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Abstract: The United Nations Sustainable Development Goals call for the eradication of poverty, and China has proposed the Rural Revitalization Strategy based on the achievements of its poverty alleviation efforts in 2020. As a vital component of this strategy, the impact of land transfer on farmers' income growth has become a hot topic in both theoretical and practical sectors. This paper utilizes data from the CFPS database for the years 2010-2018 to construct OLS regression models and a Heckman two-stage model to analyze the effects of land transfers on the incomes of different types and sources among farmers. The empirical results show: First, land transfers do promote income growth among farmers, but the effect is primarily positive for those transferring out land, with negligible impact on those acquiring land. Second, the impact of land transfers varies between different types of income for transferees and transferors. Wage income contributes up to 88.26% to the income growth of transferors, a significantly higher rate than the decrease in business income; however, the increase in business income for transferees does not offset the decline in wage income, leading to no significant change in overall income. Further sensitivity analysis using the Heckman two-stage model confirms the robustness of these findings. The conclusions of this study provide theoretical and empirical evidence to optimize land transfer policies, enhance participation in land transfers, and ultimately achieve the mission of rural revitalization.

Keywords: land transfer; farmer income; heterogeneity in farmer types; heterogeneity in income types; rural revitalization

1. Introduction

The United Nations Sustainable Development Goals call for the eradication of poverty, and on this basis, after achieving its poverty alleviation goals in 2020, China has proposed the Rural Revitalization Strategy. Meanwhile, China's central government emphasize "increasing farmers' income" as a main aspect of agricultural and rural work [1]. Currently, as China's national economy develops steadily and healthily, residents' incomes continue to grow rapidly. However, there is still a significant gap between urban and rural incomes, with rural income growth being relatively slow and lacking long-term drivers. Thus, a long journey remains to fulfill the mission of rural revitalization.

Land, as a crucial resource and the most significant asset for farmers, is an important topic of study in the realm of rural revitalization [2]. In recent years, the land contract rights transfer system has become increasingly stable, and the Chinese government has liberalized the land transfer system. With the acceleration of urbanization and industrialization, a large number of rural labor forces have moved to urban areas. Land transfer has income effects and continuously adjusts the relationship between people and land [3]. Land transfers help promote large-scale agricultural operations, enhance wage incomes, and increase property incomes through rent and land value appreciation associated with the transfers. Therefore, analyzing the impact of rural land transfers on farmers'

income and understanding the mechanisms involved are crucial for optimizing rural land transfer policies and advancing rural revitalization [4].

There is already a substantial body of research on the impact of land transfers on farmers' income. Property rights theory suggests that unrestricted land transfer markets can facilitate the transfer of comparative advantages among farmers [5,6], allowing transferees and transferors to specialize in their respective advantageous occupations, maximizing production efficiency, and improving their income levels [7]. However, it is puzzling that many studies on land transfers and farmers' income do not unanimously agree on whether land transfers can create an income premium. Some scholars have demonstrated that rural land transfers can increase farmers' income, benefiting both transferees and transferors, although the magnitude of the income effect varies [8–10]. For transferees, the expansion of operated land allows for more scaled and intensive cultivation, improving production efficiency and income [11]. For transferors, it enables the reallocation of labor and other productive assets away from agriculture into more lucrative non-agricultural sectors [12]. However, some studies suggest that land transfers may not significantly affect income levels [13]. For transferees, the transfers do not alter agricultural production methods significantly, and the rise in agricultural income does not offset the decline in non-agricultural income, leading to no substantial income growth [14,15]. For transferors, often engaged in non-agricultural production, the release of family labor through land transfers is not significant enough to substantially increase household income [16–18]. Therefore, there remains considerable disagreement among scholars regarding whether land transfers can promote income growth for farmers.

The reasons for these academic discrepancies likely include the following: firstly, previous studies often used Ordinary Least Squares (OLS) estimation methods and did not consider self-selection bias among farmers participating in land transfers, as continuous optimization of the industrial structure results in weaker marginal outputs in agriculture compared to non-agriculture. Those willing to transfer in typically have stronger economic capabilities, higher educational levels, and better agricultural management, indicating self-selecting behaviors [19]. Secondly, most studies have not adequately considered the different income growth paths for transferees and transferors post-transfer, leading to miscalculations of the income effects of land transfers [20]. Lastly, the heterogeneity in the effects on different types of income from land transfers is often overlooked, which could lead to biased estimates [21].

