EDUCATION AND LAND MARKET PARTICIPATION


w_n/w_s
w_n
$w_s(L_a; e')$
$w_s(L_a; e)$
$e'f_L(L_a)$
$ef_L(L_a)$
L_a^c
L_a^r
$L_a^{c'}$
$L_a^{r'}$
L_a


Density
$g_r(F_{T0})$
$g_c(F_{T0})$
r_c-$c(M)$
r_c
r_c+$c(M)$
r_r-$c(M)$
r_c
r_r+$c(M)$
F_{T0}


Probability of Land Market Participation
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 51 52 53 55 56 57 58 60 61
Household Average Age
Reasonable labor market
Restricted labor market


Probability of Land Market Participation
1
0.9
0.8
0.7
0.6
0.5
0.4
0
2
2.6
3
3.4
3.8
4.2
4.4
4.6
5
5.2
5.4
5.6
5.8
6
6.3
6.5
6.7
6.9
7.2
7.4
7.6
7.8
8.2
8.8
Household Averge Formal Schooling Years
Reasonable labor market
Restricted labor market