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# Farmers' Land Transfer-out Behavior from the Perspective of Household Livelihood Endowment Based on the Survey in Anhui, Hubei and Sichuan

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**Abstract** Based on the household livelihood endowment theory and the survey of 367 farmer households in Anhui, Hubei, and Sichuan in 2016, and using the orderly multi-category logistic model, the behavioral decision of farmers in the land circulation was discussed to explore the key parameters influencing the land transfer-out. It found that decisions of farmers on land transfer-out behavior are affected by many factors. Specifically, household non-agricultural income and per capita land area significantly reduce farmers' willingness to transfer land, while the household head age, agricultural input-output ratio, and confirmation of land right significantly promote the farmers' decision on land transfer-out. Therefore, increasing the allocation efficiency of household livelihood endowment has important policy value and practical significance for eliminating unreasonable land circulation and promoting large-scale agricultural production.

**Key words** Household livelihood endowment, Land transfer-out, Orderly multi-category logistic model

## 1 Introduction

Land circulation is always a hot spot in research of three rural issues. According to statistics on <http://www.tuliu.com>, by the end of 2015, the land circulation area in China had reached 29.8 million ha, accounting for 33.3% of the household contracted area, and 52.67% was the circulation between farmers. Such large area of land circulation exerts a positive effect on China's agricultural operation mode and production development, and also brings many practical issues for China's agricultural policies.

Academic research of the land circulation is carried out in macroscopic and microscopic directions. At the macro level, most theoretical studies were concentrated on the effects of land circulation on agricultural and rural economic activities, while some studies confirmed the role of agricultural land circulation in realizing the scale management of land. Chen Xinxin *et al.*<sup>[1]</sup> believed that the land circulation can reduce the efficiency loss brought by zero fragmentation of farmland, and will bring the resource allocation effect, marginal output leveling effect, and trading income effect for farmers and rural economy<sup>[2]</sup>. Some studies found that land circulation also brings some negative effects. Qian Zhonghao and Ji Xianqing<sup>[3]</sup> found that there are problems of low overall level of land circulation, frequent occurrence of farmland administrative adjustment, low willingness of agricultural land circulation, low proportion of contract of agricultural land circulation, and poor play of government guidance and management role. There are also problems of farmer class differentiation, agricultural quality change, and hollow villages<sup>[4]</sup>. At the micro level, most studies focused on key factors affecting the farmer's land circulation behavior from the perspective of land transfer willingness.

Huang Zuhui *et al.*<sup>[5]</sup> studied the influence of the characteristics of household heads (gender, age, educational level, and part-time job) on the willingness to transfer land. Zhu Lanlan and Cai Yinying analyzed the effects of population dependency ratio, percentage of non-agricultural employment of labor, and household per capita net income on the land circulation willingness<sup>[6]</sup>. Bai Xiaoran<sup>[7]</sup> and Du Wenxing<sup>[8]</sup> proved that the natural features such as land scale, quality, and geographical location exert effects on farmers' land transfer behavior. Luo Biliang *et al.*<sup>[9]</sup> and Ni Guohua and Cai Wei *et al.*<sup>[10]</sup> found that the economic factors such as rent, land right confirmation, circulation method, circulation period, and transaction cost also influence farmers' land transfer behavior.

Some scholars studied farmers' land transfer behavior and the influences from the microscopic perspective. However, most studies took all farmers as the research object. They neither distinguished actual land transfer behavior and potential land transfer behavior, not noticed there are transfer-in and transfer-out behaviors in land circulation. Thus, the findings are not accurate and deep. For example, if there is difference in influencing factors between the land transfer-in and land transfer-out? What is the decision-making mechanism influencing farmers' land transfer? These problems need to be proved separately. In addition, most studies included the land area as control variable into the empirical model, but there was no consideration of the household livelihood endowment. These are not favorable for fully understanding the effects of household endowment characteristics and household livelihood decision on the land circulation behavior. From the perspective of optimal allocation of three core resource elements (land, capital, and labor), we built the orderly multi-category logistic model using the field survey data, analyzed farmers' land transfer-out behavior, to reveal the differences, influencing

factors, and decision-making mechanism of farmers' land transfer-out rate.