To explore the impact of land transfers on different types of farmers' income and whether there are differences in relationships between different types of farmers, this paper uses authoritative Chinese database data and employs OLS regression and the Heckman two-step method for empirical test. This paper makes the following contributions and innovations: (1) By focusing on income structures, it further refines family income into business, wage, property, agricultural production, and transfer incomes, examining the differences in the effects of land transfers on these types of income, thus supplementing and expanding existing research. (2) By fully considering the heterogeneity produced by different directions of land transfers, this research refines the analysis of the impact of land transfers on farmers' incomes, studying the effects on transferees and transferors separately, finding that the impact is primarily significant for transferors, thereby providing new directions for formulating land transfer policies.

2. Literature Review and Research Hypotheses

2.1. Impact of Land Transfer on Farmers' Income

Land is the most crucial resource for farmers' production and livelihood, and its rational allocation positively affects farmers' income [22]. Farmers with higher agricultural production efficiency are more inclined to engage in land transfers [23], which leads to an optimal allocation of land resources to those with high efficiency, thus enhancing the income of participants in land transfers [24]. Studies have shown that land transfer activities significantly increase per capita net income, non-agricultural income, and land rent income of farmers [25], while per capita agricultural income significantly decreases [26]. Scholars believe that different directions of land transfers can

significantly enhance farmers' labor productivity either through agricultural production or non-agricultural employment, thereby increasing their income [27]. However, some studies argue that land transfers do not positively impact income growth due to unstable rent amounts and incomplete support mechanisms during the transfer process, preventing optimal land resource allocation [28]. But, integrating the mechanisms analyzed by most scholars, land transfers are deemed beneficial for income growth. Hence, the hypothesis H1 is proposed:

H1: Land transfers have a significant positive impact on farmers' income growth.

2.2. Impact of Land Acquisition on Farmers' Income Structure

Research has found that different types of land transfers have varying impacts on different types of income. Concerning the direction of land transfers, some studies have focused on the effects of land acquisition on farmers' income. Scholars suggest that land acquisition can enhance agricultural production efficiency, and as the area of land acquired increases, so does its positive effect on the income growth of the acquiring household [29]. Land transfers are beneficial for the business income of the transferees, as more farmers move out of rural areas to balance farming with non-agricultural jobs, primarily non-agricultural employment, leading to abandoned farmlands, which land acquisition can effectively prevent [30]. Other scholars have found that family farms and other new agricultural business entities acquiring land can increase capital investment, enhance the mechanization and intelligence levels of agricultural production, and boost the operational income of the transferees. Land acquisition can also increase the property income of transferees who can rent out their unused agricultural equipment to other farmers [31].

However, studies also show that land acquisition reduces the time farmers spend on non-agricultural employment and increases the demand for land management, which can lead to a decrease in wage income for transferees [32]. Additionally, land acquisition can make non-agricultural employment more challenging for transferees, further reducing their wage income [33]. Also, land acquisition increases the number of farmers engaged in agricultural operations, which is not conducive to enhancing the effectiveness of agricultural support policies [34]; hence, it may suppress the growth of transfer income for transferees, reducing their transfer income [35]. Therefore, discussing the heterogeneity of farmer types and income structures in relation to the impact of land transfers on farmers' income is necessary. Based on the above literature analysis, the hypothesis H2 is proposed:

H2: The impact of the direction of land transfers on farmers' income is heterogeneous.

2.3. Impact of Land Outgoing on Farmers' Income Structure

Scholars have found that with the rapid expansion of industrialization and the continuous growth of non-agricultural industries like services, land outgoing reduces the operational land area for the transferor, lowering agricultural productivity [36,37], and due to the development of China's secondary and tertiary industries, leading many farmers to seek non-agricultural employment, thereby decreasing their operational income [38]. At the same time, as non-agricultural employment continues to develop and given the limited arable land and surplus of agricultural laborers, along with challenges in advancing agricultural production technology, the wage income of transferors increases [39–41]. Furthermore, land outgoing can yield profits and rents from land transfers [42], and by integrating rural industries and facilitating the movement of production factors, land appreciation brought about by land outgoing can enhance the property income of transferors [43]. Additionally, land outgoing through non-agricultural employment can increase social security transfer payments, benefiting the transfer income of transferors [44]. Therefore, based on the above literature analysis, the hypothesis H3 is proposed:

H3: Land transfers have heterogeneous impacts on different types of income for farmers.

