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The Impact of Internet Use on Farmers' Land Transfer under the Framework of Transaction Costs

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Abstract: The problems that exist in China's agricultural operations are not only on a small scale; more seriously, there are also problems of land fragmentation and the mismatch of human and land resources. Land transfer is expected to be a tool for solving these problems. The land transfer market development is slow, leaving farmers facing serious information asymmetry. On the back of the information explosion brought about by information technology represented by the Internet, exploring the impact of Internet use on land transfer can provide ideas to improve the solution of land problems. Based on the cost theory analysis framework of new institutional economics, this paper empirically examines the impact of Internet use on farmers' land transfer behavior. The results of the study show that Internet use can significantly increase the probability and scale of household land transfer by reducing the fixed and variable costs of transactions. This conclusion still holds after using instrumental variables to address endogeneity. The impact of Internet use on land transfer is heterogeneous, with the younger, more educated, and higher-income household heads tending to participate in the land transfer market on a larger land transfer scale. Therefore, rural Internet infrastructure should be further improved to alleviate information asymmetry in the land transfer market, further strengthen the training of Internet use skills of farmers, stimulate the enthusiasm of farmers to participate in the land transfer market, further increase farmers' income, enhance the elasticity of farmers' response to the use of the Internet to reduce transaction costs, and promote land transfer.

Keywords: internet use; transaction costs; land transfer

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1. Introduction

Since the 1980s, the matter of small-scale agricultural management in China under the household contract responsibility system has garnered significant attention [1], and its profound impact on agricultural management has become a subject of focus in the domain of agricultural economics [2].

By 2020, the total area of household contracted farmland transfer in China was 555 million acres, accounting for 35.9% of the household contracted management area. The average household operating area was 7.02 acres, with 85.2% of farmers operating under 10 acres, 13.2% of farmers operating between 10 and 50 acres, and only 1.6% of households operating above 50 acres. In the same year, there were more than 440,000 agricultural production trust organizations nationwide, with a land trust area of over 1.5 billion acres serving over 60 million small farmers, accounting for 30% of the country's agricultural economic households. It can be seen that, although there has been some development in scale management, the overall economic situation of small farmers has not fundamentally changed. The closed and dispersed small-scale agricultural economy hinders the improvement of agricultural labor productivity, leading to a decrease in farmers' willingness to work and a decrease in income. Therefore, improving the efficiency of farmers' land transfer and expanding

the scale of farmers' land management are of great significance for developing various forms of land scale management, promoting agricultural modernization, and enhancing agricultural competitiveness.

With the continuous advancement of urbanization and rural modernization in China, a large amount of the labor force has flowed to urban and non-agricultural sectors, significantly increasing land transfer rates while improving agricultural productivity. In the report of the 19th National Congress of the Communist Party of China, it was proposed to further deepen the reform of the rural land system. The 14th Five Year Plan also clearly stated that the market-oriented reform of the land system should be an important task that provides institutional guarantees for achieving rural revitalization and makes land circulation a crucial support for promoting rural revitalization. The mismatch of production factors such as land, labor, and capital has seriously constrained the transformation and upgrading of agricultural management methods mainly focused on individual small-scale farmers. In the era of digital economy, the use of the Internet has a profound impact on the allocation of production factors for farmers and households by changing the way information is obtained and increasing social capital. Especially for vulnerable groups of farmers, network coverage actions represented by "online poverty alleviation", "internet education and medical care", and "e-commerce online shopping" have solved the core problem of rural information blockage, thereby changing the production and lifestyle of farmers. So, can information technology represented by the Internet improve the efficiency of agricultural land transfer by alleviating information asymmetry?

The remaining chapters of this article are structured as follows: Section 2 is the Literature Review, Section 3 is Theoretical Analysis and Research Hypotheses, Section 4 is Research Design, Section 5 is Empirical Analysis, and Section 6 is Conclusions and Policy Recommendations.

2. Literature Review

Small-scale land management's impact on agricultural production has been the subject of extensive research and debate in agricultural economics.

In addition to small-scale land management, Chinese agricultural operations face the more serious problem of land fragmentation [3,4]. Although some scholars [5–7] argue that land fragmentation can improve efficiency by diversifying operations and thus spreading risks and regulating the seasonal distribution of labor, most scholars hold the opposite view [8], arguing that fragmented land reduces the efficiency of irrigation and management and is not conducive to the formation of economies of scale, thereby suppressing land productivity. In addition, land fragmentation also brings a series of problems such as land waste, inhibiting the application of agricultural science and technology, creating difficulty in mechanization and unbalanced allocation of land endowment and human capital [9], increasing transaction costs, and creating a low degree of marketization [10,11]. Therefore, how to alleviate the fragmentation of land management and develop it into a large-scale operation adapted to modern agriculture has become an important challenge in the process of China's agricultural modernization.

Land transfer is affected by a variety of factors such as property rights systems, market awareness, and the level of economic development [12–14]. Institutionally, although the state has liberalized the land transfer market, due to the influence of historical factors it takes time for farmers' consciousness to change, so that after years of development, the current scope of land transfer is still relatively limited and small, a considerable part of it is confined to acquaintances, and the degree of marketization is still not high [15].

One of the important reasons why the development of the land transfer market is so slow is that farmers face serious information asymmetry [16,17], which is also the reason why much of the current land transfer is limited to acquaintances. Then, it becomes a question to be answered whether the information technology represented by the Internet can improve the efficiency of land transfer by alleviating the information asymmetry in

the land market and thus accelerate the development of the land transfer market while bringing about the information explosion.

