

Are farm households' land renting and migration decisions inter-related in rural China?

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Abstract

Economic reforms in rural China have stimulated the development of land and labour markets. The increasing importance of these two markets suggests that they might be closely inter-related, but proper statistical tests are lacking. This paper examines the factors that determine the participation of farm households in land renting and migration, and investigates whether participation in land renting and migration influence each other, using a seemingly unrelated bivariate probit regression. Data from a household survey held in 2000 in three villages in the north-east of the Jiangxi Province were used to estimate the land renting and migration equations. Household characteristics, fixed factors, household land and labour endowments, institutional factors, and land and labour prices were used as explanatory variables in both equations. We found that the error terms of the land renting equation and the migration equation were strongly correlated, confirming that there is a negative relationship between land renting and migration.

Additional keywords: bivariate probit model, household model, market imperfection, seemingly unrelated regression

Introduction

The development of land rental markets plays an important role in improving agricultural productivity and rural household incomes (Faruqee & Carey, 1997; Carter & Olinto, 1998; Deininger & Feder, 2001; Carter & Yao, 1999, 2002; Deininger, 2003; Deininger & Zegarra, 2003; Deininger *et al.*, 2003; Deininger & Jin, 2005; Yao, 2007). It does so through several mechanisms. First, a land rental market allows the marginal product of land to be equalized across households with different land-labour endowments and thus increases allocative efficiency. Second, a land rental market

allows households that have a comparative advantage in agricultural production or off-farm employment to specialize, and hence boosts both farm and off-farm incomes. Third, a land rental market increases households' investment incentives because households can reap the benefits through higher rental prices if they choose to participate in off-farm employment in the future.

The development of off-farm employment also plays an important role in improving agricultural productivity and rural household incomes (Rozelle *et al.*, 1999a; Reardon *et al.*, 2001; Taylor *et al.*, 2003; Anon., 2005a; Wouterse, 2006). First, off-farm employment can absorb surplus labour from agriculture. Households remaining in agriculture can consolidate farmland, extend farming operations and specialize in (labour-intensive and high-value) agricultural production and hence increase both land and labour productivity. Second, off-farm employment can supplement rural household incomes and reduce poverty, thereby increasing households' investment in agricultural inputs and human capital development, especially for those households with credit or liquidity constraints. Third, off-farm employment can diversify rural household incomes and reduce the income risks of households.

The emergence of land and labour markets in China is the result of economic reforms. In the past, off-farm employment was constrained by the household registration system (*hukou*) and collective farming. Since the mid-1980s, however, it has become a significant phenomenon in rural China. By 2000, more than 200 million rural labourers worked off-farm (De Brauw *et al.*, 2002; Zhang *et al.*, 2002). Whereas the land rental market was thin in the past, surveys of 215 villages in eight provinces in 1995 showed that less than 3% of total land was rented (Brandt *et al.*, 2002; 2004), recent studies show an increasing incidence of land rental activities (Lohmar *et al.*, 2001; Kung, 2002; Deininger & Jin, 2005). The fact that both land rental market participation and off-farm employment have been rising in recent years suggests that these two markets might be closely inter-related.

Many studies have analysed labour migration decisions in rural China, either at the individual level (Zhao, 1997; 1999a; 2002; 2003; Kung & Lee, 2001; Li & Yao, 2002; Zhang *et al.*, 2002; Shi *et al.*, 2007) or at the farm household level (Lohmar, 1999; Rozelle *et al.*, 1999a; Zhao, 1999b; Taylor *et al.*, 2003). However, the effect of land rental market participation on migration decisions has only been examined by Kung & Lee (2001) and Shi *et al.* (2007). They found that the development of land rental markets encouraged off-farm employment, with the land market participation decision being exogenously determined in their studies.

Whereas the development of land rental markets has recently attracted attention, empirical analyses of the factors determining land market participation in rural China are still rare (Yao, 2000; Lohmar *et al.*, 2001; Kung, 2002; Feng *et al.*, 2004; Zhang *et al.*, 2004; Deininger & Jin, 2005). All of these studies included the effect of off-farm employment, especially migration, on land rental market participation decisions. However, only a few of these studies considered the endogenous character of off-farm employment decisions (Yao, 2000; Kung, 2002). They all found that off-farm employment had a positive effect on households' land rental market participation decisions.