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The review of existing research reveals that scholars have not reached a consensus on whether and how land transfers can promote farmers' income growth. While most scholars believe that land transfers facilitate income growth for farmers, some argue that land transfers have no positive effect. Considering the heterogeneous impacts of land transfers, some scholars have studied different types of land transfer farmers and income types, leading to varying conclusions. Thus, the above three hypotheses are proposed, and further empirical research will be conducted.

3. Materials and Methods

To verify the hypotheses proposed above, in line with previous research, we have chosen net household income, agricultural production income, business income, transfer income, property income, and wage income as dependent variables. Land transfer, land acquisition, and land outflow are used as explanatory variables in different regression models. The OLS regression method and the Heckman two-step method are employed for empirical analysis. Given the significant differences in the impact of different land transfer directions on each type of income, this study considers heterogeneity by dividing the sample into households that have acquired and those that have transferred out land. The income is detailed into five types for further heterogeneity analysis of the impact of land transfers on farmers' income. Finally, the Heckman two-step method is used to address endogeneity issues to obtain robust research conclusions. Below is the specific research design.

3.1. Variables

3.1.1. Dependent Variables

As this paper aims to explore the heterogeneous impact of land transfer on different types of farm households from an income structure perspective, net household income is chosen as the measure of farmers' income, along with agricultural production income, business income, transfer income, property income, and wage income as dependent variables for heterogeneity analysis.

3.1.2. Independent Variables

In the baseline regression, the independent variable is land transfer. This study sets land transfer as a binary dummy variable, indicating whether the household has participated in land transfer activities. If participating, this dummy variable is assigned a value of 1, otherwise 0.

In the heterogeneity analysis, the explanatory variables are land outflow and land acquisition. This study sets both land outflow and acquisition as binary dummy variables, indicating whether the household has engaged in these activities. If so, the respective explanatory variable is assigned a value of 1, otherwise 0. The definitions of these explanatory variables are as shown in Table 1 [24].

Table 1. Variable definitions for explanatory variables.

Name	Symbol	Definition
Land transfer	LC	Whether to participate in land transfer, 1 if yes, 0 if no.
Land outflow	TO	Whether to participate in land outflow, 1 if yes, 0 if no.
Land acquisition	TI	Whether to participate in land acquisition, 1 if yes, 0 if no.

3.1.3. Control Variables

Also, based on the review of other literature, potential household head characteristics (gender, age, education level) and household characteristics (family size, number of laborers, average education years, average contracted land area, value of agricultural machinery, total household assets, household consumption expenditure) that might influence farm household income are selected as control variables. Table 2 presents a statistical description of the differences between households that have participated in transfers and those that have not, in order to identify factors influencing farm household income.

Table 2. Comparative analysis of indicators between households that participate in land transfers and those that do not.

Category	Name	Symbol	Average non-transferring Household（A）	Average outflow（B）	Mean Difference（A-B）	Average acquisition（C）	Mean Difference（A-C）	Average transfer（D）	Mean Difference（A-D）
explained variable	Farmer income	Inc	33920.231	36794.734	-2874.503*	35904.019	-1983.788**	36313.843	-2393.612***
	Agricultural production income	IncA	5123.594	3291.382	1832.212***	10763.648	-5640.054***	7325.611	-2202.017***
	operational income	IncO	6802.313	5328.902	1473.411***	11679.361	-4877.048***	8757.474	-1955.161***
	operational income	IncP	103.245	801.290	-698.045**	167.998	-64.753	459.380	-356.135***
	Transfer income	IncT	3492.094	5536.437	-2044.343***	2946.317	545.777***	4138.048	-645.954**
	Wage income	IncW	22094.293	22734.376	-640.083**	21974.985	119.308	22324.386	-230.090*
Control variable: household head characteristics	Household head gender	Gen	0.712	0.703	0.009	0.790	-0.078**	0.750	-0.038*
	Household head age	Age	54.291	59.127	-4.836**	51.092	3.199**	54.789	-0.498*
	Household head education level	Edu	5.892	6.217	-0.325	6.823	-0.931***	6.544	-0.652***
Control variable: Family characteristics	Family size	Size	3.789	3.341	0.448***	4.121	-0.332***	3.762	0.027
	Number of laborers	Lab	2.671	2.134	0.537***	2.783	-0.112***	2.484	0.187
	Average age	AAge	46.920	50.312	-3.392**	42.825	4.095***	46.270	0.650**
	Average years of education	AEdu	5.2	5.711	-0.039	6.021	-0.349***	5.878	-0.206***
	Average contracted land area	ALand	3.001	4.127	-1.126***	2.732	0.269*	3.374	-0.373
	Value of agricultural machinery	Mac	1873.922	936.196	937.726***	4263.890	-2389.968***	2732.797	-858.875***
	Total household assets	Assets	182940.283	218789.363	-35849.080***	233645.049	-50704.766***	226809.853	-43869.570***
	Household consumption expenditure	Con	32184.984	31968.807	216.177	34632.634	-2447.650***	33406.990	-1222.006***