Previous studies have emphasized the impact of property rights, non-farm employment of labor, and social security on the efficiency of land transfer. Specifically, an appropriate property rights system is an important factor for improving the efficiency of land transfer [18]; thus, land rights can effectively promote land transfer [19,20]. The non-farm transfer of the labor force will significantly increase the probability of land transfer out, and it has a certain degree of heterogeneity [21]. Social security measures such as the New Rural Cooperative and New Rural Insurance can significantly increase the willingness to transfer land by increasing family income and enhancing the stability of family livelihood [22,23]. In addition, other studies have examined the impact of family demographic status, economic status, social relations, land endowment, and other aspects on the efficiency of land transfer [24,25]. Accompanied by the in-depth development of economics, some scholars have begun to notice the important impact of high transaction costs brought about by China's land fragmentation, small-scale farmers' operation, and low degree of organization on reducing the efficiency of the land transfer market [26], which has led to discussion amongst the academic community regarding the transaction costs of the land transfer market. Meanwhile, with the rapid development of information technology, the influence of the Internet extends to the field of agriculture. As a result, some studies have begun to explore the impact of the Internet on land transfer and combined it with the transaction cost analysis framework.

Scholars mostly believe that the use of the Internet can improve the information acquisition ability of farmers, reduce the information asymmetry in the land transaction market, and reduce the transaction costs of farmers for land transfer, thus promoting the activation of the land transfer market [27–30]. The innovation of land transfer methods (Internet + land transfer securitization) can also reduce transaction costs by reducing information asymmetry, thus playing an important role in revitalizing rural land resources [31,32]. Specifically, the Internet carries a huge amount of agricultural information (including land transfer supply and demand information, agricultural product trading supply and demand information, agricultural technology exchange information, etc.) at a very low cost [33,34], which greatly improves the efficiency of information dissemination, and a large number of cyberspaces can be derived based on the mode of "Internet +" [35], such as rural e-commerce represented by live streaming and self-media, and rural e-commerce represented by the Internet and self-media. This breakthrough in information transmission and diffusion has greatly reduced the transaction costs in the land transfer market (including the information cost of searching for the target, the negotiation cost of establishing the contract, the supervision cost of supervising the execution of the contract, etc.), lowered the threshold for farmers to participate in the land transfer market, and greatly stimulated farmers' enthusiasm to participate in the land transfer market [36,37]. The enthusiasm to participate in the land transfer market is reported in [38,39].

Of course, there are scholars who hold the opposite view that, although the Internet has reduced the transaction costs of land transfer to a certain extent, it has not significantly increased the enthusiasm of farmers to participate in the land transfer market, i.e., the reduction of transaction costs by the Internet has not improved the effectiveness of the land transfer market [40], or that the effect is not universal but has significant heterogeneity [41,42].

The existing literature has greatly broadened the research horizon of the impact of Internet use on land transfer under the transaction cost framework, but there are still shortcomings. Firstly, although most of the relevant literature agrees with the effect of Internet use on the reduction of transaction costs and thus the promotion of land turnover, only a small part of the literature considers the structural problem of transaction costs, i.e., the difference between the impact of fixed and variable transaction costs on land turnover [43]. Secondly, most of the literature has only studied the effect of Internet use on land transfer but has ignored the structural problem of land transfer, i.e., the difference between the effect of Internet use on land transfer decisions and land transfer scales. Based

on this, this paper takes the farmers in the research area as the research object, considers the transaction cost and the structural problem of land transfer at the same time, and explores the impact of Internet use on farmers' land transfer decisions and transfer scales based on the theory of fixed and variable transaction costs of new institutional economics.

3. Theoretical Analysis and Research Hypotheses

In China, as a developing country, the generally low incomes of farmers coupled with the elevated transaction costs associated with the fragmentation of land operations have made transaction costs a key institutional barrier to farmers' access to the land transfer market. According to the new institutional economics, transaction costs are divided into two types: fixed transaction costs and variable transaction costs. The fixed transaction cost refers to the relatively fixed one-time payment for obtaining the entry qualification of a certain market [44] (which is the threshold for farmers to enter the market and is not related to the scale of transaction), while the variable transaction cost is the part related to the scale of transaction [45]. Specific to the land transfer market, the fixed transaction cost refers to the cost that needs to be paid to enter the land transfer market, specifically including the information cost of searching for the transaction object and the negotiation cost of establishing the contract. This part of the cost has nothing to do with the scale of land transfer and does not change with the change of land transfer scale. Variable transaction costs, on the other hand, refer to the costs of completing a particular transaction, including the cost of monitoring the execution of the contract, the cost of time, and the opportunity cost, etc., and are generally related to the scale of the land transfer.

One of the reasons why there are transaction costs in the land transfer market lies in the asymmetry of information [46]. If farmers want to participate in the land transfer market, they first need to search for information and understand the supply and demand of the market (as well as the price situation) in order to match the transaction. After matching with a suitable counterparty, they also need to negotiate and draw up the specific content of the contract. This is the part of the fixed costs (information search costs and contract negotiation costs) needed to reach a deal. Fixed transaction costs that are too high will inhibit farmers from entering the land transfer market [47–49]. In addition to fixed transaction costs, variable transaction costs are also included. Along with the expansion of the scale of land transfer, there are fewer and fewer transaction objects to match; thus, the time cost and opportunity cost of matching transactions are becoming higher and higher. At the same time, the expansion of the scale of land transfer also requires more and more vigilance against the occurrence of moral hazard and opportunistic behavior because the resulting expected loss increases with the increase in the area of land transfer. As a result, the cost of monitoring after the contract has been signed is also increasing, i.e., the variable transaction costs are becoming higher and higher. And excessive variable costs also discourage farmers from undertaking land transfers. What is more, if farmers plan to transfer a small area of land, the transaction will face diseconomies of scale, which will further increase the transaction cost [50].