## 2 General theoretical analysis of farmers' land transfer-out behavior

With nearly 40 years of rural reform and development brought about by the household contract responsibility system, farmers in rural areas have the dual status of agricultural and rural basic business entities and rural social basic livelihood units. As basic business entities, farmers have the right to legally own all economic activity resource elements, and rationally allocate and use these elements according to their operation conditions and external operation environment, to realize optimal operation objectives and obtain maximal economic benefits. In comparison, as basic units of rural social livelihoods, farmers must integrate and allocate all resource elements and their economic activities within the family to maximally protect their survival and long-term development.

At present, in the general sense, farmers own three kinds of resource elements; land obtained based on contractual right, labor of family population, and operation cost gradually accumulated. Land is the most important resource element owned by farmers. Under the existing land system arrangement of China, farmers have obtained only part of the property right of contracted land, namely, the right of use, operation, and disposal. According to Coase Theorems on Property Rights, clarifying property rights can promote efficiency improvement, reduce transaction costs, and increase the effective allocation of resources. In his book *The Theory of Share Tenancy*, Zhang Wuchang stated that clarifying the land property right system and allowing free land circulation are the only ways to bring into play the maximum efficiency of production elements and land<sup>[11]</sup>. For the land which is the most important resource element, it is believed that farmers will seek the most rational allocation decision according to their family livelihood objectives under the condition of unified allocation of all resource elements. Therefore, from the perspective of optimal allocation of household resources and household livelihood objectives, it is possible to more accurately understand the factors that influence the differentiation of households' land circulation behavior and the decision-making mechanism.

For this purpose, we used  $L$  to denote labor livelihood endowment,  $L_a$  to number of labors engaged in agricultural production,  $L_0$  to denote number of labors engaged in non-agricultural work,  $W$  to denote wage level of non-agricultural employment, and  $K_a$  to denote input capital of agricultural production.  $T$  denotes land endowment,  $T_a$  denotes actual farmland of households,  $C$  is the capital cost of the agricultural production per unit area,  $r$  is the land transfer rent, and  $P$  is the price of agricultural product. Besides, farmers' income comes from non-agricultural employment wage income, agricultural production income, and land rental income. Maximizing household income under constraints; (i) production function, (ii) acceptable minimum income level, and (iii) livelihood endowment that can be invested. Assume the agricultural

production function as  $f(K_a, L_a, T_a)$ , and it satisfies  $f(K_a, L_a, T_a)' > 0$ ,  $f(K_a, L_a, T_a)'' < 0$ . The mathematical formula can be simplified as:

$$\text{Max} Y = P \times f(K_a, L_a, T_a) + W \times (L - L_a) + r \times (T - T_a) - c \times K_a \quad (1)$$

$$S_t = Y \geq Y_{\min}; L_0 + L_a \leq L; T_a \leq T \quad (2)$$

The optimal allocation of  $L_a^*$  and  $T_a^*$  of livelihood endowment satisfies first-order partial derivative of (1), and is equal to 0, *i. e.*:

$$P \times f_{L_a}'(K_a, L_a, T_a) = W \quad (3)$$

$$P \times f_{T_a}'(K_a, L_a, T_a) = r \quad (4)$$

According to the first-order conditions, the allocation of household labor resources endowment is as follows:

(i) Labor allocation in non-agricultural sectors: the marginal output value of labor in agricultural production is less than that in non-agricultural employment wage.

(ii) Labor allocation in agricultural sectors: the marginal output value of labor in agricultural production is greater than that of non-agricultural employment wage.

Under the goal of maximizing household income, the optimal allocation of household labor endowment is that the marginal return of labor in agricultural production is exactly equal to the productivity value under the non-agricultural employment wage level.

According to the first-order conditions, the allocation of household land resources is as follows:

(i) Land transfer-out of farmers: the marginal output value of land in agricultural production is less than the land rent.

(ii) Land transfer-in of farmers: the marginal output value of land in agricultural production is greater than the land rent.

In the comparison of marginal remuneration of agricultural land and land rent, the optimal allocation of land resources is achieved only when the marginal return of agricultural production is equal to land circulation rent. Land circulation will produce the leveling effect, that is, land will be transferred from low-productivity farmers to high-productivity farmers, thereby realizing the Pareto improvement of allocation of land resources<sup>[12]</sup>.