* Note: ***, ** and * are statistically significant at the level of 1%, 5% and 10%, respectively.

Table 2 shows that in terms of agricultural production income and business income, households that have transferred out land significantly lag behind non-transferring households, while those that have acquired land and those participating in land transfers significantly exceed non-transferring households. Households that have transferred out land, as well as those participating in land transfers, have significantly higher property income and transfer income than non-transferring households, whereas the difference in property income between households that have acquired land and non-transferring households is not significant. Households participating in land transfers, whether they have acquired or transferred out land, have significantly higher average incomes than non-transferring households. There are also significant differences in other control variables between transferring and non-transferring households, suggesting the possibility of self-selection bias, that is, whether households participate in land transfers is a non-random self-selection behavior. The statistical differences in these indicators might not solely be due to land transfers but could be caused by other factors, thus further empirical research is needed to verify the impact of land transfers on farmers' incomes.

3.2. Research Methods

3.2.1. OLS Regression

To verify the impact of land transfer on farm household income and whether the impact varies across different types of farm households, the basic model (1) is set up as follows:

$$lnc_{it}=\beta_0+\beta_1 LC_{it}+\beta_2 Gen_{it}+\beta_3 Age_{it}+\beta_4 Edu_{it}+\beta_5 Size_{it}+\beta_6 Lab_{it}+\beta_7 AAge_{it}+\beta_8 Aedu_{it}+\beta_9 Land_{it}$$
$$+\beta_{10}MAC_{it}+\beta_{11}Assets_{it}+\beta_{12}Con_{it}+\gamma_i+\delta_t+\varepsilon_{it}$$

(1)

where lnc_{it} represents the income of household i in period t; LC_{it} is a dummy variable, $LC_{it}=1$ if household i participates in land transfer, land outflow, or land acquisition in time t; $LC_{it}=0$ indicates no participation in land transfer. In the empirical study, regression analyses are conducted separately for households that have participated in land transfers versus those that have not, households that have acquired land versus non-transferring households, and households that have transferred out land versus non-transferring households. Age、Edu、Size、Lab、Aage、Aedu、Land、Mac、Assets and Con represent control variables for household head characteristics such as gender, age, educational level, family size, number of laborers, average age, average years of education, average contracted land area, value of agricultural machinery, total household assets, and household consumption expenditure. γ_i denote individual fixed effects, δ_t represent time fixed effects, and ε_{it} are the random error terms.

3.2.2. Heckman Two-Step Method

In theoretical analysis, whether farm households participate in land transfer is also influenced by personal factors such as education level, health status, and income. This may result in a situation where some households that intend to engage in land transfers actually do not participate. This implies that the sample consists of self-selected households, which could potentially introduce a sample selection problem into the model [45,46]. Additionally, considering that the explanatory variables in the model are binary, this paper uses the Heckman two-step model to address endogeneity issues arising from unobservable variables.