The information technology represented by the Internet, with its rapid and extensive dissemination of information and the adaptability of "Internet Plus", has greatly reduced the costs of farmers' participation in the land transfer market, including both fixed costs and variable costs. Specifically, in terms of reducing fixed costs, the Internet carries a huge amount of transaction information, which greatly broadens the ways for farmers to obtain transaction information and reduces the difficulty for farmers to search for transaction information. The transaction information is readily available and can be quickly matched with the transaction object, thus reducing the cost of searching for information. In the contract signing process, the Internet can provide online communication channels, and the contract terms can be completed online, thus reducing the negotiation cost of contract signing and increasing the enthusiasm of farmers to participate in the land transfer market. In terms of reducing variable transaction costs, the Internet enhances the transparency of information between the contracting parties, thus reducing the risk of opportunistic

behavior. The Internet-based trading platform, as a third party to the transaction, also plays a positive role in restraining moral hazard. Even if opportunistic behavior occurs, the transaction platform can provide a fair platform for both parties to defend their rights and a standardized mechanism to protect the legitimate interests of both parties from being infringed upon, thus increasing the participation of farmers in the land transfer market and improving the scale of land transfer.

Based on the above theoretical analyses, this paper proposes two main hypotheses:

Hypothesis 1 (H1). *Internet use has significant incentives for farmers to participate in the land transfer market by reducing fixed transaction costs.*

Hypothesis 2 (H2). *Internet use has a significant incentive effect on farmers to increase the scale of land transfer by reducing variable transaction costs.*

4. Research Design

4.1. Data Sources

The data used in this paper come from a large-scale micro-farm household survey conducted from July to September 2019 by a team of major projects of the National Social Science Foundation. The survey selected representative provinces of land transfer in western China, including Shaanxi, Gansu, Guizhou, and Yunnan Provinces. The reason for choosing Yunnan Province as the control group and Shaanxi, Gansu, and Guizhou Provinces as the regional dummy variables is that, among these four provinces, Yunnan Province has the largest area of land transfer and is the most representative in the western region. Compared with the active rural land transfer in the eastern region, although the central and western regions have made bold explorations and achieved certain results in land transfer, they have not yet formed a truly successful experience as a whole. Through the implementation of the "Ten Million" New Business Entity Cultivation Project in Shaanxi Province, by 2020, the rural land transfer area of the province will be 13.24 million acres. The agricultural department of the province has recognized 9738 family farms, 48,900 farmer cooperatives, and 2892 leading agricultural industry enterprises at all levels. The land transfer rate in Gansu Province is only 21.9%, far lower than the national average of 35%, ranking 23rd in the country. The speed of land transfer cannot keep up with the speed of rural population flow, leading to a more obvious phenomenon of land abandonment. Guizhou Province has established 7, 96, and 1299 city, county, and township agricultural land transfer service institutions, promoting the transfer of 10.69 million mu of land contracted by farmers in the province, with a transfer rate of 13.7%. The land transfer area in Yunnan Province is 19.219 million mu, with a land transfer rate of 26.8%. New agricultural operators have become the main force of land transfer.

In order to accurately capture the variability of the impact of Internet use on land transfer across regions and households, prior to data collection, we interviewed local municipal and county-level leaders and village-level cadres to gather basic information on the participation or non-participation of local farm households in land transfer. Sampling was conducted through a combination of multi-stage stratified sampling and simple random sampling, and a total of 2047 samples were obtained. The questionnaire contained information on the explanatory variables, core explanatory variables, household head, family, and regional level characteristics of this paper. After removing missing values and extreme values, 1776 valid questionnaires were finally retained, with a validity rate of 86.8 percent.

4.2. Variable Selection

(1) Dependent variable: This paper divides the land transfer behavior of farmers into two aspects—land transfer decision making and land transfer scale—in order to accurately capture the structural problems of land transfer behavior. Selecting "whether to transfer land" refers to the land transfer decision of farmers, and selecting "how many acres of land to transfer" refers to the scale of land transfer of farmers.

(2) Core independent variable: Internet use is referred to as "whether or not the Internet is accessed through a mobile phone or computer", with "yes" assigned a value of 1 and "no" assigned a value of 0.

(3) Control variables: In addition to being influenced by the core explanatory variables, the transaction costs of land transfer are also endogenous to the individual characteristics of farm households and the characteristics of the institutional environment [51,52]. Therefore, this paper selects control variables from the following three aspects: First, the personal characteristics of the household head. The five variables of gender, age, health status, literacy, and social relations of the household head are selected. Second, for household characteristics, four variables were selected: household size, household income, land endowment, and total value of machinery. Third, for regional characteristics, in order to control the influence of inter-regional differences on farmers' land transfer behavior, five variables were selected, namely intra-village traffic condition and regional dummy variables. The variable definitions and descriptive statistics are shown in Table 1.

Table 1. Variable definition and descriptive statistics.

Variable	Definition	Mean	SD
Transfer Decision	Have you ever transferred land in the past? 1 = Yes, 0 = No	0.291	0.386
Transfer Scale	Land transfer area (mu)	4.263	4.747
Internet Use	Do you use your phone or computer to obtain agricultural related information? 1 = Yes, 0 = No	0.726	0.502
Gender	Gender of the head of household; 1 = male, 0 = female	0.864	0.279
Age	Age of the head of household in 2019	52.367	7.256
Health	1 = very unhealthy; 2 = relatively unhealthy; 3 = relatively healthy; 4 = very healthy	3.024	0.258
Education	Education years of the head of household	7.293	2.945
Political Relation	Are you a party member or village cadre? 1 = Yes, 0 = No	0.096	0.245
Number of Household Labor Force	Number of household labor force in 2019	2.976	0.389
Household Income	Total household income in 2018 (CNY), logarithmic	9.298	0.693
Land Endowment	Household land area (mu)	5.267	2.987
Total Value of Machinery	Total value of household machinery (CNY), logarithmic	8.296	1.384
Traffic Conditions in The Village	1 = very inconvenient; 2 = relatively inconvenient; 3 = relatively convenient; 4 = very convenient	3.627	0.429
Shaanxi Province	Are the sample farmers located in Shaanxi Province? 1 = Yes, 0 = No	0.372	0.284
Gansu Province	Are the sample farmers located in Gansu Province? 1 = Yes, 0 = No	0.197	0.328
Guizhou Province	Are the sample farmers located in Guizhou Province? 1 = Yes, 0 = No	0.274	0.180
Yunnan Province	Are the sample farmers located in Yunnan Province? 1 = Yes, 0 = No	0.157	0.205

