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Farmland Transfer and Income Distribution Effect of Heterogeneous Farmers with Livelihood Capital: Evidence from CFPS

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Abstract: Farmland transfer is a crucial aspect of modernizing China's agriculture, which has a significant impact on farmers' income distribution. With rapid urbanization, farmers' livelihood has changed significantly, and the income effects of farmland transfer will differ among heterogeneous farmers. Based on the China Family Panel Studies (CFPS) data, this study examines the impact of farmland transfer on farmers' income growth and income disparity, as well as the income differences in farmland transfer among farmers with different types of livelihood capital. An endogenous switching regression model and unconditional quantile treatment effects are used to correct the selection bias and farmer heterogeneity. The results show that (1) farmland transfer increases farmers' income. Specifically, farmland transfer-in increases farmers' income by 21.15%, while transfer-out increases it by 43.33%. (2) The impact of farmland transfer on farmers' income has a "Matthew effect" and will widen the income gap between farmers. (3) Moreover, farmland transfer exhibits diverse income effects on heterogeneous farmers with livelihood capital. Capital-rich farmers experience the largest income-growth effect from farmland transfer-in, while capital-balanced farmers experience the largest income-growth effect from farmland transfer-out. The policy implications are to further improve the farmland transfer market and enable low-income farmers to participate by improving their qualifications and abilities.

Keywords: farmland transfer; heterogeneous farmers with livelihood capital; income growth; income gap; endogenous switching regression; unconditional quantile treatment effects

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1. Introduction

Increasing farmers' income and narrowing the income gap are important ways to achieve common prosperity for developing countries [1]. In China, significant progress has been made in increasing farmers' income and narrowing the urban–rural income gap since the implementation of reform and opening-up policies [2,3]. However, it cannot be ignored that there are still prominent problems, such as unbalanced development between urban and rural areas, slower growth of farmers' income, and a large internal income gap [2]. Scholars generally believe that a large population with limited land, small scale, and low resource mobility have seriously hindered Chinese farmers from increasing their production and income [4–7]. For this reason, the Chinese government has repeatedly proposed to promote farmland transfer, aiming to expand farmers' income avenues through moderate-scale operations [6,8].

There have been numerous studies on the question of whether farmland transfer can promote farmers' income growth, but no consensus has been reached. Some scholars argue that farmland transfer improves farmers' income through optimal resource allocation [9–13], and the income-growth effect of farmland transfer-in is more obvious [14,15]. However, scholars with different views argue that farmland transfer leads to a decrease in farmers'

total income because they cannot use the comparative advantage of their labor [16]. And the transfer-out of agricultural land leads to a decrease in total household income because non-farm wages and rents are lower than agricultural income and subsidies [15]. Regarding the income distribution effect of farmland transfer, one view is that farmland transfer will widen the income gap between farmers and be more conducive to the income increase of higher-income farmers [1,17,18]. Another view is that it can reduce income inequality and alleviate the income gap between farmers [14,19–23]. In addition, Gao et al. [24] also found that farmland transfer-in reduces the income gap while transfer-out exacerbates it, indicating an asymmetric effect.

Based on the previous studies on the impact of farmland transfer on income distribution, it is found that the existing studies lack a consensus conclusion and require further improvement due to limitations in data and research methods. Firstly, scholars have realized that there is a "self-selection" problem of farmers' participation in farmland transfer, which has been solved by the PSM or DID model, but they have not solved the selection bias caused by some unobserved factors such as farmers' preferences and management abilities. Secondly, studies on the income distribution effects of farmland transfer have ignored the endogeneity of the model. Finally, the above literature mostly treats farmers as homogeneous individuals without distinguishing their heterogeneous characteristics. Livelihood capital is the basis for farmers' livelihood activities and strategies and has a direct impact on household resource allocation and income. Currently, the rapid development of industrialization, urbanization, and informatization has caused great changes in farmers' livelihood capital. There are great differences in feelings, perceptions, and disposal of land among heterogeneous farmers with livelihood capital, which may affect both the farmers' farmland transfer decisions as well as income distribution [25,26].

In this regard, this study will be refined in the following aspects: First, according to the sustainable livelihood frameworks, an analytical framework is established, which proposes research hypotheses. Second, based on the data of Chinese Family Panel Studies (CFPS), we estimate the income effects of farmland transfer using an endogenous switching regression (ESR) model to address selection biases due to unobservable factors in the model. Third, the unconditional quantile treatment effect (UQTE) is used to explore the income distribution effects of farmland transfer. Fourth, considering farmers' heterogeneity factors, the income effect of farmland transfer is compared for farmers with heterogeneity in the livelihood capital.

2. Theoretical Framework

Sustainable livelihood theory is a new theoretical perspective expanded based on sustainable development, which originates from the thinking of addressing rural poverty [27–30]. Based on the concept of sustainable livelihoods, several government departments and research institutions have proposed sustainable livelihoods frameworks (e.g., FAO, UNDP, CARE, and DFID). Among them, the sustainable livelihood framework (SLF) of the UK's Department for International Development (DFID) is the most widely used [31,32]. The SLF is based on the core concept of livelihood capital. The framework shows the process by which farmers decide livelihood strategies and pursue livelihood outcomes according to their livelihood capital (natural capital, human capital, social capital, physical capital, and financial capital) under the influence of external vulnerable environments, policies, organizations, and institutions [33,34]. This paper constructs an analysis framework based on the logical idea of "livelihood environment—livelihood capital—livelihood strategy—livelihood outcome" in the SLF (Figure 1).

At present, China's rural land reform continues to deepen, and farmland transfer and large-scale operation have become inevitable trends in the development of agricultural modernization. As an external policy environment factor, farmland transfer will inevitably affect the transformation of farmers' economic behavior. Under the influence of policy and livelihood capital heterogeneity, there will be differences in households' livelihood strategies [25]. And, farmers will choose whether to participate in the farmland transfer market. Farmers' participation in the farmland transfer market will change the allocation

patterns of households' land, labor, and capital factors, which will affect income [11]. In contrast, heterogeneous farmers with livelihood capital endowments have different behavioral capacities and their income after participating in farmland transfer will differ.