Following the methodologies of Kung, Démurger et al., and Wahba et al., this paper employs the Leave-one-out Strategy [47–49]. The proportion of households in the village, excluding household i, that engage in land acquisition or land outflow, relative to the total number of households in the village (per), is used as an instrumental variable for land acquisition and outflow. The distance from the village to the county seat (dis) might influence farmers' willingness to engage in land transfers but is unrelated to the decision to transfer land itself, and is thus also used as an instrumental variable. The model selects variables such as the age, education level, and gender of the household head, along with household size, annual dummy variables, and regional dummy variables for the first-stage Probit regression. In the first step of the Heckman method, the dependent variable is land transfer, and the independent variables influencing the willingness to engage in land transfer are used in a Probit regression. To address the sample selection problem caused by the land acquisition decision, it is necessary to calculate the Inverse Mills Ratio (IMR) to determine the presence of a sample selection issue, and then incorporate the IMR into the second stage of the model for regression. The specifics of the Heckman two-step model are as follows:

The first step constructs a Probit model to analyze the factors affecting farmers' decisions to participate in land transfers. The model is set as follows:

$$LC_{it}=\alpha_0+\alpha_1 per_{it}+\alpha_2 dis_{it}+\alpha_3 CV_{it}+\alpha_4\sum Year+\alpha_5\sum Pro+\varepsilon_{it}$$

(2)

where, LC represents the decision of the ith household regarding participation in land transfer, LC = 1 indicates the household participates in land transfer, LC = 0 indicates the household does not participate in land transfer. per represents the proportion of households within the village, excluding the household in question, that have engaged in land acquisition or outflow relative to the total

number of households in the village; dis represents the distance from the village to the county seat; CV represents other control variables; Year and Pro respectively represent the year and province; ε_{it} is the random error term.

The second step introduces the Inverse Mills Ratio (IMR) as a control variable into the second-stage model (3) for the following regression:

$$\ln c_{it}=\alpha_0+\alpha_1 LC_{it}+\alpha_2 per_{it}+\alpha_3 dis_{it}+\alpha_4 CV_{it}+\alpha_5\sum Year+\alpha_6\sum Pro+\alpha_7 IMR+\varepsilon_{it} \tag{3}$$

In model (3), after incorporating the Inverse Mills Ratio (IMR) as a control variable, if the regression coefficient $\ln c_{it}$ remains significantly positive at the 1% level, it indicates that the promotive effect of land transfer on farmers' income still holds even after controlling for potential selection bias using the Heckman two-step model.

3.3. Data

The research data is derived from the China Family Panel Studies (CFPS), conducted by the Institute of Social Science Survey (ISSS) at Peking University, which surveyed households across 24 provinces from 2010 to 2018. The data processing for this paper is as follows: First, data from non-rural households were excluded; second, only the data from farm households that were tracked in 2010, 2012, 2014, 2016, and 2018 were retained; third, data from farm households with severe missing information were discarded. Ultimately, 2368 sets of data comprising 10797 observations were obtained.

The participation of sample farm households in land transfers is shown in Table 3. In 2010, 440 households participated in land transfers, representing 18.58% of the total sample, of which 75 households transferred out land (3.17%), and 394 households acquired land (16.64%), with 29 households both acquiring and transferring out land (1.22%). Over the subsequent years, the scale of households participating in land transfers continuously expanded, with the proportion of households transferring out land increasing faster than those acquiring land. By 2018, the number of households transferring out land had risen to 692 (29.22%), while those acquiring land stood at 812 (34.29%), with a total of 1334 households participating in land transfers (56.33%). The number of households both acquiring and transferring out land grew annually, indicating that an increasing number of farm households are engaging in land exchanges to achieve concentrated production management, thereby enhancing their production management awareness.

Table 3. Sample distribution.

Year	The households of outflow		The households of acquisition		The households of transfer		The households of outflow and acquisition	
	Number	proportion/%	Number	proportion/%	Number	proportion/%	Number	proportion/%
2010	75	3.17	394	16.64	440	18.58	29	1.22
2012	247	10.43	538	22.72	743	31.38	42	1.77
2014	393	16.60	683	28.84	960	40.54	116	4.90
2016	531	22.42	772	32.60	1159	48.94	144	6.08
2018	692	29.22	812	34.29	1334	56.33	170	7.18

4. Results

4.1. Baseline Regression Analysis

This study employs Model (1) to test the impact of land transfer on farmers' income. Before using Model (1), tests for multicollinearity and the Hausman test are conducted. The results indicate: first, that the variance inflation factors (VIF) are all less than 10, suggesting that there are no severe multicollinearity issues in the model; second, a fixed effects model is chosen for the analysis.