4.3. Empirical Methods

4.3.1. Benchmark Regression

In terms of land transfer decisions, since whether or not households participate in land transfers is a binary dummy variable, this paper uses a probit model to estimate the impact of Internet use on households' land transfer decisions:

$$Probit(transfer_i) = \alpha_0 + \alpha_1 \times Internet_i + \alpha_2 \times X_i \quad (1)$$

In terms of the scale of land transfer, OLS regression is used to study the effect of Internet use on the scale of household land transfer:

$$Scale_i = \beta_0 + \beta_1 \times Internet_i + \beta_2 \times X_i \quad (2)$$

In Equation (1), the dependent variable $transfer_i$ is a binary dummy variable for whether household i carries out land transfer or not, and in Equation (2), the dependent variable $Scale_i$ indicates the scale of land transfer of household i. The core independent variable $Internet_i$ is a binary dummy variable for whether household i uses the Internet. X_i is a control variable, including the characteristics of the head of household i, family characteristics, and regional characteristics.

4.3.2. Endogenous Processing

Since Internet use is an individual choice behavior, this paper may suffer from potential endogeneity issues arising from omitted variables, sample self-selection, and two-way causation. In this paper, the conditional mixed estimation method (CMP) proposed by Roodman [53] is used to deal with this. The method is implemented in two steps: In the first step, instrumental variables are found and their correlations with endogenous variables are tested. In the second step, the correlation values are substituted into the baseline regression model and exogeneity is determined by the endogeneity test parameters. If the parameter is significant, the CMP estimation is more accurate, and if the parameter is not significant, the benchmark model is more accurate. This paper draws on the study of Shan Depeng et al. [54] and adopts the previous year's household communication expenditure, i.e., the "2018 household communication expenditure" variable as the instrumental variable for Internet use to conduct the endogeneity test. On the one hand, the Internet itself is a communication tool in a broad sense, so the instrumental variable (communication expenditure) satisfies the correlation assumption with the endogenous variable (Internet use). On the other hand, expenditures on communication are exogenous relative to land transfer because the use of communication tools does not directly affect farmers' land transfer behavior. This, coupled with the fact that the instrumental variables selected for this paper take values from the previous year's data, further strengthens the exogenous nature of the instrumental variables.

5. Empirical Analysis

5.1. Benchmark Model Regression Results

The results of the baseline regression on the impact of Internet use on land turnover are shown in Table 2, where the marginal effects of the model are reported. Column (1) adds household head level control variables, column (2) adds both head level and household level control variables, and column (3) adds head, household, and regional level control variables.

Table 2. Estimated results of the impact of Internet usage on land transfer decision and scale.

Variable	(1)		(2)		(3)	
	Transfer Decision	**Transfer Scale**	**Transfer Decision**	**Transfer Scale**	**Transfer Decision**	**Transfer Scale**
Internet Use	0.0062 **	0.0735 ***	0.0042 ***	0.0746 ***	0.0090 ***	0.0616 ***
	(0.0012)	(0.0112)	(0.0011)	(0.0147)	(0.0017)	(0.0103)
Gender	−0.0358	−0.0167	−0.0337	−0.0108	−0.0355	−0.0013
	(0.0095)	(0.0164)	(0.0103)	(0.0544)	(0.0104)	(0.0168)
Age	−0.00723 **	−0.00692 **	−0.00815 **	−0.00796 ***	−0.00882 ***	−0.00734 ***
	(0.00219)	(0.00148)	(0.00223)	(0.00247)	(0.00225)	(0.00164)

Table 2. *Cont.*

Variable	(1)		(2)		(3)	
	Transfer Decision	**Transfer Scale**	**Transfer Decision**	**Transfer Scale**	**Transfer Decision**	**Transfer Scale**
Health	−0.00847 (0.00295)	−0.07425 *** (0.04968)	−0.00700 (0.00445)	−0.07803 *** (0.01627)	−0.00682 (0.00460)	−0.07720 ** (0.02858)
Education	0.00214 * (0.00122)	0.00288 (0.00193)	−0.00106 (0.00142)	0.00368 (0.00294)	−0.00751 (0.00139)	0.00196 (0.00397)
Political Relation	−0.00364 (0.0161)	−0.00289 (0.0193)	−0.00925 (0.0157)	−0.00394 (0.0458)	−0.00497 (0.0265)	−0.00480 (0.0482)
Number of Household Labor Force			0.0693 *** (0.0434)	0.1132 *** (0.1255)	0.0717 *** (0.0447)	0.1233 *** (0.1590)
Household Income			0.08033 *** (0.0414)	0.61449 *** (0.2714)	0.07615 *** (0.0457)	0.79015 *** (0.4101)
Land Endowment			−0.00676 *** (0.0396)	−0.03701 *** (0.0225)	−0.00683 *** (0.0237)	−0.04534 *** (0.0290)
Total Value of Machinery			0.00510 *** (0.0019)	0.06311 ** (0.0524)	0.00355 ** (0.0018)	0.02612 ** (0.0624)
Traffic Conditions in The Village					0.00321 *** (0.00205)	0.00415 ** (0.00174)
Shaanxi Province					0.000174 (0.00624)	0.000711 (0.00409)
Gansu Province					0.000523 (0.0573)	0.000093 (0.0141)
Guizhou Province					0.000773 (0.00490)	0.001156 (0.00796)
Yunnan Province					0.00735 (0.0563)	0.00172 (0.0171)
Observations	1776		1724		1693	

Note: *, **, *** indicate significant differences at the 10%, 5%, and 1% levels, respectively. The results are reported as marginal effects of the model.