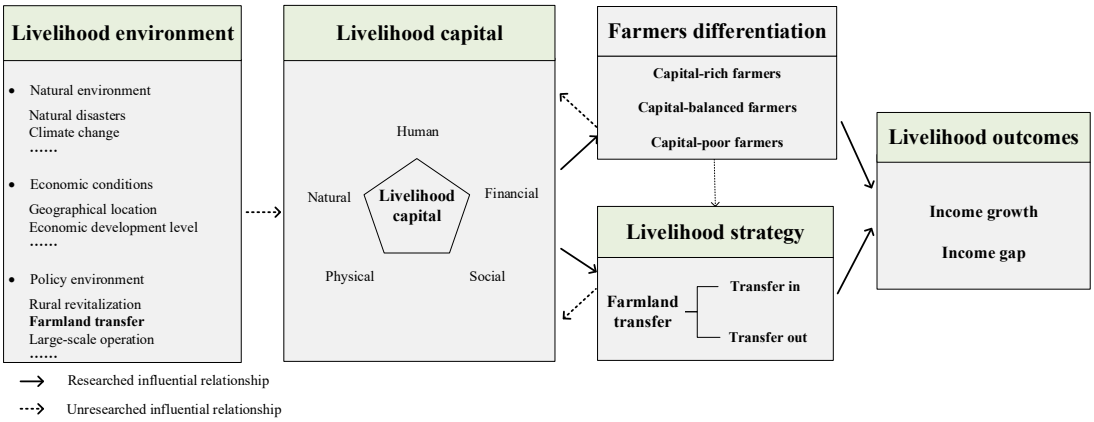

Figure 1. Analytical framework.

2.1. Income Effect of Farmland Transfer

It is assumed that farmers are rational economic agents with the behavioral goal of maximizing household income. Then, farmland transfer is a process of reallocating land resources by farmers, which inevitably affects family income. According to the direction of farmland transfer, this study divides farmers' behavior into two categories: transfer-in and transfer-out.

For the transfer-in households, the land transfer-in has expanded the operation scale of agricultural land. This helps to take full advantages of resources such as family labor and production equipment, realize the optimal allocation of production factors, and thus improve land and labor productivity [35,36]. Farmland scale operation is also easy to popularize and use advanced production technology and equipment, improve farmers' production management capacity, and provide sustainable power for improving agricultural production efficiency [37]. At the same time, the unified procurement of production inputs by large-scale farm reduces the price of agricultural materials and the cost of agricultural production [15,38]. Furthermore, large-scale operation facilitates the control and management of diseases and insects and reduces farmers' production and management risks. Consequently, by improving agricultural production efficiency and reducing production costs, the transfer-in households can achieve higher agricultural income.

The size of Chinese farmers' land is generally small, and the plots are scattered. Farmland transfer-out can reduce the number of plots and reduce the economic loss caused by land fragmentation [39,40]. Farmers who rent out farmland can obtain stable land rent, and at the same time, they put more labor into non-agricultural employment, which increases non-agricultural income [5].

In summary, under the premise of farmers' voluntary transfer, farmers with higher agricultural productivity tend to transfer-in land and obtain higher income through scale operation [10,41,42]. In contrast, farmers with lower agricultural productivity and the advantage of non-agricultural employment, are more inclined to transfer-out land to increase total household income [12]. Therefore, the study proposes the following hypothesis:

Hypothesis 1. *Farmland transfer (transfer-in and transfer-out) can improve farmers' income.*

2.2. Income Distribution Effect of Farmland Transfer

With well-functioning factor markets, the farmland transfer market can transfer land at relatively low transaction costs, improve land use efficiency, reduce family vulnerability of poor farmers, and improve the equity of income distribution [17,19]. However, the

farmland transfer market in China is not perfect at present, and it is difficult to exert the leveling effect of transaction returns [43]. In addition, due to the objective reality of the heterogeneity of family resource endowment in rural society, not all farmers can participate in the farmland transfer market as desired [18].

From the perspective of farmland transfer-in, the income gap caused by land scale under certain production technologies is an important reason for the agricultural income gap among farmers [44]. It has been shown that farmland transfer is a decision and behavior of "rich people" [45]. Due to a lack of innate resource endowment, some low-income farmers are less likely to enter the farmland transfer market [18]. At the same time, low-income farmers do not have the ability to transfer-in more land due to capital, technology and credit constraints, making it difficult to reach the "threshold" of working at scale and achieving economies of scale. Even if they transfer a small amount of land, the return is low as a consequence of limited agricultural production and management capacity [46]. While high-income farmers have financial advantages and can transfer more land to achieve large-scale operations. They have high social and human capital, can obtain timely market information, adopt new technologies, change agricultural production and operation methods, and obtain higher profits by reducing production costs or changing cropping patterns [18]. Therefore, compared with low-income farmers, high-income farmers can take advantage of large-scale land operations, and earn a higher agricultural income.

As for the farmland transfer-out, low-income farmers are more dependent on land, so the probability of land transfer-out is low [45]. Due to poor labor quality, low-income farmers face more constraints in the non-agricultural employment market. And, they are not competitive enough for employment and also have difficulties obtaining a higher wage. However, high-income farmers are less dependent on land, so they can get rent by transferring-out farmland. At the same time, with higher human and financial capital, they not only have access to employment opportunities with higher wages but can also increase their non-agricultural income through entrepreneurship.

In summary, farmland transfer has heterogeneous effects on farmers with different income levels. Compared with high-income farmers, low-income farmers are constrained by their own resource endowments and benefit less from the farmland transfer market. Therefore, the study proposes the following hypothesis:

Hypothesis 2. *Farmland transfer (transfer-in and transfer-out) will widen the income gap between farmers*.

2.3. Income Effect of Farmland Transfer of Farmers with Livelihood Capital Heterogeneity

With the advance of marketization, the livelihood capital of farmers gradually differentiates. Farmers are no longer highly homogeneous groups, but groups with heterogeneous livelihood capital. The heterogeneity of farmers' livelihood capital leads to different returns from the farmland transfer to individual income.

There are differences in the impact of farmland transfer on the agricultural income of heterogeneous farmers with livelihood capital. First, there is a close relationship between the size of the transfer and the capital endowment of farmers [47]. Farmers with rich livelihood capital have strong fund payment ability; they can reach the "threshold" of the optimal farm scale and thus obtain scale economy benefits [15]. Second, in terms of production costs, large farms facilitate the use of large machinery and new technologies, making agricultural production management efficient and intensive. At the same time, capital-rich farmers who buy production inputs in large quantities lower the prices of agricultural materials and thus lower the cost of agricultural production [38]. Third, in terms of technology adoption, capital-rich farmers have higher human capital and are more willing to adopt new technologies to earn higher profits [12]. However, farmers with relatively poor livelihood capital are less sensitive to new technologies and prefer traditional production routes. Therefore, there will be differences in agricultural income between them.

In terms of non-agricultural income, capital-rich farmers have relatively high levels of human capital and can earn a higher wage through entrepreneurship or non-agricultural employment after giving up their farmland [48]. Meanwhile, capital-rich farmers are sensitive to market changes. Facing the active farmland transfer market, they can also take advantage of their physical capital to provide farm machinery services for other farmers and earn property income. In contrast, farmers with poor livelihood capital are more dependent on land for subsistence. Due to lack of funds, they may not have invested enough in agricultural production, resulting in lower returns on agricultural income. At the same time, due to the lack of certain skills and qualities, they cannot get higher wages in the non-agricultural job market. Therefore, the study proposes the following hypothesis:

Hypothesis 3. *There are differences in the effects of farmland transfer on income among heterogeneous farmers with livelihood capital*.