The baseline regression results regarding the impact of participating in land transfers on farmers' income are shown in Table 4. The regression coefficient for land transfer is 0.216, significant at the 1% level, indicating that participation in land transfers can effectively increase income levels and that there is a significant positive relationship between land transfers and farmers' income. After participating in land transfers, households that transfer out land can gain rental income, while those acquiring land can increase their agricultural income due to expanded production operations. Thus, participating in land transfers significantly enhances farmers' income levels, confirming Hypothesis 1. This conclusion is also consistent with existing research [50–52]. Additionally, the effects of other control variables on the income of different types of farm households are broadly consistent with the findings of existing research.

Table 4. Baseline regression results.

Variable	household income
LC	0.216***
	(0.052)
Year FE	control
Individual FE	control
Other	control

*Note: ***, ** and * are statistically significant at the level of 1%, 5% and 10%, respectively.

4.2. Considering Endogeneity

Whether farmers participate in land transfers can be influenced by a variety of factors, such as internal characteristics including education level, health status, and income, and external characteristics like rural land policies, the agricultural production service system, and land transfer prices. These factors may all affect farmers' choices to participate in land transfers, thereby easily leading to numerous endogeneity issues such as reciprocal causation, selection bias, and omitted variables. In such cases, OLS estimates may be biased. When self-selection bias is present, it is necessary to assume that individuals choose whether to participate in land transfers based on unobservable variables. Therefore, following common practices in authoritative literature, this paper uses the Heckman two-step model to control for these issues [45].

Endogeneity test results as shown in Table 5. First, within the Heckman two-stage model, the regression coefficient for the Inverse Mills Ratio (IMR) is significantly indicative of the presence of sample selection bias. Second, when the IMR is included as a control variable in the model, the regression results are broadly consistent with the baseline regression. This suggests that the baseline regression conclusions still hold after somewhat mitigating issues like sample selection bias and other forms of endogeneity.

Table 5. Regression results of robustness test.

Variable	household income	operational income	Transfer income	property income	Wage Income	Agricultural production income
	（1）	（2）	（3）	（4）	（5）	（6）
LC	0.989***	2.092***	1.829***	4.290***	0.781	1.494***
	(0.221)	(0.508)	(0.264)	(0.982)	(0.620)	(0.252)
IMR	-0.454***	-1.866***	-0.598**	-1.242***	-0.657*	-0.977***
	(0.131)	(0.342)	(0.278)	(0.324)	(0.392)	(0.281)
TO	0.942**	-3.808***	0.914***	8.672***	1.492**	-2.891***
	(0.408)	(0.722)	(0.108)	(0.625)	(0.646)	(0.344)
IMR	-0.098	0.698***	-0.387	-1.438***	-0.417	0.855***
	(0.763)	(0.148)	(0.421)	(0.211)	(0.489)	(0.197)
TI	0.190	1.929***	2.482***	0.091	-2.877***	3.983***

	(0.245)	(0.353)	(0.556)	(0.209)	(0.631)	(0.323)
IMR	-0.095	-1.348***	-0.467***	-1.273	0.964***	-1.673***
	(0.087)	(0.311)	(0.125)	(1.149)	(0.259)	(0.386)
Year FE	control	control	control	control	control	control
Region FE	control	control	control	control	control	control
Other	control	control	control	control	control	control
VIF	control	control	control	control	control	control

*Note: ***, ** and * are statistically significant at the level of 1%, 5% and 10%, respectively.

Looking at the income situations of households that have acquired and those that have transferred out land, although land transfers significantly enhance farmer incomes, the effect is primarily concentrated on those transferring out land, with no significant impact on those acquiring land. This phenomenon may arise because households that transfer out land directly receive transfer income at the time of transfer, making the increase in income more apparent. In contrast, although households that acquire land expand their production and operational area, their income gains are not substantial due to limitations like natural disasters, land quality, agricultural insurance, and agricultural technology, suggesting substantial variation among the sampled households in these respects. Moreover, the composition of farmers' income is complex; while land acquisition primarily affects agricultural business income, farmers' income also includes wage and transfer income, which may fluctuate due to seasonal and other factors. From the perspective of farmers' income composition, the coefficients of the impact of land acquisition on wage and business income are 1.929, significant at the 1% level. This indicates that land acquisition has a significant positive effect on business income, corroborating the previous discussion that land acquisition primarily increases agricultural business income.