## 3 Empirical analysis on factors influencing land circulation behavior of farmers

**3.1 Data source** The research data were collected from our survey in the two cities in Anhui Province, two towns in Chengdu City of Sichuan Province, and two townships in Yingshan County of Hubei Province in 2016. Survey objects included ordinary farmers, local new agricultural management entities (large growers, family farmers), village-level cadres and township-level cadres. The content of the questionnaire mainly involved four aspects: individual characteristics of family members of households, income of agricultural operation cost, household income and expenditure, and basic status of land circulation. A total of 400 copies of questionnaires were distributed to ordinary farmers, 20 were distributed to large growers, 12 to village cadres, 8 to township cadres, 389 were collected, 22 invalid ones were rejected, finally obtained 367

valid samples, and the valid response rate reached 94.34%.

**3.2 Variable description** With the aid of Stata13.0 statistical software and using the principal component analysis (PCA) method, we reduced the dimension of 38 factors influencing the land transfer-out rate. From the perspective of the contribution rate, we divided the variables into four types according to the extraction conditions of eigenvalue  $\geq 1$  as the principal component. From

the principal component load, we analyzed the correlation coefficient between each principal component and the variable. Next, we used a stepwise regression method to reject the least significant variables according to 95% confidence interval, till there were only 12 variables with higher significance. The meaning and description of independent variables were shown in Table 1.

**Table 1 Basic characteristics of household livelihood endowment**

| Characteristic variables                        | Definition or assignment of variable  | Min.  | Max.   | Mean   | SD     |
|---|---|-------|--------|--------|--------|
| Whether the land is transferred out ( $Y_1$ )   | No = 0; Yes = 1   | 0     | 1      | 0.820  | 0.385  |
| Land transfer-out degree ( $Y_2$ )              | Low = 1; Medium = 2; High = 3   | 1     | 3      | 2.311  | 0.814  |
| 1. Characteristics of labor endowment           |   |       |        |        |        |
| Age ( $X_1$ )                                   | Continuous variable (years old)   | 27    | 84     | 56.204 | 10.701 |
| Educational level ( $X_2$ )                     | No = 0; Primary school = 1; Junior middle school = 2; Senior middle school = 3; Vocational school = 4; College and university and above = 5 | 0     | 5      | 1.583  | 0.763  |
| Major work ( $X_3$ )                            | Agricultural = 0; Non-agricultural = 1  | 0     | 1      | 0.634  | 0.532  |
| Population dependency ratio ( $X_4$ ) *         | Continuous variable   | 0     | 5      | 0.734  | 0.796  |
| 2. Characteristics of capital endowment         |   |       |        |        |        |
| Annual income per capita ( $X_5$ )              | Annual family income/number of family members   | 4.682 | 13.087 | 9.009  | 1.228  |
| Percentage of non-agricultural income ( $X_6$ ) | Non-agricultural income / total family income   | 0     | 1      | 0.832  | 0.297  |
| 3. Characteristics of land endowment            |   |       |        |        |        |
| Per capita land area ( $X_7$ )                  | Total area of contracted land / total family population   | 0.133 | 8.170  | 1.269  | 1.093  |
| Rent ( $X_8$ )                                  | Land circulation price  | 100   | 700    | 6.065  | 0.334  |
| Agricultural input-output ratio ( $X_9$ ) **    | Total cost of agricultural production / total agricultural income   | 0     | 7.742  | 0.340  | 0.695  |
| 4. Other characteristics                        |   |       |        |        |        |
| Confirmation of land right ( $X_{10}$ )         | No = 0; Yes = 1   | 1     | 2      | 1.399  | 0.490  |
| Land circulation contract ( $X_{11}$ )          | Oral = 0; Written = 1   | 1     | 2      | 1.289  | 0.454  |
| Land circulation period ( $X_{12}$ )            | Non-periodic = 1; One harvest = 2; One year = 3; 1-5 years = 4; 5-10 years = 5; 10 years or longer = 6                                      | 1     | 6      | 4.003  | 1.892  |

Note: The production expenditure includes the purchase of seeds, fertilizers, pesticides, plastic film, and feeds; on incomplete market conditions, land circulation will inevitably have certain transaction costs, but the existing theoretical and empirical analysis lack unified quantitative indicators and operation standards.