3. Data and Methods

3.1. Data Sources

The data used in this study comes from the Chinese Family Panel Studies (CFPS). The CFPS database is tracked and updated every two years, starting with the 2010 baseline survey. The survey covers 25 provinces (municipalities and autonomous regions), and the questionnaire covers three levels: individual, family, and community. The CFPS database comprehensively reflects China's economic, social, demographic, and health changes, which can be regarded as national and representative sample data.

To ensure the validity of data, the data processing procedure in this study is as follows: (1) Since there may be a reverse causality between livelihood capital and farmland transfer, to avoid the endogeneity problem caused by cross-sectional data, this paper draws on existing studies [49,50] and selects historical data on farmers' livelihood capital to ensure that livelihood capital precedes farmland transfer decisions. Therefore, the livelihood capital data in this paper uses the survey implemented in 2012 because it contains detailed information on farmers' land, labor, agricultural production, and assets, while farmland transfer and household income data are from CFPS2018.

(2) To capture the impact of regional economy and geography on farmers' income, this paper also selects regional and village characteristics variables among the control variables. In the CFPS database, community-level surveys are only available for 2010 and 2014, and the village-level data in the paper are from CFPS2014 (Table 1).

Table 1. Data source.

Variable Type	Variables	Date Sources	Year
Dependent variable	Household income	Family database	2018
Treatment variable	Farmland transfer	Family database	2018
Control variable	Livelihood capital	Family database	2012
	Village and region	Community database	2014

(3) The 2012 and 2018 household databases were merged and matched with the 2014 community database in this study. Farm households with missing values were excluded, and the final valid sample included 5265 households, involving 374 villages in 24 provinces. In addition, based on the level of economic development and geographical conditions, this study divided the sample region into three regions: eastern, middle, and western. The eastern region mainly consists of coastal provinces with a relatively developed economy. The middle region is located in the inland areas of China and is characterized by a higher proportion of plains and relatively balanced economic development. The western region has higher terrain and a relatively underdeveloped economy [51]. According to this regional division, there are 1804 households, 1535 households, and 1926 households in the eastern, middle, and western regions, respectively. The study area is shown in Figure 2.

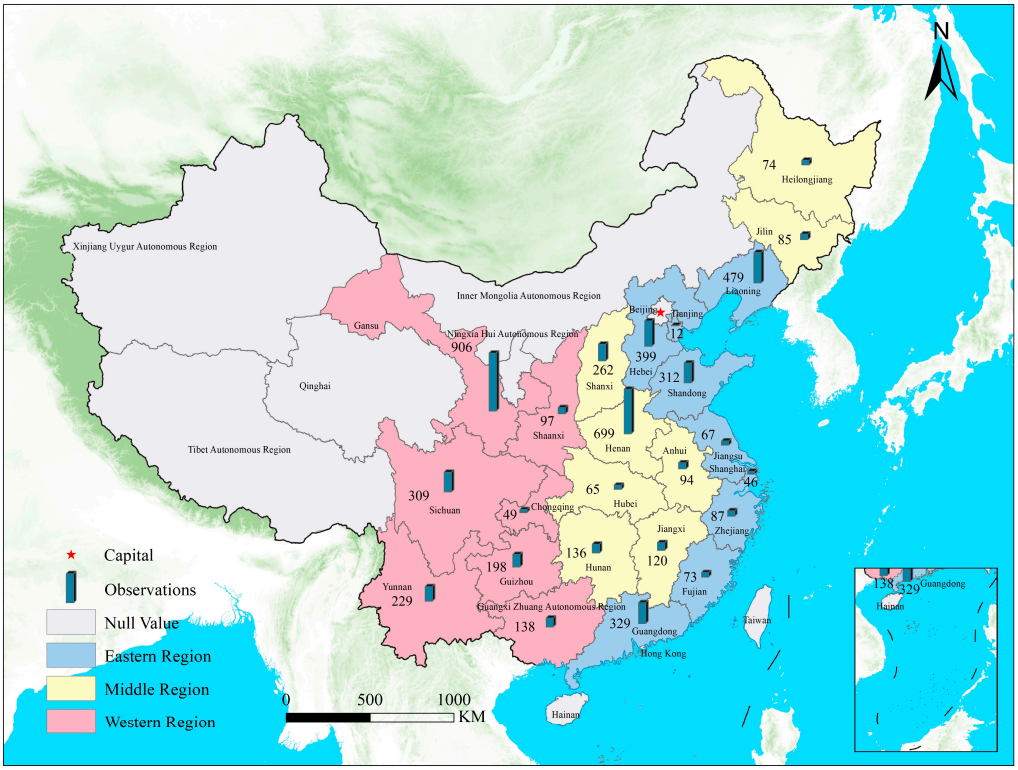

Figure 2. Study area and survey sample distribution.

3.2. Methods

3.2.1. Endogenous Switching Regression Model

As rational individuals, whether farmers participate in farmland transfer is often a "self-selection" that takes into account their own comparative advantages. There are unobservable factors that affect both farmers' farmland transfer behavior and household income such as farmers' management capacity and production preferences. When such unobservable factors are not measured, then there would be a correlation between the farmers' behavior and the error term, resulting in biased estimation results. In view of this, this study uses the endogenous switching regression model (ESR) proposed by Lee [52] to estimate the income effects of farmland transfers, so as to solve the problem of model self-selection.

In the first step, a Logit model is used to estimate the selection equation for farmers' participation in farmland transfer. The formula is given as follows:

$$T_i^* = \gamma Z_i + \mu_i, \tag{c}$$

$$T_i = \begin{cases} 0, \ T_i^* = \gamma Z_i + \mu_i \leq 0 \\ 1, T_i^* = \gamma Z_i + \mu_i > 0 \end{cases}. \tag{2}$$

Equation (1) is a model of the potential utility of farmers' participation in farmland transfer, where T_i^* is the latent variable that farmer i captures net returns from transferring farmland. T_i represents the probability that farmer i chooses farmland transfer. Z_i are observed variables, including the farmers' livelihood capital and village characteristics. Farmer i will choose farmland transfer if it leads to higher net returns than not transfer, that is, if $T_i^* = \gamma Z_i + \mu_i > 0$. Finally, μ_i is the error term.