The regression results for land transfer decision making show that the regression coefficients for Internet use are all greater than 0 and significant at least at the 5 percent statistical level, suggesting that Internet use has a significant impact on farmers' participation in the land transfer market, and that Internet use can significantly increase the incentives and probability of households' participation in the land transfer market. The possible explanation for this is that, in the past, the reason why households did not participate in the land transfer market could have been due to the high fixed transaction costs, which made it difficult to cross the market threshold for land transfer transactions. However, the convenience, low cost, and wide availability of the Internet and the huge amount of information it carries can effectively reduce the fixed costs (i.e., information searching costs and contract negotiation costs) of farmers' participation in the land transfer market, lower the threshold of the market, and thus greatly stimulate the enthusiasm of farmers to participate in the land transfer market. Based on this, Hypothesis (H1) is verified.

The regression results of the land transfer scale show that the land transfer scale of farmers who use the Internet is at least 6.16 percent higher than that of farmers who do not use the Internet, which is significant at the 1 percent statistical level, suggesting that Internet use has a significant impact on the increase in the size of the land transfer scale of farmers and that it can significantly increase the size of the household land transfer. The possible explanation for this is that the use of the Internet enhances the transparency of information

between the contracting parties and thus reduces the risk of opportunistic behavior. At the same time, Internet-based trading platforms, as third parties to the transaction, also help to constrain the occurrence of opportunistic behavior. Even if opportunistic behavior occurs, the transaction platform can provide a fair platform for both parties to protect their rights, along with a standardized rights protection mechanism to protect the legitimate interests of both parties from being infringed upon, thus reducing the variable transaction costs used by farmers for ex-post supervision, increasing the participation of farmers in the land transfer market, and increasing the scale of land transfer. Based on this, Hypothesis (H2) is verified.

The regression results of the control variables on land transfer show that there is a significant negative correlation between the age of the head of household, land endowment, and the decision to transfer land. The possible explanation is that, along with the age of the head of household, his willingness and ability to carry out agricultural business gradually declines and his willingness to carry out land transfer will also decline. The greater the land endowment, the more it suggests that land income is likely to constitute the household's main source of income, and thus the less likely it is to be transferred out of the land. At the same time, the more land that is transferred, the better it is not, so there is a significant negative correlation between the two. Significant positive correlations were found between the number of household laborers, the household income, the total value of machinery, the traffic condition in the village, and the decision to transfer land. The possible explanation is that the higher the number of household laborers, the more likely they are to transfer to land, thus optimizing the factor ratio between people and land. The higher the household income, the more capable the household is to pay the fixed transaction costs such as information gathering costs and contract negotiation costs (one-time payments required to participate in the land transfer market), and thus the more likely the household is to transfer land. The reason why households with a higher total value of machinery are more likely to participate in the land transfer market is that agricultural machinery, as a necessary input to agricultural operations, can be considered as part of the sunken costs of agricultural operations, and thus the more likely they are to engage in land transfers in order to optimize the factor ratios between land and machinery inputs. The positive effect of intra-village accessibility on participation in the land transfer market can be explained by the fact that the better the accessibility, the higher the value of the land, thus the more likely it is to be recognized by the market and therefore the more likely it is to enter the market.

With regard to the scale of land transfer, there is a significant negative correlation between the age of the head of household and the health status of the head of household and land endowment and the scale of land transfer. A possible explanation is that, as the age of the head of household increases, his or her ability to conduct land management decreases, and he or she may even stay at home without conducting any agricultural activities, thus staying away from the land transfer market and thus reducing the scale of land transfer. The reason why the better the health of the head of household, the less inclined to increase the scale of land transfer may be that, in China's industrial compensation ratio, due to the existence of long-term industrial and agricultural sectors, agricultural income is always in the low-income sector, so the better the health of the agricultural household, the more inclined the household is to transfer labor to the non-agricultural sector, which therefore will reduce the scale of land transfer. The reason behind the better the land endowment the smaller the scale of land transfer may be because there may be an optimal threshold for the size of land already owned, and when the size exceeds this threshold (accompanied by rising management costs and possible declining economies of scale), farmers may tend to reduce the scale of land transfer. Significant positive correlations were found between the number of household laborers, household income, total value of machinery and intra-village transportation, and land transfer size. A possible explanation is that the higher the number of household laborers, the greater the need for a sufficiently large land size to match. The higher the household income, the greater the ability to transfer large-scale land. The higher the total value of machinery, the greater the need to expand the scale of

operation to achieve the optimal ratio between machinery and land. The positive effect of intra-village transport on the size of land transfers may be due to the fact that land located on major transport routes has easier access to the transfer market (as analyzed above) and is therefore more likely to be transferred on a larger scale.