5. Discussion

5.1. Analysis of the Heterogeneity of Impacts on Different Sources of Income

Although land transfers lead to an increase in farmers' income, the impact varies across different sources of income. For instance, households that transfer out land may face a reduction in agricultural income due to decreased operational land area, but they can allocate more time to urban employment, thus earning wage income [50]. Therefore, the effects of land transfers on different sources of income vary, necessitating a heterogeneity analysis of income composition.

The regression results for the impact of participation in land transfers on different sources of income are shown in Table 6. Overall, participation in land transfers has an impact coefficient of 0.452 on transfer income and 1.498 on property income, with the impact on agricultural production income being -0.438, all significant at the 1% level, while the impacts on wage income and business income are not significant. Three possible reasons for this phenomenon are: first, some farmers engage in non-farm business activities instead of working outside after transferring out land, which could lead to a significant decrease in their agricultural production income; second, after participating in land transfers, farmers' overall income increases, and more income is allocated to investments, leading to increased property income; third, there is a large variance in income increase among different households participating in land transfers, resulting in non-significant changes in wage income and business income in the overall analysis [50,52].

Table 6. Regression results of heterogeneity analysis on the impact of land transfer on peasant household income.

Variable	household income	operational income	Transfer income	property income	Wage Income	Agricultural production income
	（1）	（2）	（3）	（4）	（5）	（6）
LC	0.216***	-0.219	0.452***	1.498***	-0.109	-0.438***
	(0.052)	(0.192)	(0.101)	(0.034)	(0.142)	(0.078)
TI	0.032	1.285***	0.462**	-0.390***	-0.495***	0.367***
	(0.048)	(0.283)	(0.194)	(0.052)	(0.093)	(0.076)
TO	0.475***	-1.039***	0.352***	3.842***	0.364**	-1.394***
	(0.108)	(0.294)	(0.102)	(0.082)	(0.153)	(0.219)
Year FE	control	control	control	control	control	control
Individual FE	control	control	control	control	control	control
Other	control	control	control	control	control	control

*Note: ***, ** and * are statistically significant at the level of 1%, 5% and 10%, respectively.

Furthermore, for different types of households, the regression coefficient for the impact of land outflow on farmers' income is 0.475, significant at the 1% level, whereas the impact of land inflow on farmers' income is not significant. Land outflow positively impacts farmers' income, possibly because, after transferring out land, farmers can allocate their labor time to non-agricultural sector jobs and secure a steady rental income. Simultaneously, farmers' investment in agricultural production decreases, allowing surplus funds to be used for other investments, thereby earning property income. In contrast, land inflow does not significantly enhance farmers' income, possibly due to the lack of adequate agricultural protection and support policies in China, leading to low, slow, and less obvious growth in agricultural business income. Consequently, Hypotheses H2 and H3 are supported.

5.2. Heterogeneity Analysis of Different Types of Transferring Households

The impact of land transfer on the income levels of different transferring households also varies. This is mainly evident in two aspects: firstly, for households that transfer out land, they can directly obtain rental income; secondly, for households that acquire land, due to low agricultural profits and high risks, expanding the scale of production and operations has a relatively small effect on increasing agricultural income [50]. Therefore, the impact of participating in land transfers may differ among different types of farm households, necessitating a heterogeneity analysis based on household types.

The extent to which land transfers enhance income promotion is still unclear. Currently, many scholars use the average treatment effect on the treated (ATT) derived from Propensity Score Matching (PSM) to demonstrate the impact of land transfers on income. However, the calculation of standard errors in PSM requires the assumption that the estimated propensity scores are the true scores, making the treatment effect estimates potentially biased. Abadie et al. considered the estimation bias of propensity scores and adjusted the large sample variance of the scores to correct the propensity score estimation, obtaining a robust standard error, namely the AI robust standard error [53]. Hence, this paper uses the Teffects-Psmatch method based on AI robust standard errors to estimate the impact of land transfers on the income of different types of farm households. After the treatment, the average treatment effects (ATE) of land transfer, land outflow, and land inflow on farm income and various types of income are calculated.