In the second stage of ESR, it estimates the effects of participation in farmland transfer on income using ordinary least squares (OLS) regression, including selectivity correction terms. The farmers' income equation for each possible choice is given as:

$$\begin{cases} Y_{Ti} = \beta_T X_{Ti} + \varepsilon_{Ti}, \ if \ T_i = 1 \\ Y_{Ui} = \beta_U X_{Ui} + \varepsilon_{Ui}, \ if \ T_i = 0 \end{cases}, \tag{3}$$

where Y_{Ti} represents the income of farmer i who transfers farmland; Y_{Ui} represents the income of farmer i who dose not transfer farmland. X_i is a group of explanatory variables. β is the estimated coefficient; ε_i is the error term. To avoid estimation errors caused by unobservable factors, the inverse Mills ratio calculated in Equation (2) is introduced into the income equation. The second stage of ESR leading to consistent estimates is then specified as follows:

$$\begin{cases} Y_{Ti} = \beta_T X_{Ti} + \varepsilon_{Ti}, \ if \ T_i = 1 \\ Y_{Ui} = \beta_U X_{Ui} + \varepsilon_{Ui}, \ if \ T_i = 0 \end{cases}, \tag{4}$$

where ϵ_i is the error term; σ_μ is the covariance between ε_i and μ_i, $\sigma_{T\mu} = cov(\varepsilon_T, \mu)$, $\sigma_{U\mu} = cov(\varepsilon_U, \mu)$. λ_i is the inverse Mills ratio. In order to identify the model, there is at least one instrumental variable (IV) in Equation (2). The IV should not influence farmers' income directly except through farmland transfer.

Evaluating the impact of farmland transfer requires information on the outcome of farmers participating in farmland transfer (actual outcome) and the outcome of these farmers had they not participated in farmland transfer (counterfactual outcome). The ESR computes the counterfactual outcome, which estimates the potential effects of non-transfer for farmers who participated in farmland transfer. According to Equation (4), the conditional expectations can be calculated for each farmer in the case of transfer and non-transfer farmland.

Farmland transfer participants (actual outcome):

$$E[Y_{Ti}|T_i = 1] = \beta_T X_{Ti} + \sigma_{T\mu}\lambda_{Ti}. \tag{5}$$

Farmland transfer participants had they not participated (counterfactual outcome):

$$E[Y_{Ui}|T_i = 0] = \beta_U X_{Ui} + \sigma_{U\mu}\lambda_{Ui}. \tag{6}$$

Equation (5) represents the actual expected income in the sample for farmland transfer participants, respectively, while Equation (6) represents the counterfactual income. The average treatment effect on the treated (ATT) can be then calculated as the difference between Equations (5) and (6):

$$ATT = E[Y_{Ti}|T_i = 1] - E[Y_{Ui}|T_i = 1] = (\beta_T - \beta_U)X_{Ti} + (\sigma_{T\mu} - \sigma_{U\mu})\lambda_{Ti}. \tag{7}$$

3.2.2. Unconditional Quantile Treatment Effect

In applied econometrics, 95% of studies explore average effects, often ignoring the distributional effects of variables [53]. While public policy makers are more concerned with the distributional effects of policy impacts. This paper hopes to understand not only the average impact of farmland transfer on farmers' income but also the heterogeneous impact of farmland transfer on different income groups. The estimation of quantile treatment effects (QTEs) is required.

QTEs are divided into conditional quantile treatment effects (CQTE) and unconditional quantile treatment effects (UQTE). There are differences between the two methods. Taking the topic of this paper as an example, CQTE reveals the effect of farmland transfer on the income distribution of farmers with the same observed characteristics (e.g., household background characteristics, etc.). Whereas UQTE summarizes the causal effect of farmland transfer on the income distribution for the entire population, regardless of their household

background characteristics [54]. The definition of UQTE is not a function of the covariates, so it does not change when changing the set of covariates [55,56].

Further, depending on the type of treatment, the QTEs are divided into exogenous treatment effects and endogenous treatment effects. If the treatment is random and exogenous to the outcome variable, the exogenous treatment effects can be used; otherwise, instrumental variables need to enter the model to identify causal effects [53]. Since there is "self-selection" in farmers' farmland transfer behavior, this paper uses the unconditional endogenous QTEs proposed by Frölich and Melly [55] to estimate the effect of farmland transfer on farmers' income at different income distribution points.

T_i is a binary variable representing the farmland transfer. Y_i^1 and Y_i^0 denote the potential income of farmer i who transfers land or does not transfer land, respectively. Y_i is the observed outcome, which is $Y_i = Y_i^1 T_i + Y_i^0(1 - T_i)$. Assuming that farmers' income Y_i is a linear function of the farmland transfer T_i and covariates X_i, the model is set as follows:

$$Y_i^T = a^\tau X_i + d^\tau T_i + \mu_i,\ Q_{\mu_i}^\tau = 0, \tag{8}$$

where $i = 1, 2 \cdots\cdots, n$; $T_i \in (0, 1)$; and $Q_{\mu_i}^\tau$ is the τth quantile of the unobserved random variable μ_i. a^τ and d^τ are the unknown parameters. The UQTE of farmland transfer on income (for quantile τ) is given by

$$\Delta^\tau = Q_{Y^1}^\tau - Q_{Y^0}^\tau, \tag{9}$$

where $Q_{Y^T}^\tau$ represents the τ quantile of Y^T.

This estimation method is only for the case where the treatment and instrumental variables are binary variables. When the treatment variable is endogenous in the model, the estimator as following [55]:

$$\left(\hat{\alpha}_{IV}, \hat{\Delta}_{IV}^\tau\right) = \underset{\alpha,\Delta}{argmin} \sum W_i^{FM} \times \rho_\tau(Y_i - \alpha - T_i\Delta), \tag{10}$$

$$W_i^{FM} = \frac{Z_i - Pr(Z = 1|X_i)}{Pr(Z = 1|X_i)\{1 - Pr(Z = 1|X_i)\}}(2T_i - 1). \tag{11}$$

Equation (10) is a bivariate quantile regressor estimator with weights. Z is a binary instrumental variable. It can be found that $\alpha_{IV} + \Delta_{IV}^\tau$ is identified only from $T_i = 1$ observations and that α_{IV} is identified only from $T_i = 0$ observations. Therefore, the Δ_{IV}^τ is equivalent to using two univariate weighted quantile regressions [55].

3.3. Variables

3.3.1. Dependent Variable

The focus of this study is the income effect of farmers, referring to the research conducted by Peng et al. [9], Guo et al. [14], and Chen et al. [57], the per capita net income of households is selected as the dependent variable. The per capita net income of households can exclude the influence of population size, which better reflects the actual situation of household income. The model variables and summary statistics are described in Table 2.

3.3.2. Treatment Variable

Farmers' farmland transfer behavior is the treatment variable. In this paper, farmland transfer-in and transfer-out behaviors are selected to represent the farmland transfer characteristics of farmers. In the total sample, there were 1497 farmers participating in farmland transfer, accounting for 28.43%. Among them, 586 farmers transferred into the land, accounting for 11.13% of all farmers; 911 farmers transferred out of the land, accounting for 17.30% of all farmers.

Table 2. Variable definition and descriptive statistics.