\* Population dependency ratio (*i.e.* dependency rate) = (aging population + minor population)/labor population, which measures the proportion of the working population to non-working population. \*\* Agricultural input-output ratio = Agricultural input (material + labor)/Total agricultural output value.

**3.2.1 Characteristics of labor endowment.** Characteristics of household heads include age, educational level, and major work, to comprehensively the human resource endowment characteristics of household heads. Xu Hengzhou *et al.*<sup>[13]</sup>, Du Y and Sun B<sup>[14]</sup>, and Zhang Zhongming and Qian Wenzhong<sup>[15]</sup> analyzed differences and influencing factors of farmers' land circulation, and found that the age, educational level, and part-time job of household heads have significant effects on farmers' land circulation. The population dependency ratio reflects the endowment and living burden of family labor population<sup>[16]</sup>.

**3.2.2 Characteristics of capital endowment.** The annual family income per capita reflects the family living standard. Through DID model and using per capita net income as main variables, Xue Fengrui *et al.* made an empirical analysis on income of farmers who have participated or not participated in land circulation; Zhong Xiaolan *et al.*<sup>[18]</sup> studied the willingness of farmers to circulate land from the perspective of non-agricultural employment and income source. In this study, we selected the population dependency ratio, annual family income per capita, and proportion of

non-agricultural income to reflect the characteristics of farmers transferring out land.

**3.2.3 Characteristics of land endowment.** Land is a long-term guarantee for farmers to resist life risks. In this study, we adopted following three variables: per capita family land area (the proportion of initial land area and family population change), land rent (land rent price will influence the land circulation to a certain extent), and agricultural input-output ratio (reflecting agricultural production and operation efficiency, and reflecting characteristics of land resources)<sup>[19-21]</sup>.

**3.2.4 Other characteristics.** This mainly includes land right confirmation, land circulation form (written contract or oral agreement), and land circulation period. The confirmation of agricultural land right not only strengthens the property right intensity of farmland, increases the intrinsic value of land resources, but also reduces the transaction costs, accordingly influencing land circulation<sup>[22]</sup>. We studied whether the written contract of land circulation was signed, so as to locate the risks and disputes of land circulation<sup>[23]</sup>; farmers make rational choices according to their fami-

ly livelihood endowment and realistic predicament, and the land circulation period also reflects the expectation of farmers for the recoverable degree after land transfer.

**3.3 Model building** In this study, we mainly analyzed the effects of family livelihood endowment on farmers' land transfer behavior. First, we discussed the binary discrete choice of farmers' land transfer, assigned 0 to the dependent variable of not transferred, and assigned 1 to those transfer rate higher than 1. Then, we made an in-depth analysis of land transfer-out degree and divided the land transfer-out rate into three levels: one for low transfer rate within 25%, two for medium transfer rate of 25% - 75%, and three for high transfer rate. Finally, we made an estimation using multi-category orderly logistic model.

Using the logistic model, we studied the dependence of the probability variable  $p$  and the independent variable  $x$  on the variable  $y$ . We set the dependent variable  $Y$ , and denoted  $k$  variables influencing  $Y$  as  $X_1, X_2, \dots, X_k$ . Set the probability of land transfer-out rate of farmer  $J$  at  $P_j$ . They are non-linear function consisted of independent variables  $X (X_1, X_2, \dots, X_k)$ . When  $y = 1, 2, \text{ and } 3$ , the logistic regression model is as follows:

$$\begin{aligned} \text{prob}(y = 1) &= L(1 - \sum_{\kappa}^k \beta_{\kappa} \chi_{\kappa}) \\ \text{prob}(y = 2) &= L(\mu_2 - \sum_{\kappa}^k \beta_{\kappa} \chi_{\kappa}) - L(- \sum_{\kappa}^k \beta_{\kappa} \chi_{\kappa}) \\ \text{prob}(y = J) &= 1 - L(\mu_{J-1} - \sum_{\kappa}^k \beta_{\kappa} \chi_{\kappa}) \end{aligned}$$

It gives the linear function of variable  $Y = \text{logit}(P)$  on  $x$ :

$$\text{log} \left[ \frac{P(y \leq j | \chi)}{1 - P(y \leq j | \chi)} \right] = \mu_j - \sum_{\kappa}^k \beta_{\kappa} \chi_{\kappa} \quad (j = 1, 2, \dots, J - 1)$$

$P_j = \rho(y \leq j | \chi)$  denotes the cumulative probability of  $y$  taking the first  $j$  values.