However, the estimation of the inter-relationship of land and labour market

participation will be biased if household decisions on land and labour market participation are jointly determined. Therefore, the effect (if any) that household decisions on land rental market participation and off-farm employment have on each other remains an unresolved issue. This paper analyses the factors determining households' decisions on land renting and migration, and examines empirically whether farm households' land renting and migration decisions influence each other. The insights obtained from this study can provide an important input into the design of appropriate policies to improve the functioning of land and labour markets.

The remainder of this paper is organized as follows. The next chapter gives a brief description of the study area and data, followed by a description of the recent trends in land rental market development and off-farm employment in Jiangxi Province. Thereafter the model specification is discussed and the results are presented of a seemingly unrelated bivariate probit regression explaining household land renting and migration decisions. The paper ends with conclusions and policy implications, presented in the last chapter.

Research area and data description

This paper uses data from a farm household survey that was held in three villages in the north-east of the Jiangxi Province, located in the south-east of China. Agriculture plays an important role in the economy of this province. In 2004, 20.4% of its GDP was derived from agriculture, 5.2% more than the average for the whole country. Its GDP per capita was 77% of the national average (Anon., 2005b).

The villages were selected using a series of criteria including economic development level, market access and geographical conditions. Local researchers and policy makers were consulted and several site visits were made as part of this process. The three villages are considered representative of the diversity of rural conditions that can be found in the north-east of the Jiangxi Province and in the much larger hilly area of south-east China with rice-based production systems (Kuiper *et al.*, 2001). The three villages selected were Banqiao in Yujiang County, Shangzhu in Guixi City and Gangyan in Yanshan County. Banqiao is the smallest village, and is located in a hilly area. Market access is good, with a major city located within 10 km. Shangzhu is a middle-sized village located in a mountainous area. The transport infrastructure is bad. It takes about two hours by car from the county capital to the hamlet where the village offices are located. Gangyan is the most populous village. It is located in a flat area, 20 km away from a major market. Road conditions are good.

The farm household survey was carried out in 2000 and the beginning of 2001. The questions in the survey referred to the entire year of 2000. In each village, 23% of the households were interviewed. A stratified random sample was used for selecting the households, with the hamlets within each village forming the strata (Kuiper *et al.*, 2001). A total of 329 farm households were interviewed, 54 in Banqiao, 108 in Shangzhu and 167 in Gangyan. The information collected included demographic characteristics, assets, land tenure, and participation in factor markets.

Participation in land and labour markets in the north-east of the Jiangxi Province

Land rental market

Since the introduction of the household responsibility system (HRS) at the end of the 1970s, land use rights have been assigned to farm households on the basis of family size, labour force, or a combination of both. Land transfers were initially not allowed, because policy makers believed that land transfers would lead to a concentration of land with a few households, leaving most households landless. Instead, frequent administrative reallocations of land by village leaders have been used to correct for changes in the land-labour ratios of households caused by demographic changes. However, administrative reallocations are normally slow, involve high transaction costs, and are possibly subject to bureaucratic inefficiencies and rent-seeking behaviour (Johnson, 1995). Owing to the absence of a rural social security system, rural households in China consider land as a form of social insurance. When households become involved in off-farm employment, they do not usually give up their land, giving them the option of returning to farming in case of losing their off-farm jobs. Administrative reallocation cannot replace land market transfers in solving these problems.

Since the mid-1980s, however, the authorities have permitted land rentals. An overview of land rental market participation in the three surveyed villages, sub-divided into irrigated land and dryland, is presented in Table 1. Renting forestland is negligible and therefore not considered in our analysis. Land rental activities are mostly limited to irrigated land. Of all the households in the three villages, 46% rented irrigated land, whereas only 6% rented dryland. In Banqiao village, the village with a relative large area of dryland, 20% of the households rented additional dryland.

There were large differences between the proportion of households that rented land and the proportion of households that leased land, especially for irrigated land. Of all the households in the sample, 46% rented additional irrigated land, whereas only 8% leased

Table 1. Land rental markets for irrigated land (I) and dryland (D) in three villages in 2000.