5.2. Endogeneity Problem Handling

In this paper, the CMP method is used to mitigate the possible endogeneity problem of the core explanatory variables, and the estimation results are shown in Table 3. It can be seen that the coefficients of the instrumental variables are all significant at the 1% level, indicating that the selection of instrumental variables satisfies the correlation assumption. The endogeneity test parameter atanhrho_12 is also significant, indicating that there is an endogeneity problem in the benchmark regression when the estimation results of the CMP are more accurate. In contrast to the estimation results of the benchmark regression, it can be found that the estimation results of CMP are significantly smaller, indicating that the endogeneity problem of the core explanatory variables overestimates the impact of the Internet on land transfer. But even so, the coefficients of the core explanatory variables are significant at the 1 percent level, and the impact of Internet use on land transfer decisions and land transfer scale can still reach 0.31 percent and 3.84 percent, respectively, which is still of strong economic significance.

Table 3. Estimated CMP results of Internet use on land transfer.

Variable	(1)		(2)		(3)	
	Transfer Decision	**Transfer Scale**	**Transfer Decision**	**Transfer Scale**	**Transfer Decision**	**Transfer Scale**
Internet use	0.0037 *** (0.0021)	0.0428 *** (0.0218)	0.0029 *** (0.0016)	0.0416 *** (0.0165)	0.0037 *** (0.0024)	0.0384 *** (0.0175)
Household communication expenses in 2018	0.0075 *** (0.0031)	0.0154 *** (0.0127)	0.0070 *** (0.0030)	0.0176 *** (0.0132)	0.0063 *** (0.0028)	0.0169 *** (0.0130)
atanhrho_12	−0.301 ** (0.0422)	−0.279 *** (0.0300)	−0.221 *** (0.0379)	−0.117 *** (0.0232)	−0.218 *** (0.0357)	−0.133 *** (0.0263)
Household head control variable	yes		yes		yes	
Family control variables			yes		yes	
Regional control variables					yes	
Observations	1769		1730		1716	

Note: **, *** indicate significant differences at the 5%, and 1% levels, respectively. The results are reported as marginal effects of the model.

5.3. Robust Test

5.3.1. The Impact of Internet Use on Paid Land Transfer

During the research, we found that, in China's land transfer market, a certain percentage of the transfer is carried out between acquaintances, and this kind of transaction generally has no monetary involvement and is unpaid [55]. Based on this, in order to test the robustness of the regression results, we exclude this type of land transfer from the sample and study only the effect of Internet use on paid land transfer. The regression results are shown in Table 4. Instrumental variables are significant at the 1% level, indicating that the choice of instrumental variables satisfies the correlation assumption. The endogeneity test parameter atanhrho_12 is significant at least at the 5 percent level, indicating that the baseline regression has an endogeneity problem, at which point the CMP estimates are more accurate; thus, we report only the CMP estimates. The estimation results for the paid transfer sample show that Internet use has a significant effect on both farmers' land transfer decisions and on the size of farmers' land transfers, which is basically consistent with the estimation results in Table 3, and the results are robust. It can also be seen that the coefficient of the paid transfer sample is larger than the coefficient of the full sample,

indicating that Internet use has a greater impact on paid land transfer. Compared with the CMP regression, the benchmark regression overestimates the impact of Internet use on farmers' land transfers because of the endogeneity problem. A one-unit increase in Internet use increases the probability of farmers' participation in the land transfer market by 0.40 percent and increases the size of land transferred by farmers by 3.97 percent, which is economically significant.

Table 4. Estimated results of Internet use on paid land transfer.

Variable	Benchmark Regression		CMP	
	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale
Internet use	0.0097 *** (0.0019)	0.0716 *** (0.0123)	0.0040 *** (0.0027)	0.0397 *** (0.0181)
Household communication expenses in 2018			0.00378 *** (0.000397)	0.00419 *** (0.000253)
atanhrho_12			−0.231 ** (0.0750)	−0.307 *** (0.0298)
Household head control variable	yes		yes	
Family control variables	yes		yes	
Regional control variables	yes		yes	
Observations	1745		1731	

Note: **, *** indicate significant differences at the 5%, and 1% levels, respectively. The results are reported as marginal effects of the model.

5.3.2. The Impact of Internet Use on Land Transfer for Above-Scale Households

In Section 4.2, we report the differences in land endowment between households. The mean value of household land size is 5.267 and the standard deviation is 2.987, with some households owning more land and others owning less. In general, if a household owns very little land, then the share of agricultural income in household income is likely to be lower. A lower share of agricultural income may imply that land has a lower status in the household and that the farmer's attitude towards dealing with land will be more casual. To verify the robustness of the previous estimation results, we define households with land size above 2 acres as above-scale households and households with land size below 2 acres as below-scale households. Other variables are kept constant and the regression is run again excluding below-scale households to see whether below-scale households affect the robustness of the estimation results. The results are shown in Table 5. It can be seen that the effects of Internet use on land transfer for above-scale households are all significant at the 1 percent level, and their coefficients are also closer to the estimation results above, proving the robustness of the estimation results.

Table 5. Estimated results of Internet use on land transfer for above-scale households.

Variable	(1)		(2)		(3)	
	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale
Internet use	0.0029 *** (0.0018)	0.0482 *** (0.0137)	0.0031 *** (0.0025)	0.0396 *** (0.0161)	0.0033 *** (0.0020)	0.0411 *** (0.0179)
Household head control variable	yes		yes		yes	
Family control variables			yes		yes	
Regional control variables					yes	
Observations	1677		1629		1610	

Note: *** indicates significant differences at the 1% level. The results are reported as marginal effects of the model.

5.3.3. The Impact of Different Internet Access Methods on Land Transfer

Against the background of the rapid development of communication technology, there are various ways and means of accessing the Internet, including mobile phone Internet access, tablet computer Internet access, laptop computer Internet access, and desktop computer Internet access. In our research, we found that the rural population's access to the Internet was dominated by mobile phone Internet access and desktop computer Internet access (referred to as computer Internet access); therefore, this paper distinguishes between these two types of Internet access in the sample, and excludes the sample with both mobile phone Internet access and computer Internet access in order to study the impact of different Internet access on land transfer and to validate the robustness of the model. The results are shown in Table 6. It can be seen that the impacts of both mobile phone Internet access and computer Internet access on household land transfer are significant at the 1% level, and their coefficients are also closer to the estimation results above, proving the robustness of the estimation results.