Variables	Definition of Variables	Mean	SD
Dependent variable			
Income	Per capita net income of household (yuan/person)	18,110.47	54,158.19
Treatment variable			
Farmland transfer-in	Transferring in farmland (=1 if farmer transfers in land; 0 otherwise)	0.111	0.315
Farmland transfer-out	Transferring out farmland (=1 if farmer transfers out land; 0 otherwise)	0.173	0.378
Natural capital			
Land area	Family contracted land area (mu [1])	10.291	31.711
Human capital			
Labor	Number of labor force in households between 16–60 years old (person)	3.028	1.215
Education level	Average education level of household labor force (year)	7.079	3.143
Physical capital			
Agricultural machinery	Total value of agricultural equipment (yuan)	1691.441	6413.613
House	The market value of currently occupied housing (yuan)	111,733.8	203,327.5
Financial capital			
Deposits	Total household cash and savings (yuan)	15,389.55	35,592.97
Borrowing capacity	Ability to obtain loans from banks or informal financial institutions (=1 if farmer can access loans; 0 otherwise)	0.363	0.481
Social capital			
Relatives	Participating in ancestor worship and tomb-sweeping activities (=1 if farmer Participates; 0 otherwise)	0.691	0.462
Relational network	Household expenditure on economic transactions with non-resident relatives (yuan)	800.51	4028.15
Village and regional variable			
Village location	The distance between village and county town (li [2])	52.621	41.717
Village economic condition	Very Poor --1--2--3--4--5--6--7--> very rich	3.837	1.259
Middle [3]	Middle region = 1, else = 0	0.292	0.455
Western [4]	Western region = 1, else = 0	0.366	0.482
Instrumental variables			
Village farmland transfer ratio	The ratio of land circulation in the village (%)	0.512	0.500
Village farmland transfer degree	high ratio = 1, low ratio = 0	0.255	0.187

Note: [1]. 1 mu = 667 m^2 or 0.067 ha. [2]. 1 li = 500 m. [3]. The middle region includes Jilin, Heilongjiang, Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan Provinces. [4]. The western region includes Guangxi, Guizhou, Yunnan, Chongqing, Sichuan, Shanxi, and Gansu Provinces.

3.3.3. Instrumental Variable

The IVs should not influence farmers' income directly except through farmland transfer. Both models in this paper require IVs.

First, the election equation in the ESR model requires IV to ensure identification. Based on the studies of Xiao et al. [46] and Chen et al. [58], this paper uses the farmland transfer ratio in farmers' villages as an IV. Considering the "cohort effect" of farmers' farmland transfer behavior, the farmland transfer ratio in farmers' villages may influence the farmers' transfer behavior, but it does not have a direct impact on their income.

Second, a binary dummy variable is required as an IV in the UQTE. Following Frölich and Melly [55], the study uses the median farmland transfer ratio in farmers' villages as the threshold value. The IV is assigned a value of 1 if the ratio surpasses the median and 0 otherwise.

3.3.4. Control Variable

The control variables include livelihood capital variables, village variables, and regional variables. Livelihood capital variables are based on the SLF with a selection of natural, human, social, financial, and physical capital [33]. Natural capital is the natural resources, including land, water resources, and biological resources, on which farmers depend to sustain their livelihoods [30]. In this paper, the area of land contracted by households is selected to measure natural capital [51]. Human capital includes the knowledge, labor skills, and health that farmers possess to earn a living [30]. Two indicators are selected to measure the level of human capital: the number of households' labor forces and the average education level of the labor forces [33,59]. Financial capital is the financial resources that farmers can use to dispose of their production and livelihood, including their own savings and credit [60]. Two indicators were selected to measure the level of financial capital of farm households: total household cash and deposits, and the availability of loans from banks or non-financial institutions [47,61]. Physical capital is the material base that supports the livelihoods of farmers, including infrastructure as well as production tools. The market value of a house and the total value of farm machinery are selected to measure physical capital [62]. Social capital is the network of relationships or social resources that farmers can use to achieve their livelihood activities [60]. In this paper, two variables are selected to represent social capital: household gift expenditure and whether to participate in ancestor worship and tomb-sweeping activities [25,60]. To capture the effect of regional economy and geography on farmers' income, control variables such as village distance from the county, village economic status, and region were selected.

4. Results

4.1. Influencing Factors of Farmers' Income

Table 3 reports the estimation results of the ESR model between farmland transfer and farmers' income. The LR test of independence equations is significant at a 1% level. In some of the models, the error term correlation coefficients are statistically significant, indicating the presence of sample selection in the participation in farmland transferring. Therefore, it is necessary to use an endogenous switching model to correct the problem of sample selection bias caused by unobservable factors. The estimated results of the income equations for transferred-in and non-transferred-in households are presented in models 1 and 2 of Table 3. The income equation results for transferred-out and non-transferred-out households are presented in models 4 and 5. Because of the focus of this article on analyzing the impact of farmland transfer on farmers' income, the results of selected models (Model 3 and Model 6) are not specifically analyzed here.

The results of Model 1 and Model 4 indicate that natural capital has a positive effect on the income of transferred-in households, while it has a negative but insignificant effect on the income of transferred-out households. For human capital, the number of family laborers has a significant positive impact on the income of transferred-out households. This suggests that households with ample labor resources can allocate their workforce more flexibly across agricultural and non-agricultural sectors, leading to a wider range of income sources. The level of education among the family labor force has a significant effect on increasing farmers' income. On the one hand, highly educated farmers have certain advantages in the non-agricultural labor market, which gives them more employment opportunities and higher non-agricultural wages. On the other hand, highly educated farmers have a certain reserve of knowledge, which allows them to master the latest agricultural production management techniques and thus increase agricultural income [12].

In the case of physical capital, the total value of agricultural equipment has a significant negative impact on the income of transferred-in households. House value has a significant positive effect on the income of transferred-out households. For financial capital, deposits have a positive effect on the income of transferred households and have a significant impact on the income of the transferred-out households, indicating that rural households with

more deposits have production input and investment capabilities, which help them make high-profit, high-risk investments and increase their household income [63]. In the case of social capital, relational networks have a significant positive effect on transferred-out households' income. One possible reason is that households with more extensive social networks have access to more external information channels, which can help farmers obtain information about agricultural production, the market, and non-agricultural employment opportunities, thus increasing household income [64]. Finally, the instrumental variable, village farmland transfer ratio, has a significant positive effect on farmers' participation in farmland transfer.