Village	No. of farm households	Households involved in:									
		Renting		Self-sufficient		Leasing		Renting & leasing		Total	
		I	D	I	D	I	D	I	D	I	D
----- (%) -----											
Banqiao	54	54	20	35	76	11	2	0	2	100	100
Shangzhu	108	48	3	46	96	6	1	0	0	100	100
Gangyan	167	41	4	48	93	8	2	2	0	100	100
Average		46	6	45	91	8	2	1	0	100	100

irrigated land. One reason for this large discrepancy may be that those farm households that leased their land did so to more than one household at the same time. But part of the discrepancy may also have been caused by the fact that some farm households that leased their land had migrated, but still retained their land use rights, and could not be interviewed during the survey. In addition, some farm households may not have reported leasing for fear of losing their land in the next round of land reallocations.

A few farm households rented and leased land at the same time. Of all the farm households in the three villages, only one rented and leased dryland, whereas four farm households rented and leased irrigated land simultaneously.

Labour market

Off-farm employment

China's population recently reached 1.3 billion, with about 60% still living in rural areas. The average size of landholdings is only around 0.52 ha per family (Anon., 2005b), which normally cannot fully employ a family's labour force. Since the early 1980s, an off-farm economy consisting of jobs in township and village enterprises (TVEs) in urban centres and more recently private enterprises has emerged and has accelerated its growth since 1995 (De Brauw *et al.*, 2002).

Local off-farm employment and migration are the two basic off-farm employment categories. Migrants are family members working off-farm and not living together with other household members. Households categorized as involved in migration have at least one family member working as a migrant. Those classified as involved in local off-farm employment have no household members who are involved in off-farm employment working as migrants. Their impact on household incomes and the village economy may differ substantially, because migrants live apart from other household members and spend a large share of their earnings outside the village. Local off-farm employment includes agricultural wage employment, non-agricultural wage employment, and self-employment. Participation in off-farm employment in the three villages in 2000 is presented in Table 2. Up to 82% of farm households in the three villages participated in off-farm employment in 2000. Migration was relatively more

Table 2. Type of off-farm employment in three villages in 2000.

Village	No. of farm households	Off-farm employment		
		Local	Migration	Total
		----- (%) -----		
Banqiao	54	27	43	70
Shangzu	108	21	52	73
Gangyan	167	19	73	92
Average		21	61	82

Table 3. Type of labour demand for rice production in three villages in 2000.

Village	No. of farm households	Households involved in:	
		Hired labour	Exchange labour
		----- (%) -----	
Banqiao	54	15	26
Shangzu	108	15	38
Gangyan	167	29	45
Average		22	40

important than local off-farm employment. Of all the households in the three villages, 21% participated in local off-farm employment and 61% in migration. This difference was mainly caused by the much higher participation in migration than in local off-farm employment in Gangyan village. As much as 73% of farm households participated in migration in Gangyan village, the village where per capita farmland resources are scarce while market access is good. The overall participation in off-farm employment is also much higher in this village (92%) than in the two other villages (70% and 73%) due to a relatively high migration rate.

Agricultural labour demand

In rural China, agricultural labour markets are found despite the surplus of rural labour. They provide mechanisms for labour-constrained farm households to deal with labour shortages, especially during peak agricultural seasons. A distinction can be made between agricultural wage labour and exchange labour. Exchange of labour mainly takes place among relatives and friends, and does not involve payment. Rural labour demand for rice production, the most important crop in the three villages, is shown in Table 3. Exchange labour was relatively important in these villages. Only 22% of the farm households hired additional labour, whereas 40% of the farm households used exchange labour in rice production. Both the hiring of agricultural labour and exchange of labour were highest in Gangyan village. In this village, migration was also the highest.

Household labour demand and supply

A summary of the labour market situation of households in the three villages is presented in Table 4. Hiring out labour through off-farm employment without hiring in agricultural labour occurred most often (63% of the farm households). Only 2% of the farm households hired additional labour for rice production without being involved in off-farm employment. Of the remaining households, 15% neither hired in nor hired out labour, whereas 19% of the farm households hired labour in and out in the same year. This latter finding provides support for the hypothesis that the optimal

Table 4. Distribution of labour market participation in three villages in 2000.

Village	No. of farm households	Type of labour participation				Total & hiring out
		Hiring in	Self-sufficient	Hiring out	Hiring in	
		----- (%) -----				
Banqiao	54	7	22	63	7	100
Shangzhu	108	3	24	61	12	100
Gangyan	167	1	7	64	28	100
Average		2	15	63	19	100

permanent labour force should normally be less than the peak labour demand and be greater than the slack labour demand (Binswanger & Rosenzweig, 1986). Gangyan village had the highest share of farm households that both hired in and out, and also had the lowest share of self-sufficient households. This is consistent with the relatively high incidence of migration and farm labour hiring in this village.