**3.4 Analysis of results** To ensure the validity of the regression results, it is necessary to make a multiple collinearity diagnosis for the selected variables before the model is run. The test results indicate that the variance expansion factor of the selected 12 variables is lower than 10, and that there are no significant multiple collinearity problems among the explanatory variables; the model passed the test of parallel lines, and from the  $F$  statistics and the corresponding  $P$  distribution values, it shows that the fitting effect of the model is good, as indicated in Table 2.

**Table 2 Fitting of land transfer model**

| Characteristic variables                        | Model 1               |        | Model 2                |        |
|---|-----------------------|--------|------------------------|--------|
|   | Logit                 | OR 1   | Ologit                 | OR 2   |
| 1. Characteristics of labor endowment           |                       |        |                        |        |
| Age ( $X_1$ )                                   | -0.041 **<br>(0.016)  | 0.960  | -0.022 *<br>(0.011)    | 0.978  |
| Educational level ( $X_2$ )                     | -0.160<br>(0.212)     | 0.852  | -0.061<br>(0.158)      | 0.941  |
| Major work ( $X_3$ )                            | -0.029<br>(0.040)     | 1.029  | -0.015<br>(0.029)      | 0.985  |
| Population dependency ratio ( $X_4$ )           | 0.156<br>(0.236)      | 1.169  | 0.078 *<br>(0.153)     | 1.081  |
| 2. Characteristics of capital endowment         |                       |        |                        |        |
| Annual income per capita ( $X_5$ )              | -0.544 **<br>(0.259)  | 0.580  | -0.473 **<br>(0.191)   | 0.623  |
| Percentage of non-agricultural income ( $X_6$ ) | 2.339 **<br>(1.057)   | 10.371 | 2.592 ** *<br>(0.784)  | 13.564 |
| 3. Characteristics of land endowment            |                       |        |                        |        |
| Per capita land area ( $X_7$ )                  | 0.722 **<br>(0.300)   | 2.059  | 0.546 ** *<br>(0.188)  | 1.726  |
| Rent ( $X_8$ )                                  | -0.029<br>(0.818)     | 0.971  | -0.326<br>(0.526)      | 0.722  |
| Agricultural input-output ratio ( $X_9$ )       | 1.196 ** *<br>(0.312) | 3.307  | -2.144 ** *<br>(0.307) | 0.117  |
| 4. Other characteristics                        |                       |        |                        |        |
| Confirmation of land right ( $X_{10}$ )         | -1.197 **<br>0.457    | 3.310  | -0.940 ** *<br>(0.299) | 0.391  |
| Land circulation contract ( $X_{11}$ )          | -0.043<br>0.550       | 0.958  | 0.547<br>(0.437)       | 1.728  |
| Land circulation period ( $X_{12}$ )            | 0.102<br>(0.139)      | 1.107  | 0.042<br>(0.108)       | 1.043  |
| Constant term                                   | 8.535<br>(5.184)      |        | -<br>-                 | -<br>- |
| $F$ test  | 3.220                 |        | 7.660                  |        |
| Prob > $F$                                      | 0.000                 |        | 0.000                  |        |

Note: \*\*\*, \*\* and \* denote that variable is significant at 1%, 5% and 10% respectively.