In Table 7, compared to non-transferring households, transferring households experienced an income increase of 2493.518 yuan, of which 1344.716 yuan was due to an increase in business income, contributing 53.93% to the growth. Wage income growth was not significant, consistent with previous regression results. Specifically, for households transferring out land, their income increased by

8023.246 yuan, with 88.26% of this increase coming from wage income, and other income contributions to household income changes were small, which is also consistent with previous analyses. This may be because the probability of household labor forces engaging in non-agricultural operations increases after transferring out land, so the decrease in family business income is less than the decrease in agricultural production income. For households acquiring land, their wage income decreased by 2865.583 yuan, which was much higher than the increase in business income, meaning that compared to households that did not transfer land, the income of households acquiring land actually decreased. Moreover, the contribution analysis results show that while land transfers significantly promote farm household income, it is mainly the households transferring out that benefit; the agricultural production income and business income of the households acquiring land did not significantly improve, and the welfare effects of land transfers on these households are not evident

Table 7. Teffects-Psmatch average processing effect output results.

Variable	household income (1)	operational income (2)	Transfer income (3)	property income (4)	Wage Income (5)	Agricultural production income (6)
The ATE of households of transfer	2493.518*** (473.659)	1344.716*** (290.983)	389.112 (365.784)	453.394*** (69.425)	301.297 (346.523)	1406.357*** (325.732)
The ATE of households of outflow	8023.246*** (2122.353)	-895.543 (790.457)	930.443 (894.243)	683.329*** (104.675)	7081.564*** (1546.352)	-1654.094*** (231.897)
The ATE of households of acquisition	-1560.523 (1010.862)	1844.365*** (214.098)	-675.743** (310.551)	147.436 (132.868)	-2865.583*** (428.547)	2679.864*** (344.981)

*Note: ***, ** and * are statistically significant at the level of 1%, 5% and 10%, respectively; Numbers in brackets are AI robust standard errors.

6. Conclusions

This paper aims to explore how governments worldwide use land resources to meet the United Nations' Sustainable Development Goals' mandate to "eliminate poverty." It employs an OLS regression model and supplements it with a Heckman two-stage regression model to analyze the impact of land transfers on farmers' income and the effects on income structures of households that acquire and transfer out land, based on cross-period panel microdata from the CFPS database. The empirical findings confirm that land transfers generally promote income growth among farmers. A heterogeneity analysis of the impact of different directions of land transfers on various types of income reveals that the promotion effect of land transfers on farmers' income is mainly manifested in significantly improving the income of households transferring out land. The analysis of income structure heterogeneity shows that the differences in the impact of land transfers on farmers' income are primarily due to the considerable improvement in labor allocation caused by land transfers, with transfer-out households channeling more labor into non-agricultural production, such as increased likelihood of working outside or entrepreneurship. In contrast, households acquiring land invest more labor in agricultural production, and their promotion effect on other types of income is not evident. Therefore, land outflow can significantly boost farmers' income through increased wage and property income. Further analysis of the contributions of land transfers shows that for households transferring out land, the increase in wage income is much higher than the decrease in business income, resulting in a significant rise in farmers' income, with 88.26% of the income growth coming from an increase in wage income. For households acquiring land, the income improvement effect from agricultural operation and production is weak, leading to no apparent improvement for these households, which explains the results of the heterogeneity analysis.

The findings suggest that there is still room for improvement in how land transfers enhance farmers' income, particularly regarding the welfare benefits for households acquiring land. Thus, potential policy implications include: to foster income growth for households acquiring land, on one hand, technical training should be conducted to enhance farmers' management awareness and harness the advantages of scaled and intensive production to improve agricultural production efficiency and increase per-acre net income. On the other hand, China's agricultural support and protection policies need to be improved. Taking the current policy of subsidies for agricultural machinery purchases as an example, only farmers purchasing large machinery can benefit from these transfer payments, but most small and medium-scale acquiring households cannot afford large agricultural machinery and thus do not benefit, potentially exacerbating the wealth gap in rural areas, leading to further expansion of income disparities within the countryside. Therefore, agricultural subsidy policy standards need to be adjusted to allow typical acquiring households to benefit. Previous analysis shows that land outflow primarily promotes income growth through wage and property income, but the proportion of property income remains extremely low. Thus, the government needs to develop the land transfer market, make the asset value of land resources more visible, and enhance farmers' property income. For households that have not engaged in land transfers, guidance should be based on their family resource endowments to enable them to participate in the process of acquiring or transferring out land, thereby improving farmers' income levels and further achieving rural revitalization.

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