Model specification

As discussed in the foregoing, there were large differences between the proportion of households that rented land and the proportion of households that leased land: only 16 households leased land. Missing observations in the data set caused by migrated households may bias the estimation results. Based on personal observations in the research area, the data for households' land renting decisions are likely to be more precise than the data for land leasing decisions. So we confined our analysis to households' decisions on land renting. A dummy variable was therefore constructed for land renting. This variable equalled 1 if the household rented land and 0 otherwise. Off-farm employment included both local off-farm activities and migration. People involved in local off-farm employment live at home. They can combine local off-farm work with working on-farm due to the small size of landholdings and the seasonality of agricultural production, and are therefore less likely to participate in the land rental market. For that reason, we limited the analysis of participation in off-farm activities in our paper to migration. A dummy variable for migration was used, which equalled 1 if the household was involved in migration and 0 otherwise. Reduced-form equations derived from a theoretical model of rural household decision-making presented in Appendix 1 (Equations 16, 17 and 18) were used to specify the factors that potentially affect household decisions on land renting and migration. This gives the following model:

$$R = \alpha_0 + \alpha_1 Z^h + \alpha_2 Z^q + \alpha_3 \bar{L} + \alpha_4 \bar{A} + \alpha_5 w + \alpha_6 r + \alpha_7 Z + \varepsilon \quad (1)$$

$$M = \beta_0 + \beta_1 Z^h + \beta_2 Z^q + \beta_3 \bar{L} + \beta_4 \bar{A} + \beta_5 w + \beta_6 r + \beta_7 Z + \eta \quad (2)$$

where

- R = dummy variable for land renting (= 1 if the household rented land)
 M = dummy variable for migration (= 1 if there was at least one household member involved in migration)
 Z^h = a vector of household characteristics
 Z^q = a vector of fixed factors
 \bar{L} = household labour endowment
 \bar{A} = household land endowment (in mu; 1 mu = 1/15 ha)
 w = wage rate
 r = land rent
 Z = a vector of institutional factors affecting land renting and migration
 α, β = unknown coefficients
 ε, η = error terms with standard properties

It was expected that migration reduced land renting, because it reduces the amount of labour available for agricultural production (Yao, 2000; Lohmar *et al.*, 2001; Kung, 2002; Feng *et al.*, 2004; Zhang *et al.*, 2004). In the research area, land rental activities were mainly restricted to irrigated land. Therefore, the analysis of land rental activities was confined to irrigated land only. Similarly, land renting was expected to have a negative effect on migration, because renting land reduces the labour available for

Table 5. Descriptive statistics for variables used in the analysis (n = 278).

	Mean	SD	Minimum	Maximum
<i>Dependent variables</i>				
Renting land (1=yes)	0.47	0.50	0	1
Migration (1=yes)	0.59	0.49	0	1
<i>Independent variables</i>				
Household size (persons)	4.46	1.51	1	14
No. of dependants (persons)	1.27	1.11	0	4
No. of durable assets	6.39	1.84	1	11
No. of cattle	0.76	0.80	0	10
Age household head (years)	46.69	10.35	23	75
Age adults (years)	37.82	7.30	24.5	63
Education of household head (years)	4.80	2.78	0	13
Education adults (years)	4.35	1.66	0	10
Female–male adults ratio	1.02	0.57	0	4
Irrigated land per adult (mu)	1.94	0.93	0.25	9
Possession land contract (1=yes)	0.28	0.45	0	1
Land transfer rights	0.58	0.13	0	1
Social network (1=yes)	0.32	0.47	0	1
Banqiao dummy (1=yes)	0.17	0.38	0	1
Shangzhu dummy (1=yes)	0.33	0.47	0	1

migration (Rozelle *et al.*, 1999b; Kung & Lee, 2001; Kung, 2002; Shi *et al.*, 2007). Deleting the households with missing information on one or more variables from our sample and leaving out the (few) households that both rented and leased land, the total number of observations used in the analysis was 278. Descriptive statistics of both dependent and explanatory variables are presented in Table 5.