Table 6. Estimated results of land transfer with different Internet access methods.

Internet Access Method	(1)		(2)	
	Transfer Decision	**Transfer Scale**	**Transfer Decision**	**Transfer Scale**
Mobile Internet access	0.0074 *** (0.0021)	0.0692 *** (0.0107)		
Computer Internet access			0.0069 *** (0.0019)	0.0710 *** (0.0131)
Household head control variable	yes		yes	
Family control variables	yes		yes	
Regional control variables	yes		yes	
Observations	1372		1372	

Note: *** indicates significant differences at the 1% level. The results are reported as marginal effects of the model.

5.4. Heterogeneity Analysis

While the above examines the impact of Internet use on land transfer among farm households, this result can only reflect the average effect at the full sample level and cannot reflect the heterogeneity among different groups. Based on this, this paper examines the heterogeneity of the effect of Internet use on land transfer among farm households at three levels: income level, education level, and age level.

The basis for choosing income levels as a grouping in this paper is that a large number of rural laborers are currently moving to towns and cities and to non-agricultural employment channels, and the differentiation in employment channels leads to differences in the sources of income for farm households. If the income of agricultural households mainly comes from agriculture, they attach more importance to land. If the income of farm households mainly comes from non-farm employment, they will attach less importance to land. This will further affect the land transfer behavior of farmers [56].

The choice of education level as a basis for grouping is based on the consideration that the Internet, as an information advancement, has a distinctly technologically biased character (skill-biased technical change), and therefore the acceptance and effectiveness of the Internet may vary among populations with different levels of education [57].

The choice of age level as a grouping is based on the fact that the Internet, as a representation of the technological revolution, may be accepted differently by different age groups and therefore may produce different effects. Young people may be more susceptible to the effects of the Internet due to their young age and ability to accept new things [58]. The opposite is true for older people. This, in turn, may further affect their land transfer behavior.

5.4.1. Grouping by Income Level

Using the 0.33 quantile and 0.67 quantile of per capita household income, the sample households were categorized into low, middle, and high income levels and estimated using the CMP method. The regression results are shown in Table 7. The results show that the instrumental variables are significant at least at the 10 percent level, indicating that the selection of instrumental variables satisfies the correlation assumption. The endogeneity test parameter atanhrho_12 is significant at least at the 10 percent level, indicating that there is an endogeneity problem in the baseline regression, when the CMP estimates are more accurate. It can be seen that Internet use has a non-significant impact on the land transfer behavior of low-income level households and middle-income level households, while it has a significant impact on the land transfer behavior of high-income level households. For every unit increase in Internet use of high-income people, the probability of their participation in the land transfer market increases by 0.45 percent and the size of land transfer increases by 2.95 percent. This implies that farmers with higher income levels are more likely to make good use of the Internet to mitigate information asymmetry. The possible explanation is that high-income groups have a stronger capacity to pay and are more resilient to the influence of the Internet, and thus are more likely to make land transfer decisions stimulated by Internet information.

Table 7. CMP estimation results for different income levels.

Income Levels	Low Income Level		Medium Income Level		High Income Level	
	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale
Internet use	0.0029 (0.0017)	0.0372 (0.0203)	0.0021 (0.0011)	0.0381 (0.0136)	0.0045 *** (0.0029)	0.0295 *** (0.0159)
Household communication expenses in 2018	0.0068 * (0.0027)	0.0163 * (0.0131)	0.0064 * (0.0025)	0.0158 * (0.0119)	0.0059 *** (0.0024)	0.0160 *** (0.0127)
atanhrho_12	−0.101 * (0.0212)	−0.217 * (0.0264)	−0.208 * (0.0225)	−0.114 * (0.0211)	−0.212 ** (0.0261)	−0.126 ** (0.0223)
Control variables	yes		yes		yes	
Observations	586		604		586	

Note: *, **, *** indicate significant differences at the 10%, 5%, and 1% levels, respectively. The results are reported as marginal effects of the model.

5.4.2. Grouping by Educational Level

Based on the number of years of education received by the head of household (primary and below, junior high school, senior high school and above), we categorized the sample households into three levels of low education (primary and below), medium education (junior high school), and high education (senior high school and above), which were estimated using the CMP method. The regression results are shown in Table 8. The results show that the instrumental variables are significant at least at the 10 percent level, indicating that the selection of instrumental variables satisfies the correlation assumption. The endogeneity test parameter atanhrho_12 is significant at least at the 10 percent level, indicating that there is an endogeneity problem in the baseline regression, at which point the CMP estimation results are more accurate. It can be seen that Internet use has a significant impact on the land transfer behavior of households with medium and high education levels, while it does not have a significant impact on the land transfer behavior of households with low education levels. Moreover, the marginal coefficient of high education level households is larger than the marginal coefficient of medium education level households, which indicates that the higher education level farmers are more likely to make good use of the Internet to alleviate the problem of information asymmetry. A possible reason for this is that households with a low level of education have a lower ability to obtain effective information through the Internet. At the same time, due to the lack of education, they are

also more likely to have incorrect ways of using the Internet [59], which leads to effect dissipation (ED) of the Internet in mitigating information asymmetry.

Table 8. CMP estimation results for different levels of education.