**3.4.1** Effects of the characteristics of labor endowment on farmers' land transfer-out degree. When other variables remain unchanged, the age and educational level of household heads exert negative effects on the land transfer-out, and it passed the significance test, indicating that the older and the higher educational level of household heads, the less land is transferred out. This is possibly because most household heads were 4 – 60 years old in our survey. With the growth of the age, migrant workers become more willing to return to rural areas. The land plays an important role in guaranteeing the endowment and basic life of rural residents. Thus, their land transfer-out degree is low. The educational level of household heads is mainly primary school and junior middle school. Due to this limitation, their migrant work is mainly physical or manual crafts, such as building (craftsmen, masons, plumber and electrician) and manufacturing (tailors and carpenters), and less in agriculture, forestry, animal husbandry, and fishery. Their opportunity of getting jobs outside is little and working treatment is low.

In the multivariate ordered Logit model, the population dependency ratio and the land transfer-out degree had positive effects at the 0.1 significance level. In the binary Logit model, they showed positive correlation, but they failed to pass the significance test. In this study, we included the students and those who lost their labor capacity into the non-labor population. If the population dependency ratio is greater, the number of people dependent on the labors will be larger, which means that the economic burden of the labors will be heavier. The income from small-scale agricultural production is lower. Under the living pressure, the workers with certain skills go out to work to feed their families, and the decrease in labor of agricultural production promotes land circulation.

**3.4.2** Effects of the characteristics of capital endowment on farmers' land transfer-out behavior. When other variables are not changed, the annual family income per capita is negatively correlated with the land transfer-out, and it passed the significance test at 0.05 level, indicating that the increase in the annual family income per capita leads to the decline of land transfer-out degree. If the annual family income per capita is higher, the dependency of family on the land will be lower. Some rural families go to cities to work or settle down, and they freely transfer their farmland to relatives or friends, so the transfer-out degree becomes lower.

To further understand the dependence of farmers' agricultural production on land, the proportion of agricultural income to total family income is an excellent reference. However, to avoid the endogenous problem due to the possible mutual influence of agricultural income proportion and land transfer, we substituted it with the non-agricultural income proportion. In the regression results, the estimated coefficient of non-agricultural income was 2.592, and two models passed the significance test at 0.01 level, indicating that the family non-agricultural income had a high positive effect on land transfer. This is because the contribution rate of non-agricultural income to total family income is up to 83%, the non-agricultural employment income is the main income source of the family, and farmers have lower dependency on agricultural production. Farmers can buy agricultural products in the market to meet their own ration needs. What's more, numerous young and

middle aged rural residents go to cities to do migrant work, those left behind for agricultural production are mainly the women and elderly. The drop of agricultural labors is also a reason for increase in the land transfer.

**3.4.3** Effects of the characteristics of land endowment on farmers' land transfer-out degree. The per capita family land area and farmers' land transfer-out degree showed a significantly positive correlation, and both passed the significance test. The binary logistic regression results show that when the per capita land area increases one unit, the probability of land transfer will rise by 0.722. The family land area was determined by the household contract responsibility system implemented since 1983. At that time, the per capita land area was basically the same. With more than 30 years of change, the per capita family land area is different because of changes in family population but basically no change in family contracted land area. The shrinkage of existing family population will lead to increase of per capita family land area. Then, it will basically satisfy the grain ration demand and there will be surplus, so it will increase the land transfer-out degree.

The effects of land rent on farmers' land transfer did not pass the statistical significance test. According to our survey, there exists oligopoly in rural land circulation. When there are few large land contractual households, the transfer-in party will collectively negotiate the price of land transfer, to keep consistent internal land rent. For the convenience of land circulation, the land quality is averaged, both poor and good land are circulated at consistent price. Combined with the research area and the data volume limit, the land rent factor has no significant regression effect on the land transfer-out degree of the farmers.

The agricultural input-output ratio exerted a positive effect on farmers' land transfer, and it passed the significance test at 0.01 level. The smaller the agricultural input-output ratio, the higher the return of investment in agricultural labor production, the higher the return on agricultural production, the higher the farmers' income, the higher the farmers' willingness to cultivate land, and the lower the land transfer-out rate. On the contrary, the higher the agricultural input-output ratio, the higher the land transfer-out rate.