Table 3. Estimation results of ESR model between farmland transfer and farmers' income.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Transferred-In Households	Non-Transferred-In Households	Selection Model of Farmland Transfer-In	Transferred-Out Households	Non-Transferred-Out Households	Selection Model of Farmland Transfer-Out
Land area (log)	0.077	−0.050 ***	−0.038	−0.037	−0.031 *	−0.033
	(0.050)	(0.016)	(0.026)	(0.039)	(0.016)	(0.023)
Labor	−0.041	0.015	0.035 *	0.062 **	0.019	−0.053 ***
	(0.039)	(0.012)	(0.020)	(0.030)	(0.013)	(0.018)
Education level	0.099 ***	0.065 ***	−0.020 **	0.023 *	0.064 ***	0.033 ***
	(0.016)	(0.005)	(0.008)	(0.012)	(0.005)	(0.007)
Agricultural machinery (log)	−0.044 ***	−0.000	0.044 ***	0.013	0.006	−0.021 ***
	(0.013)	(0.004)	(0.006)	(0.010)	(0.004)	(0.006)
House (log)	−0.005	0.025 ***	0.001	0.027 **	0.020 ***	−0.002
	(0.020)	(0.006)	(0.010)	(0.012)	(0.006)	(0.008)
Deposits (log)	0.014	0.028 ***	0.010	0.046 ***	0.021 ***	0.006
	(0.017)	(0.005)	(0.009)	(0.013)	(0.006)	(0.008)
Borrowing capacity	−0.115	0.028	0.213 ***	0.091	0.047	−0.023
	(0.095)	(0.031)	(0.050)	(0.074)	(0.032)	(0.045)
Relatives	0.028	0.057 *	−0.017	−0.125	0.068 **	0.070
	(0.097)	(0.031)	(0.051)	(0.077)	(0.032)	(0.046)
Relational network (log)	−0.014	0.022 ***	0.005	0.026 **	0.015 ***	0.002
	(0.014)	(0.005)	(0.008)	(0.011)	(0.005)	(0.007)
Village location (log)	−0.042	−0.041 **	−0.005	0.046	−0.052 ***	−0.021
	(0.057)	(0.016)	(0.028)	(0.040)	(0.017)	(0.024)
Village economic condition	0.099 ***	0.052 ***	−0.004	−0.048	0.055 ***	0.089 ***
	(0.036)	(0.012)	(0.019)	(0.029)	(0.012)	(0.017)
Village farmland transfer ratio			0.875 ***			0.913 ***
			(0.111)			(0.108)
Middle	−0.177	−0.113 ***	0.151**	−0.064	−0.075**	−0.006
	(0.113)	(0.036)	(0.059)	(0.088)	(0.037)	(0.053)
Western	−0.073	−0.046	0.023	−0.258 ***	0.007	0.049
	(0.119)	(0.036)	(0.062)	(0.086)	(0.039)	(0.053)
Constant	10.826 ***	8.283 ***	−1.710 ***	10.177 ***	8.290 ***	−1.507 ***
	(0.427)	(0.114)	(0.196)	(0.331)	(0.121)	(0.172)
ρ_1	−1.408 ***			−1.159 ***		
	(0.107)			(0.117)		
ρ_2		−0.122 *			−0.097	
		(0.073)			(0.072)	
Observations	5265	5265	5265	5265	5265	5265
Log likelihood		−8963.5611			−9515.2413	
Wald chi2		79.03 ***			59.99 ***	
LR chi2		41.07 ***			23.45 ***	

Note: *, **, *** indicate the significance levels of 10%, 5%, and 1%, respectively. Due to the existence of zero values in variables such as agricultural machinery, house, deposits, and relational network, the logarithm is taken using the form log(x + 1).

In addition, in terms of regional characteristics, the middle region variable has a significant negative effect on the income of non-transferred households, implying that the income of non-transferred households is lower in the middle region compared to the eastern region. There are several potential reasons for this disparity. Firstly, the eastern region benefits from its flat terrain and abundant water resources, which create favorable conditions for agricultural production. Consequently, farmers in the eastern region enjoy higher levels of income from agricultural activities. Additionally, the eastern region boasts a more developed economy, offering numerous non-farm employment opportunities and higher wage rates for farmers seeking alternative sources of income [51].

The western region variable has a significant negative effect on the income of transferred-out households, indicating that the income of transferred-out households is lower in the western region compared to the eastern region. This discrepancy can primarily be attributed to the relatively less developed economic conditions in the western region. After transferring out their land, farmers in the western region encounter limited opportunities for non-agricultural employment, which further contributes to their reduced income prospects [51].

4.2. Impacts of Farmland Transfer on Farmers' Income

Table 4 presents the actual and counterfactual estimates and the average treatment effects (ATT) of farmland transfer on farmers' income. Results show that the farmland transfer has a significant positive effect on the income growth of farmers. And both farmland transfer-in and transfer-out can increase farmers' income. The research hypothesis 1 has been verified.

Table 4. Average treatment effects (ATT) of farmland transfer on farmers' income.

Farmers' Type	Actual Outcome	Counterfactual Outcome	ATT
Transferred-in	9.308 (0.015)	9.060 (0.013)	0.248 *** (0.010)
Transferred-out	9.533 (0.012)	9.173 (0.010)	0.360 *** (0.007)

Note: *** indicate the significance levels of 1%. Standard errors are in parentheses.

At the same time, the effect of farmland transfer on farmers' income is "asymmetric" in nature [37]. The results indicate that farmland transfer-in increases farmers' income by 21.15%[1], while transfer-out increases it by 43.33%. That is, the magnitude of the impact is relatively higher for farmers who transfer-out than those who transfer-in. This result is consistent with the findings of Shi et al. [18] and Mao et al. [37], implying that current agricultural returns are lower than non-agricultural returns, and that transferred-out households obtain higher income growth by transferring labor force to non-agricultural sectors.

4.3. Impacts of Farmland Transfer on Income Distribution of Farmers

Table 5 reports the unconditional quantile treatment effect (UQTE) of farmland transfer on income distribution. To facilitate the analysis, this paper divides households into the low-income group ($\tau = 0.2$), middle-income group ($\tau = 0.4$–0.6), and high-income group ($\tau = 0.8$) according to income quantile.

Table 5. Estimation results of the effect of farmland transfer on income distribution.

Quantile	Farmland Transfer-In	Farmland Transfer-Out
$\tau = 0.2$	0.683 (0.974)	0.716 (0.741)
$\tau = 0.4$	0.695 *** (0.181)	1.167 *** (0.242)
$\tau = 0.6$	0.836 *** (0.309)	1.306 *** (0.383)
$\tau = 0.8$	1.267 *** (0.439)	1.129 ** (0.458)

Note: **, *** indicate the significance levels of 5%, and 1%, respectively. Standard errors are in parentheses.

The results show that, except for the lowest quantile, both farmland transfer-in and transfer-out have a significant effect on farmers' income, indicating that farmland transfer can generally contribute to increasing farmers' income. As the income quantile of farmers increases, the effect of farmland transfer-in on farmers' income gradually rises. Furthermore, high-income farmers gain greater returns from farmland transfer-in, indicating that it widens the income gap among rural households.