The selected household characteristics (Z^h) were household size, number of dependants in a household, ratio of female to male adults, and the number of durable assets. Number of dependants in a household was defined as the number of household members under 16 and over 66 years old, and durable assets included durable goods such as televisions, fridges, radios and transportation vehicles. Household characteristics have a direct effect on consumption preferences, and may have either positive or negative effects on the demand for leisure and consumption goods. It was expected that larger households and those with fewer dependants consume more food. If household decisions are non-separable, such households may increase agricultural production and therefore increase land renting and decrease migration.

Fixed factors (Z^f) were represented by the number of cattle in the household at the end of the previous year, the age of the household head (the average adult age), the education of the household head (the average adult education), and the ratio of female to male adults. Households that use cattle in agricultural production tend to rent more land and reduce migration, because with the draft power that they provide, they increase land and labour productivity. Renting land was expected to depend positively on the age and education of the household head, as households with an older and more educated head have more skills and experience and are more productive in agriculture. For the same reasons average adult age and education were expected to negatively influence migration. However, education can also play a role in getting access to the limited migration opportunities. Therefore, the impact of education on migration is ambiguous. The square of the age of the household head (the average adult age) was added to the equation to capture possible life-cycle effects. Females and males may differ in physical strength in agricultural production. A higher ratio of female to male adults was expected to have a negative effect on renting land and a positive effect on migration if males are more productive in agriculture.

The household time endowment (\bar{L}) was determined by its labour force size and so depends on household size and the number of dependants. In addition, it may also depend on the ratio of female to male adults, as taking care of children and doing housework are usually female tasks in Chinese society. Households with a relatively large time endowment were expected to rent more land and be more involved in migration. The household land endowment (\bar{A}) was represented by the irrigated land contracted per adult. Households with relatively more land were expected to rent less land and participate less in migration. The square of this variable was added to the equation to capture possible nonlinearities in its impact.

Institutional factors affecting land renting and migration (Z) were represented by tenure security, transfer rights, and the presence of a social network. As mentioned earlier, since the end of the 1970s, China has implemented a fundamentally new land tenure system (the HRS). Farmland in China is legally owned by the village collective (the hamlet). Initially, the village collective (the hamlet) distributed land use

rights equally to individual households for a period of 15 years. In 1993, the Chinese government adopted a new policy, allowing land use rights to be extended for another 30 years. On 1 January 1999, the Chinese government implemented the amended Land Administration Law (LAL). To guarantee long-term tenure security and encourage land-attached investment, the amended LAL regulates that the village collective (the hamlet) should sign written land contracts with individual households and the duration of the land contract should be 30 years. The written contract should include the rights and responsibilities of both parties. Both parties' rights to the contracted land are protected by the amended LAL. Even though the Chinese government has implemented uniform land laws and policies, different village collectives (hamlets) have their own land institutions, such as different rules in land distribution, land adjustment, and land transfer, different timing of implementing land laws and policies, and different durations of land contracts. During the survey households were asked whether they possessed a land contract, which was taken as an indication for tenure security. Tenure security was expected to stimulate land market participation (Lohmar, 1999; Lohmar *et al.*, 2001; Kung, 2002). Secure tenure was also acknowledged as a major incentive to improve land-attached investment (Besley, 1995). Households with secure tenure may therefore spend more time on agriculture and have less labour available for migration. In the survey, households were also asked whether they had the right to transfer land within the village, the right to transfer land outside the village, inheritance rights or mortgage rights. The information was used to derive a land transfer right indicator, defined as the number of transfer rights enjoyed by the household, divided by four. A high value of the land transfer right indicator was expected to have a positive impact on land renting (Li & Yao, 2002). Land transfer rights may also promote land-attached investment (Carter & Yao, 1999), and therefore reduce migration, because households with more transfer rights are more likely to recoup the value of land investment if they should exit farming.

Another institutional factor affecting land renting and migration is the presence of a social network. The presence of a social network may play an important role in participating in land renting and obtaining off-farm employment. A dummy variable was defined that equalled 1 if the household received remittances from family members who did not belong to the household or if the household had participated in migration before the survey year. Having a social network (previous migration experience may indicate experience in land rental transactions) may reduce transaction costs of finding partners in land rental agreements and of monitoring and enforcing these agreements, and was therefore expected to encourage land renting. The presence of a social network may help the household to find job information and initial accommodation in the migration destination and therefore will positively affect migration (Kung & Lee, 2001; Zhang & Li, 2003; Zhao, 2003).