**3.4.4** Effects of other characteristics on farmers' land transfer-out degree. The results of land right confirmation are opposite to the expected direction, which has negative influence on the land transfer-out degree of farmers, and it passed the significance test at 0.01 level. As it is known to all, after land reform, the rural land in China is collectively owned. In 2013, No. 1 documents of the central government stated to implement the process of confirmation, registration and certificate issue of rural land. In the opinion of farmers, the confirmation of land right is the signal of government paying closer attention to rural land, indicating that rural land has higher and higher value. This increases the expected value of farmers for land. The theory of endowment effect was put forward by Richard Thaler. According to this theory, when an individual owns an item that he does not own before, his evaluation of the value of the item would increase greatly. Therefore, for fear of loss, people tend to ask for excessive price when they sell their merchandise<sup>[24]</sup>, which may lead to negative correlation between

land ownership and land transfer.

The effects of whether the written land circulation contract is signed and land circulation period on the farmers' land transfer-out are not significant, and only the circulation contract passed the significant test at 0.1 level in linear regression. With improvement of China's laws, people's legal awareness is constantly increasing. The signing of a written land circulation contract can directly reduce the costs for land circulation transaction, lock risks, and reduce land disputes. Besides, the land circulation form is favorable for the transition from the previous "acquaintance transaction" to "contractual circulation" and is helpful for the market based management of land. Therefore, signing land circulation contract plays a positive role in promoting land transfer-out. As for the land circulation period, if it is short, the transfer-in party will quickly reach the deadline of circulation, which is detrimental to land fertility and not favorable for land recovery and cultivation. In the legal period, the longer the general land circulation period, the stronger the farmer's willingness to transfer land, which is consistent with the regression direction of the model.

#### 4 Further verification of decisive factors influencing farmers' land transfer-out behavior

According to theoretical analysis, farmers' land transfer-out decision is mainly the game between the marginal output value of labor and non-agricultural employment wage, the marginal output value of land and the land transfer rent in agricultural production. In this section, we made a further verification based on the microscopic survey data. First, through building the Cobb-Douglas (C-D) production function, we estimated relationship between factor productivity growth and human-land ratio. The C-D function is concise and easy to understand and analyze the meaning and relationship between economic variables. We assumed that the farmer has a labor livelihood endowment of  $L$ , of which  $L_a$  is the number of labor engaged in agricultural production, and  $W$  is the non-agricultural employment wage level. The land endowment is  $T$ , where  $T_a$  is the land actually cultivated by the farmer,  $r$  is average land rent, and  $P$  is the price of the agricultural product. Besides, farmers' income comes from non-agricultural employment wage income, agricultural production income, and land rental income. The specific production function is as follows:

$$j(K_a, L_a, T_a) = AK_a^\alpha L_a^\beta T_a^\delta \exp(\varepsilon)$$

where  $Y$  denotes the total agricultural output value,  $A$  denotes the combination of technological progress and other influencing factors,  $K$ ,  $L$ , and  $T$  denote capital, labor, and land inputs in agricultural production, respectively, and  $\alpha$ ,  $\beta$ , and  $\delta$  are output elasticity coefficient for the corresponding production factors, and  $\varepsilon$  is a random disturbance item, as listed in Table 3.

The production function expression simulated on the basis of data is:  $\ln Y = -0.374 + 0.047 \ln k + 1.163 \ln L + 0.065 \ln T$ . In the C-D production function, the labor output elasticity coefficient is  $\beta = \frac{\partial Y}{\partial L} / \frac{Y}{L}$ , and the marginal productivity of labor  $MP_L = \frac{\partial Y}{\partial L}$ . Thus, the marginal productivity of labor  $MP_L = \frac{\partial Y}{\partial L} =$

$\beta \frac{Y}{L}$ , the marginal contribution of labor is  $Y \times MP_L = Y \times \frac{\partial Y}{\partial L} = Y \times \beta \frac{Y}{L}$ , indicating that the contribution of labor in the total value of agricultural output when funds and land are constant. Through calculation,  $MP_L = \frac{\partial Y}{\partial L} = \beta \frac{Y}{L} = 1.163 Y/L = 1.163 (2\,582.489/558.125) = 5.38$ , and marginal output value of agricultural labor is  $2\,582.489 \times 5.381 = 13\,896.373$  yuan, indicating that the output value brought by labor input in agricultural production is 13 896.373 yuan. When there are many people but scarce land, only farmers with high productivity will obtain high marginal return on labor and accordingly input many labors to agricultural production. For ordinary farmers, the level of non-agricultural employment wages is much higher than the labor return obtained from agricultural production. In the actual survey, the average non-agricultural income of families was 15 568.482 yuan, which is higher than the marginal labor value in agriculture. Therefore, the distribution of labor endowment is more inclined to the outflow of labor, and less labor is put to agricultural production. The shortage of agricultural surplus labors promotes the transfer of family land, and this belongs to external pull.