Education Levels	Low Education Level		Medium Education Level		High Education Level	
	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale
Internet use	0.0027 (0.0016)	0.0302 (0.0184)	0.0029 *** (0.0015)	0.0356 *** (0.0131)	0.0051 *** (0.0032)	0.0376 *** (0.0214)
Household communication expenses in 2018	0.0072 * (0.0029)	0.0154 * (0.0127)	0.0055 *** (0.0021)	0.0143 *** (0.0104)	0.0053 *** (0.0022)	0.0157 *** (0.0115)
atanhrho_12	−0.210 * (0.0231)	−0.194 * (0.0189)	−0.199 ** (0.0200)	−0.208 ** (0.0214)	−0.157 *** (0.0176)	−0.173 *** (0.0160)
Control variables	yes		yes		yes	
Observations	602		783		381	

Note: *, **, *** indicate significant differences at the 10%, 5%, and 1% levels, respectively. The results are reported as marginal effects of the model.

5.4.3. Grouping by Age Level

Based on the age of the head of the household, we categorized the sample into three levels, low age level (below 35 years), medium age level (35–65 years), and high age level (above 65 years), which were estimated using the CMP method. The regression results are shown in Table 9. The results show that the instrumental variables are significant at least at the 10 percent level, indicating that the selection of instrumental variables satisfies the correlation assumption. The endogeneity test parameter atanhrho_12 is significant at least at the 10 percent level, indicating that there is an endogeneity problem in the baseline regression when the CMP estimates are more accurate. It can be seen that Internet use has a significant impact on the land transfer behavior of low- and middle-age level households, but not on the land transfer behavior of high-age level households. Moreover, the marginal coefficient of low-age level households is larger than the marginal coefficient of middle-age level households, which indicates that the lower-age level farmers are more likely to make good use of the Internet to alleviate the problem of information asymmetry. A possible reason for this is that the lower the age level, the higher the acceptance of emerging things such as the Internet, the greater the influence of the network, the greater the ability to use the Internet to obtain valuable agricultural information, and therefore more likely to be the basis of Internet information for land transfer. On the other hand, the higher the age level, the lower the degree of acceptance of the Internet and other emerging things may be, with more infrequent use of the Internet, less influence from the network, more difficulty obtaining valuable agricultural information from the Internet, thus inhibiting their land transfer behavior.

Table 9. CMP estimation results for different age levels.

Age Levels	Low Age Level		Medium Age Level		High Age Level	
	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale
Internet use	0.0046 *** (0.0032)	0.0311 *** (0.0129)	0.0036 *** (0.0027)	0.0279 *** (0.0124)	0.0041 (0.0029)	0.0254 (0.0117)
Household communication expenses in 2018	0.0059 *** (0.0023)	0.0173 *** (0.0161)	0.0049 *** (0.0017)	0.0151 *** (0.0144)	0.0049 * (0.0020)	0.0143 * (0.0110)
atanhrho_12	−0.184 ** (0.0165)	−0.210 ** (0.0193)	−0.180 ** (0.0161)	−0.231 ** (0.0240)	−0.171 * (0.0158)	−0.190 * (0.0171)

Table 9. *Cont.*

Age Levels	Low Age Level		Medium Age Level		High Age Level	
	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale	Transfer Decision	Transfer Scale
Control variables	yes		yes		yes	
Observations	501		429		743	

Note: *, **, *** indicate significant differences at the 10%, 5%, and 1% levels, respectively. The results are reported as marginal effects of the model.

6. Conclusions and Policy Recommendations

Based on the transaction cost analysis framework, this paper explores the impact of Internet use on land transfer decision making and transfer scale at the household level, respectively. The results show that Internet use can significantly increase the probability of farmers' participation in the land transfer market by reducing the fixed transaction costs in the land transfer market (including the information cost of searching for the target and the negotiation cost of establishing the contract). Internet use can significantly increase the scale of farmers' participation in the land transfer market by reducing the variable transaction costs in the land transfer market (including the cost of monitoring contract enforcement, the cost of time, and the resulting opportunity costs due to moral hazard and opportunistic behavior). This conclusion still holds after addressing endogeneity using CMP estimation. This result suggests that the Internet, as the most important application of communication technology, has a significant impact on the land transfer behavior of farmers, which is important for mitigating the problems of small-scale land management and fragmentation of land management, as well as the mismatch of human and land resources in China.

The results of the robustness tests in terms of land transfer with compensation, family land transfer above scale, and the impact of different Internet access on land transfer still support the above findings. Heterogeneity analyses show that the impact of Internet use on land transfer has obvious population heterogeneity. Internet use has a significant impact on the land transfer behavior of high-income level households, middle- and high-education level households, and low- and middle-age level households, but not on the land transfer behavior of low-income level and middle-income level households and low- and high-education level households.

Based on the above findings, in order to better play the positive role of Internet use in promoting land transfer, this paper puts forward three policy recommendations: First, the rural Internet infrastructure should be further improved, the construction of a unified Internet information platform should be strengthened, and the information bridge between the Internet and farmers should be built in order to further bring the distance between the Internet and farmers closer, increase the penetration rate of the Internet, and further alleviate the phenomenon of information asymmetry in the land transfer market. Second, the accessibility of educational resources should be further improved, the training of farmers in Internet-use skills should be strengthened, and the awareness and ability of farmers to obtain agricultural information through the Internet should be improved in order to optimize the factor inputs of the Internet, reduce the cost of farmers in obtaining agricultural information, and stimulate the enthusiasm of farmers to participate in the land transfer market. Thirdly, since the impact of Internet use on the land transfer behavior of low-income level households and middle-income level households is not significant, further economic development should be carried out to increase farmers' incomes in order to enhance the elasticity of farmers' response to the reduction of transaction costs by Internet use and to promote land transfer.

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survey, interview, and questionnaire. All authors have read and agreed to the published version of the manuscript.

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