The effect of farmland transfer-out on farmers' income increases with increasing income in the low-middle quantile range, with the greatest income-growth effect for farmers in the middle-income group. Overall, the income-growth effect of farmland transfer is more pronounced for the middle and high-income groups, and research hypothesis 2 has been tested. In addition, for the two types of farmland transfer, the effect of farmland transfer-out on farmers' income is larger than that of farmland transfer-in for the low-middle income groups, indicating that the income effect of farmland transfer is asymmetric.

4.4. Income Effects of Farmland Transfer for Heterogeneous Farmers with Livelihood Capital

To further test the differences in income effects of farmland transfer among heterogeneous farmers with livelihood capital, this paper refers to existing studies [25,26,65], quantifies farmers' livelihood capital indicators using the entropy method, and then classifies farmers into three categories using the K-means cluster analysis method: namely, livelihood capital-rich type, livelihood capital-balanced type, and livelihood capital-poor type. The characteristics of each type of farmer are shown in Table 6 (see Appendix A for the specific procedure of the entropy method). Among the five types of livelihood capital, the proportion of human capital in sample households is the highest, followed by financial capital, indicating that human capital has become the main capital of farmers' livelihood activities.

Table 6. Characteristics of livelihood capital of all kinds of farmers.

Farmers' Type	Observations	Natural Capital	Human Capital	Physical Capital	Financial Capital	Social Capital	Livelihood Capital
Livelihood capital-rich	1775	0.0117	0.3372	0.0142	0.4653	0.1163	0.9447
Livelihood capital-balanced	1929	0.0086	0.3342	0.0127	0.0601	0.1145	0.5301
Livelihood capital-poor	1561	0.0074	0.2050	0.0071	0.0061	0.0628	0.2884
Total sample	5265	0.0093	0.2969	0.0116	0.1807	0.0998	0.5982
F		10.16	912.43	43.85	11,002.03	323.13	16,812.52
Prob > F		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

In terms of the differences in livelihood capital between farmers, various types of livelihood capital were tested by the one-way ANOVA method among the three categories of farmers, indicating that there are significant between-group differences in livelihood capital among farmers. The capital-rich farmers have significantly higher levels of livelihood capital compared to the other two types of farmers. Moreover, the financial capital of capital-rich farmers has the highest proportion among their total livelihood capital, while for balanced or poor farmers, human capital has the highest proportion.

Table 7 presents the actual and counterfactual estimates and the average treatment effects (ATT) of farmland transfer on the income of farmers with livelihood capital heterogeneity. In general, there is a significant positive effect of farmland transfer on the income of different types of farmers, and there are differences in the effects, so hypothesis 3 has been verified.

The income-growth effect of farmland transfer-in on capital-rich farmers is larger than that of the other two types of farmers, and the income-growth magnitude of capital-poor farmers is the smallest, suggesting that the payoffs of land scale differ among farmers.

While the income growth effect of farmland transfer-out is much greater for livelihood capital-balanced farmers than for other farmers, in contrast, the income growth effect is lowest for livelihood capital-rich farmers, indicating that farmland transfer-out is more beneficial for livelihood capital-balanced farmers to increase income.

Table 7. The effects of farmland transfer on income of heterogeneous farmers with livelihood capital.

Farmland Transfer Decision	Farmers' Type	Observations of Farmland Transfer	Actual Outcome	Counterfactual Outcome	ATT
Transfer-in	Livelihood capital-rich	238	9.464 (0.021)	9.154 (0.015)	0.310 *** (0.021)
	Livelihood capital-balanced	203	9.269 (0.032)	9.075 (0.022)	0.194 *** (0.023)
	Livelihood capital-poor	145	9.070 (0.024)	8.910 (0.029)	0.160 *** (0.026)
Transfer-out	Livelihood capital-rich	300	9.559 (0.021)	9.355 (0.011)	0.204 *** (0.013)
	Livelihood capital-balanced	355	9.664 (0.016)	9.143 (0.019)	0.521 *** (0.009)
	Livelihood capital-poor	256	9.312 (0.018)	8.931 (0.019)	0.381 *** (0.014)

Note: *** indicate the significance levels of 1%. Standard errors are in parentheses.

Further comparing the income-growth effects of different transfer directions for the same type of farmer can find that the income-growth effect of farmland transfer-in is greater than that of farmland transfer-out. However, the income increase effect of farmland transfer-out is greater than that of farmland transfer-in for livelihood capital-balanced and capital-poor farmers.

5. Discussion

This article primarily focuses on the impact of farmland transfer on farmers' income growth and income disparity, as well as the income differences in farmland transfer among farmers with different types of livelihood capital. Based on sustainable livelihood theory, a theoretical analysis framework of the impact of farmland transfer on farmers' income is constructed and three research hypotheses are proposed. Using microdata from the CFPS, an ESR model and an unconditional endogenous QTE are used to analyze the income distribution effect of farmers' farmland transfer. The study found that both farmland transfer-in and farmland transfer-out significantly increased farmers' income, which is consistent with the findings of Peng et al. [9], Zhu et al. [17], Shi et al. [18], Gao et al. [24], Mao et al. [37], and Chen et al. [57]. The main reason is that China's agricultural population is growing, but the arable land area is limited, and land scarcity has become the main bottleneck inhibiting farmers' income. However, the redistribution of land resources through farmland transfer is beneficial in breaking this constraint and providing a prerequisite for increasing farmers' income. When farmers transfer-in farmland, the scale of production and operation expands, and farmers are more motivated to change their traditional production management methods to achieve income growth by increasing the output value per unit of land. And when farmers transfer out of the land, they have more employment options, can get salary increases and promotions through continued human capital accumulation, and ultimately achieve income growth through increased wages and land rents [9,57]. In addition, Guo et al. [14] and Zhang et al. [61] found that farmland transfer-in can increase farmers' income, but farmland transfer-out has a negative effect on farmers' income. This result differs from this paper mainly because these studies focus on different regions of China and have relatively small sample sizes; at the same time, the endogeneity issue in the model is not sufficiently considered.

Regarding the impact of farmland transfer on income disparity, this paper finds that the income-growth effect of farmland transfer is more pronounced for the middle- and high-income groups, indicating that it widens the income gap among rural households. This result is consistent with the findings of Huo et al. [2], Zhu et al. [17], and Shi et al. [18]. The possible reason is that, under the premise of voluntary transfer, low-income farmers are excluded from the farmland transfer market due to financial and capacity constraints. As a result, it becomes challenging for them to achieve income growth through large-scale farming operations [17,18]. In this study, the sample of households was divided into quintiles based on per capita net income, ranging from low to high. It was found that the proportion of farmers renting land is 10.0%, 11.0%, 12.6%, 12.8%, and 9.8% from the lowest to the highest income groups. This finding verifies the above speculation to some extent. Additionally, low-income households exhibit a stronger reliance on land and are less likely to rent out their land, which limits the increase in non-agricultural income within the household. Consequently, this further widens the income gap between low-income and high-income farmers.