Likewise, the land production elasticity coefficient  $\delta = \frac{\partial Y}{\partial T} / \frac{Y}{T}$ , the marginal productivity of land  $MP_T = \frac{\partial Y}{\partial T} = \delta \frac{Y}{T}$ , the marginal contribution value of the land is  $Y \times MP_T = Y \times \frac{\partial Y}{\partial T} = Y \times \delta \frac{Y}{T}$ , denoting the contribution value of land in total value of agricultural production when there is no change in funds and labor. Through calculation,  $MP_T = \frac{\partial Y}{\partial T} = \delta \frac{Y}{T} = 0.0652 \times Y/L = 0.065 \times (2\,582.489/983.783) = 0.171$ , so marginal production value of land is  $2\,582.489 \times 0.171 = 441.606$  yuan, while the average land rent input is 983.783 yuan. When the rent for land circulation is higher than the value brought by the land in agricultural production, farmers are willing to transfer the land. At this time, the marginal return of the land is low and forms an internal thrust and promotes the land transfer.

**Table 3 Estimation results of Cobb-Douglas production function**

|          | Coefficient | $T$ value | $P >  t $ |
|----------|-------------|-----------|-----------|
| $\ln K$  | 0.047 0     | 2.30      | 0.023     |
| $\ln L$  | 1.163 0     | 10.28     | 0.000     |
| $\ln T$  | 0.065 0     | 1.22      | 0.225     |
| Constant | -0.374 0    | -0.48     | 0.629     |
| $R^2$    | 0.459 5     | -         | -         |
| $F$      | 53.280 0    | -         | -         |

## 5 Conclusions and recommendations

**5.1 Conclusions** In this study, we mainly analyzed the effects of family livelihood endowment on farmers' land transfer-out behavior. With the reference to previous theoretical basis and research ideas, we carried out an empirical analysis on the effects of family livelihood endowment on farmers' land transfer-out behavior. We

reached following conclusions. (i) From the perspective of human resource endowment, the age of household head has a significant negative effect on farmers' land transfer-out behavior, while the educational level and work type do not have a significant effect on farmers' land transfer-out behavior. (ii) In the family characteristics, the annual family income per capita and non-agricultural income ratio are essential factors influencing land circulation, and non-agricultural income plays an absolute role in promoting land circulation. Farmers can get rid of the land restriction, and spend their time in other industries than agricultural production, so as to increase the total family income. (iii) From the perspective of land resource endowment, it has a significant positive relationship with the per capita land area; there is a significant negative relationship between agricultural input-output ratio and whether the land right is confirmed; land rent, signing of circulation contract, and land circulation period do not have significant effects on the land transfer-out.

**5.2 Recommendations** (i) It is recommended to continue to undertake the confirmation, registration, and certificate issue of rural land contractual management right, and strengthen the propaganda and training of laws and knowledge about land right confirmation. It is required to guarantee that farmers have certificates, identify certificates, and use certificates, to fully implement the policy of land right confirmation. (ii) It is recommended to promote technical training of non-agricultural employment of rural laborers and landless farmers. The contribution rate of non-agricultural income to total family income is up to 83%, the non-agricultural employment income is the main income source of the family and also an essential factor promoting the land circulation. Free labor market can attract more rural laborers to work in cities and release more land resources. This is helpful for increasing the allocation efficiency of rural land resources and promoting large scale agricultural operation. (iii) Villages with high per capita land area should improve the construction of land circulation platform and strengthen supervision and management of land circulation contracts. For the farmers whose endowment depends on the land, it is recommended to improve the local agricultural production infrastructure and strengthen the development of agricultural production services. For farmers with high agricultural input-output, it is not recommended to transfer land.

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