Finally, the land rent (r) and wage rate (w) were assumed to be the same for all households living in the same village. Two dummy variables for Banqiao and Shangzhu village, reflecting these and other factors that systematically differed between the villages, were therefore added to the model.

Results for land renting and migration

Seemingly unrelated bivariate probit regression was used to examine whether participation in land renting and migration influence each other. To this end, some of the explanatory variables should differ between the land renting and migration equations. We assumed that land renting decisions are made in particular by the household head, whereas migration decisions are made jointly by all household members. As a consequence, we used the age and education of the household head to specify the land renting equation, and the average adult age and education to specify the migration equation. The results are presented in Table 6.

Results for land renting

As expected, the number of cattle in a household had a positive impact on the probability of renting land. The age of the household head showed an inverted U-

Table 6. Determinants of land renting and migration – a seemingly unrelated bivariate probit regression (n = 278).

Independent variable	Land renting		Migration	
	Coefficient ¹	z-score	Coefficient ¹	z-score
Household size (persons)	-0.05	-0.59	0.74 ***	5.47
No. of dependants (persons)	0.11	0.86	-0.67 ***	-4.83
Ratio female to male adults	-0.16	-1.09	-0.09	-0.51
No. of durable assets	0.03	0.50	-0.14 **	-2.12
No. of cattle	0.31 **	2.28	-0.15	-1.12
Age household head (years)	0.15 **	2.09		
(Age household head) ²	-0.002 **	-2.29		
Adult age (years)			0.28 **	2.55
(Age adults) ²			-0.004 ***	-2.82
Education household head (years)	-0.05	-1.60		
Education adults (years)			0.03	0.47
Irrigated land per adult (μ)	-0.16	-0.47	1.07 **	2.38
(Irrigated land per adult) ²	-0.03	-0.56	-0.22 **	-2.51
Possession land contract (1=yes)	0.08	0.42	0.33	1.26
Land transfer rights	0.48	0.81	0.36	0.56
Social network (1=yes)	-0.19	-1.07	0.96 ***	3.91
Banqiao dummy (1=yes)	0.31	1.33	-0.68 ***	-2.50
Shangzhu dummy (1=yes)	0.12	0.58	-0.57 **	-2.21
Intercept	-2.97 *	-1.72	-7.44 ***	-3.36
Log pseudo likelihood		-289.83		
rho		-0.35 (-2.80) ***		
Wald test for rho = 0		$\chi^2(1) = 7.83; P > \chi^2 = 0.005$		

¹ * = $P < 0.10$; ** = $P < 0.05$; *** = $P < 0.01$. Standard errors are robust to heteroskedasticity.

shaped relationship with households' land renting decisions. The turning point was 43 years. This finding suggests that households with young heads as well as households with old heads are less likely to rent land than middle-aged heads. A possible explanation is that households with young heads have less farming skills whereas households with old heads have less physical strength; they are therefore less likely to rent land. The other variables did not have a significant impact on land renting. Also the joint significance of the institutional factors (possession of a land contract, land transfer rights and presence of a social network) was tested, and the result indicates that institutional variables had no significant impact on household land renting decisions. The same model was therefore estimated without these institutional variables. The results, which are not shown, differ only marginally and do not change the conclusions drawn for the other explanatory variables.

Results for migration

The regression results indicate that household size had a positive impact on migration, whereas the number of dependants in a household had a negative effect. These findings confirm the results of earlier studies, which showed that larger households and households with fewer dependants tend to migrate (Zhao, 1997; 1999a, b; 2002; 2003; Rozelle *et al.*, 1999a, b; De Brauw *et al.*, 2002). The number of durable assets owned by a household had a negative effect on migration, suggesting that richer households tended not to migrate. The average adult age showed an inverted U-shaped relationship with migration, supporting the findings of previous studies (Kung & Lee, 2001; Zhang *et al.*, 2002). The turning point was 37 years.