In terms of the differential impact of farmland transfer on income among different types of farmers, previous studies have often classified farmers into pure-agricultural households, part-time households, and non-agricultural households based on the proportion of non-agricultural income [15,25]. However, this study takes into account the heterogeneity of farmers' livelihood capital and classifies them into livelihood capital-rich, balanced, and poor farmers. By comparing the income differences resulting from farmland transfer among different types of farmers, it was found that the income impact of farmland transfer-in is greatest for livelihood capital-rich farmers. There are two possible reasons for this phenomenon. First, livelihood capital-rich farmers have higher capital endowments and market advantages and can use their financial capital advantages to obtain enough land from the farmland transfer market to realize large-scale operations. Second, capital-rich farmers have higher levels of human capital and can use knowledge and technology to improve agricultural production efficiency and thus increase agricultural income. While the capital-poor farmers have the problems of lack of capital and lack of return and are constrained by capital to reach the threshold of large-scale operation, coupled with the lack of production facilities and management level, they are unable to realize the advantages of large-scale operation and, therefore, fall into a situation of slow income growth [18,44].

While the income impact of farmland transfer-out is greatest for livelihood capital-balanced farmers, possible explanations are that capital-balanced farmers have strong human and social capital, and farmers with high levels of human capital have a relative advantage in the labor market and can obtain higher wage rewards. In addition, capital-balanced farmers have higher social capital, can obtain information about the labor market and the farmland transfer market, and will measure the difference in returns between farmland operation and transfer-out, and eventually transfer-out the land to farmers with higher rental rewards, thereby increasing household income through the increase in wages and rents.

Based on the above discussion, this study draws the following policy implications. First, the government should continue to improve the farmland transfer market and establish a market platform for farmland transfer, so that more farmers have the opportunity to participate in farmland transfer. Secondly, it is necessary to promote the transfer of surplus rural labor by accelerating the development of the non-agricultural economy and providing more employment opportunities for farmers to work in cities so that more farmers can transfer-out farmland. Third, the government should improve rural financial credit services, encourage credit guarantee institutions to expand their rural businesses, set up multiple forms of collateral for the actual situation of farmers, provide green financial service channels for low-income farmers, and improve the ability of low-income farmers to participate in the farmland transfer market. Finally, the government could increase investment in rural continuing education to cultivate farmers' relevant professional skills

and techniques, enhance their adaptability to non-agricultural employment, as well as improve farmers' farmland management.

Compared with existing studies, the possible contributions of this article are as follows: (1) This study analyzes the impact of farmland transfer on farmers' income distribution from the perspective of livelihood capital heterogeneity, which provides a new perspective for analyzing the income effect of farmland transfer. (2) In terms of research methods, an ESR model is used to correct sample selection bias caused by unobservable factors and an unconditional endogenous QTE is used to identify the heterogeneous effects of farmland transfer on different income levels of the whole population. The research methods effectively solve the endogeneity problem in the model and make the research results more accurate.

Although this study provides a new research perspective for analyzing the income effects of farmland transfer, there are also some limitations. Firstly, due to the lack of panel data on farmers' livelihood capital, the dynamic analysis of the income effect of farmland transfer is limited. Secondly, the absence of data on farmers' agricultural income and the area of farmland transfer hinders further analysis of the impact of farmland transfer on different income structures and the effect of farmland transfer area on income. Lastly, this study only analyzes the impact of regional characteristics on farmers' income and does not examine the spatial dependence and spatial heterogeneity of the income effects of farmland transfer. In the future, we will continue to focus on the income effects of farmland transfer and strive to find suitable data and methods to further improve this study.

6. Conclusions

Improving farmers' income is a global topic, and as the world's largest developing country, China has always regarded increasing farmers' income and narrowing income gaps as important goals for social and economic development. Since the reform and opening-up, China has continuously deepened the rural land system reform and witnessed rapid development of the rural land leasing market. The income effects of farmland transfer have received widespread attention in academia, but existing research results have not reached a consensus. Furthermore, with a large number of rural laborers transitioning to the non-agricultural sector, farmers' livelihoods have become diversified, leading to variations in the income effects of farmland transfer among different types of farmers. Based on this, this study utilizes data from the China Family Panel Studies (CFPS) and analyzes the effects of farmland transfer on farmers' income growth and income inequality, as well as income differences among heterogeneous farmers with livelihood capital, using an endogenous switching regression model and unconditional quantile treatment effects. The main conclusions are as follows:

(1) Farmland transfer has an income-growth effect. Farmland transfer exhibits an asymmetric income-growth effect, with farmland transfer-out having a greater impact than farmland transfer-in. (2) The income-increasing effect of farmland transfer-in for farmers increases with the improvement of family income levels. Farmland transfer-out has the most significant income-increasing effect on middle-income and high-income farmers, with minimal impact on low-income farmers. That is, the impact of farmland transfer on the income of farmers has a "Matthew effect", which will widen the income gap between farmers. (3) The impact of farmland transfers on income differs for heterogeneous farmers with livelihood capital. The farmland transfer has a significant positive impact on the income of three types of farmers. Capital-rich farmers benefit the most from farmland transfer-in, while capital-balanced farmers experience the greatest income increase from farmland transfer-out.

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Appendix A

T In this paper, the entropy method is used to assign weights to the indicators and obtain the value of farmers' livelihood capital. The specific process is as follows:

(1) Standardization of raw data.

$$x'_{ij} = \frac{x_{ij} - \min(x_{ij}, \ldots, x_{nj})}{\max(x_{1j}, \ldots, x_{nj}) - \min(x_{1j}, \ldots, x_{nj})}. \quad \text{(A1)}$$

In the formula, suppose there are n farmers and m livelihood capital indicators. x_{ij} is the original value of indicator j of the farmer i.

(2) Calculate the share of the value of the jth indicator to the value of the ith farmer indicator.

$$p_{ij} = x'_{ij} / \sum_{i=1}^{n} x'_{ij}. \quad \text{(A2)}$$

(3) Calculate the entropy value of the jth indicator.

$$e_j = -k \sum_{i=1}^{n} p_{ij}(lnp_{ij}), k = 1/\ln(n). \quad \text{(A3)}$$

(4) Calculate the weight of each indicator.

$$w_j = (1 - e_j) / \sum_{i=1}^{n} (1 - e_j). \quad \text{(A4)}$$

(5) Measure the total value of farmers' livelihood capital.

$$s_i = \sum_{j=1}^{m} w_j x'_{ij}. \quad \text{(A5)}$$

Notes

[1] The income of farmers in this article is expressed in logarithmic form. The formula used to calculate the growth rate is exp(x) − 1, where x represents the coefficient of the average treatment effect.

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