Interestingly, migration showed an inverted U-shaped relationship with land availability per adult. So households with low and households with high land availability are more likely to stay on the farm. This result is consistent with the finding of Li & Yao (2002) that land resources in rural China not only have a wealth effect, used for financing migration, but also a substitution effect that holds back migration when the land rental market is imperfect. So households with small land endowments may not be wealthy enough to be able to pay the transportation and other costs to migrate, whereas households with relatively large land endowments may have difficulties in leasing their land and therefore stay on the farm instead of migrating. The turning point was 2.38 mu.

As expected, having a social network positively affected migration. The other two institutional factors, possession of a land contract and land transfer rights, did not have a statistically significant effect on the probability of migration. Finally, the results for the two village dummy variables indicate that village-specific factors such as the wage rate and the land rent make households in Banqiao and Shangzhu village less likely to migrate than households in Gangyan village.

The inter-relationship between land renting and migration

After taking out the effects of the explanatory variables, the correlation coefficient

between the error terms of the two equations was -0.35 , which is statistically significant ($P < 0.01$). This finding implies that there was a negative relationship between household land renting and migration decisions. So if the household is more likely to rent land, then the probability of migration is less and *vice versa*. This finding confirms the negative impact of migration on renting land found by both Yao (2000) and Kung (2002), who used village level instrumental variables to take into account the possible endogeneity of migration decisions. This finding also confirms the negative impact of renting land on migration found by Kung & Lee (2001) and Shi *et al.* (2007), who did not take into account the possible endogeneity of land rental market participation decisions.

Conclusions and policy implications

Economic reforms in rural China have led to the emergence of land and labour markets. Off-farm employment has become a significant phenomenon since the mid-1980s. Recent studies also show a rapid increase in land rental transactions (Lohmar *et al.*, 2001; Kung, 2002; Deininger & Jin, 2005). The fact that both land rental market participation and off-farm employment have been rising in recent years suggests that these two markets might be closely inter-related. Our study examined the factors determining households' land renting and migration decisions, and investigated whether households' land renting and migration decisions influence each other, using data from a survey among 329 farm households in three villages in Jiangxi Province, of which 278 households could be used for the analysis. A seemingly unrelated bivariate probit model was estimated to take into account the endogeneity problem of household land and labour market participation decisions and to examine the inter-relationship of household land renting and migration decisions.

The empirical results show that the number of cattle in a household had a positive impact on the probability of renting land. The age of the household head showed an inverted U-shaped relationship with households' land renting decisions, suggesting that households with young or old heads are less likely to rent land. A possible explanation is that households with young heads have less farming skill whereas households with old heads have less physical strength. Institutional variables played no role in household land renting decisions.

The analysis also showed that a larger household size and a lower number of dependants had a positive impact on migration. The number of durable assets owned by a household had a negative effect on migration, suggesting that richer households tended not to migrate. The average adult age showed an inverted U-shaped relationship with migration, indicating that both young and old households tend to work and stay on the farm. Land availability also showed an inverted U-shaped relationship with migration. This finding indicates that households with small land endowments may not be wealthy enough to be able to migrate, whereas households with relatively large land endowments may have difficulties to lease their land in case of land rental market imperfections. Having a social network was found to have a positive effect on migration.

The empirical evidence indicates that land renting and migration do influence each other. A negative relationship was found between land renting and migration. Given the prevalence of surplus labour and the great scarcity of agricultural land, this finding implies that creating more off-farm employment opportunities and improving the functioning of land rental markets are important mechanisms for increasing agricultural productivity and rural household incomes, particularly in poor areas. Policies aimed at building local institutions (e.g., rural credit, off-farm employment information offices, and land transaction offices) to facilitate land rental activities and improve access to available off-farm employment opportunities may therefore play an important role in improving efficiency in agricultural production.

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Appendix 1

Theoretical model of land and labour market participation

A theoretical model of household decision making can be developed to examine the determinants of land rental market participation and off-farm employment. Suppose the household is endowed with labour L , cultivated land A , household characteristics Z^h , and fixed factors Z^q . Assume that the household does not hire additional labour (hiring of additional labour only takes place in peak seasons and is done in small quantities in the research area; it is therefore left out of our analysis), that the household can allocate its labour to agricultural production l^a , off-farm employment l^o , or leisure l at a given wage w , and that the household can rent land A^{in} and lease land A^{out} at a given rent r . So the household can have income from on-farm agricultural production, off-farm employment and land rental activities. The household chooses l^a , l^o , l , A^{in} and A^{out} to maximize utility:

$$\begin{aligned} \text{Max} \quad & U(y, l, Z^h) \\ & l^a, l^o, l \\ & A^{in}, A^{out} \end{aligned} \tag{1}$$

Subject to:

$$y = f(l^a, A, Z^q) + wl^o - (A^{in} - A^{out})r \tag{2}$$

$$l^a + l^o + l = \bar{L} \tag{3}$$

$$A = \bar{A} + A^{in} - A^{out} \tag{4}$$

$$l^o \leq l^o_{\max}(Z) \tag{5}$$

$$A^{out} \leq A^{out}_{\max}(Z) \tag{6}$$

$$A^{in} \leq A^{in}_{\max}(Z) \tag{7}$$

$$l^a, l^o, l, A^{in}, A^{out} \geq 0 \tag{8}$$

where y is the household income; $f(l^a, A, Z^q)$ is the household agricultural production function that satisfies the standard assumptions; l^o_{\max} , A^{out}_{\max} and A^{in}_{\max} are the institutional constraints that limit household participation in the land and labour markets, where Z are the institutional factors, such as tenure security, transfer rights and having a social network that affect land rental market participation and off-farm employment. The price of the agricultural product is set at one; all other prices are expressed relative to this agricultural product price.

The Lagrangian of the utility maximization problem can be formulated as:

$$\begin{aligned} L = & U[f(l^a, A, Z^q) + wl^o - (A^{in} - A^{out})r, l, Z^h] \\ & + \mu^o[l^o_{\max} - l^o] + \mu^{A^{in}}[A^{in}_{\max} - A^{in}] + \mu^{A^{out}}[A^{out}_{\max} - A^{out}] \end{aligned} \tag{9}$$

where μ^o , $\mu^{A^{in}}$ and $\mu^{A^{out}}$ are the Lagrange multipliers for the constraints on l^o , A^{in} and A^{out} .

Household optimal labour allocation can be represented by the following first-order condition (Kuhn-Tucker condition):

$$\begin{aligned} \partial L / \partial l^o &= U_y(-f_{1a} + w) - \mu^o \leq 0 \\ l^o \geq 0 \text{ and } l^{o*} (U_y(-f_{1a} + w) - \mu^o) &= 0 \end{aligned} \tag{10}$$

where superscript * indicates the optimum level.

The first-order condition can be rearranged as (assuming an interior solution with $l^o > 0$):

$$f_{1a} = w - \mu^o / U_y \tag{11}$$

Equation 11 shows that the marginal value product of agricultural labour is smaller than the market wage rate when the off-farm employment constraint is binding.

Household optimal land allocation can be represented by the following first-order conditions:

$$\begin{aligned} \partial L / \partial A^{in} &= U_y(f_A - r) - \mu^{A^{in}} \leq 0 \\ A^{in} \geq 0 \text{ and } A^{in*} (U_y(f_A - r) - \mu^{A^{in}}) &= 0 \end{aligned} \tag{12}$$

$$\begin{aligned} \partial L / \partial A^{out} &= U_y(-f_A + r) - \mu^{A^{out}} \leq 0 \\ A^{out} \geq 0 \text{ and } A^{out*} (U_y(-f_A + r) - \mu^{A^{out}}) &= 0 \end{aligned} \tag{13}$$

These first-order conditions can be rearranged as (assuming an interior solution for either $A^{in} > 0$ or $A^{out} > 0$):

$$f_A = r + \mu^{A^{in}} / U_y \tag{14}$$

$$f_A = r - \mu^{A^{out}} / U_y \tag{15}$$

Either Equation 14 or Equation 15 holds (or neither holds). In other words, the household either rents land or leases land (or is self-sufficient in the land market). Equation 14 shows that the marginal value product of land is greater than the market land rent when the land renting constraint is binding, and Equation 15 states that the marginal value product of land is less than the market land rent when the land leasing constraint is binding.

Based on these first-order conditions, the following reduced-form equations for land rental and off-farm labour market participation can be derived:

$$l^o = l^o(Z^h, Z^q, \bar{L}, \bar{A}, w, r, Z) \tag{16}$$

$$A^{in} = A^{in}(Z^h, Z^q, \bar{L}, \bar{A}, w, r, Z) \tag{17}$$

$$A^{out} = A^{out}(Z^h, Z^q, \bar{L}, \bar{A}, w, r, Z) \tag{18}$$