

Article

Rural Land Transfer in the Information Age: Can Internet Use Affect Farmers' Land Transfer-In?

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Abstract: Land transfer is an essential prerequisite for moderate-scale operation. Using the internet realizes the rational allocation of resources and promotes the development of agriculture and rural areas. Based on the data of 8198 farmers surveyed in the 2016 China Labor Dynamics Survey, the conditional mixed estimation method (CMP) was used to analyze how the internet use of rural households affects their land transfer-in. The results showed that: (1) There was a significant negative correlation between internet use and land transfer-in, and the marginal effect was 0.206. (2) Internet use can affect land transfer-in through social networks and the stability of off-farm employment. Among them, social networks have a positive mediating effect, which is 0.026%. The non-agricultural employment stability of the labor force has a negative mediating effect, which is 0.51%. (3) Internet use has no significant heterogeneity in land management scale, income, or suburb status, but there is heterogeneity in the way of surfing the internet. This research can deepen our understanding of the relationship between internet use and land transfer-in, and provide a reference for rural digital construction and land transfer-related policy formulation.

Keywords: internet; land transfer-in; rural area; China

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1. Introduction

China uses about 7% of the world's arable land to feed about 22% of the world's population. However, land fragmentation and the transfer of labor force restrict the development of land-management scale and land-factor market [1]. Unlike the privatization and large-scale land management in Western developed countries such as Europe and the United States, China is a country with more people and less land. The per capita arable land in China is only 0.097 hectares, and the land is fragmented and scattered [2]. In the context of separating the three rights in China, Land ownership is owned by the state and collectives, and contract rights and management rights are granted to farmers. With the development of urbanization, many farmers are engaged in the secondary and tertiary industries, resulting in a large amount of land being idle. To make full use of land resources, the government encourages farmers to carry out land transfers, that is, transfer land management rights. Farmers' participation in land transfer involves two interrelated choices: transfer into land and transfer out of land. The focus of this paper is land transfer-in, which refers to the behavior of farmers who transfer land management rights from other operators for a certain period and a specific remuneration to engage in agricultural production and management. It makes the adequate land resources able to be concentrated and run using large-scale management. In recent years, with the promotion of a rural revitalization strategy, land transfer has become a hot trend in rural development. By 2019, the rural land-transfer area had increased to over 37 million hectares, but the growth rate increased slowly [3]. The factors restricting the transfer of land is worth further discussion.

Regarding the factors of rural households' participation in land transfer activities, the existing literature believes that rural households' involvement in the land transfer market can be attributed to regional, cultural, production, and social factors. First, different geographical locations and regions with varying levels of economic development are essential factors that affect land transfer [4,5]. Secondly, human factors such as age, education, family income, employment status, and other factors of rural families will impact land transfer [6–8]. In addition, production factors such as arable-land fragmentation, crop type, and degree of mechanization also play an essential role in the transfer of farmland [9,10]. Finally, social factors such as state system and land-use policy will also impact land transfer [11]. However, the role of information and communication technology in the land transfer market has been neglected. The internet revolution has been regarded as a catalyst for the development and change for today's knowledge-based society [12]. Since 2015, China has been leading a "Internet+" demonstration project and proposed implementing a digital-village strategy. The popularization of the internet, the acceleration of information exchange and dissemination, and its impact on the land transfer market remain to be explored.

Currently, China's rural informatization construction is developing rapidly, the scale of internet users is expanding, and the internet-based digital economy has become an essential support for the high-quality development of China's economy [13,14]. According to statistics, as of June 2021, netizens in rural areas increased from 23 million in 2006 to 297 million. The popularization and development of the internet has dramatically changed the production and lifestyle of farmers [15]. Many studies have documented the impact of internet use in areas such as off-farm employment, home entrepreneurship, economic development, energy, and environmental protection [16–18]. In agriculture, there is more focus on the relationship between internet use and agricultural productivity, agricultural extension, and smart agriculture [19–22]. However, farmers in many developing countries, such as China, still face the challenge of information asymmetry in seeking agricultural and business management information. As a medium of information acquisition, the internet can reduce information asymmetry and the cost of information search [23] and has strong social interaction, which can effectively expand the social capital of the labor force and improve the probability of employment [24]. Then, whether the internet use will affect farmers' land transfer-in, and if so, what is the mechanism between the two, has become the focus of this paper.

In the few existing studies that focus on both residents' internet use and land transfer behavior, Liu et al. [25] used the survey data of 14 provinces in China. They found that the internet can help farmers obtain agricultural information and then promote land transfer (including transfer-in and transfer-out). In addition, Zhang and Zhang [26] and Zou et al. [27] only focused on land transfer-out. They found that using the internet would significantly increase the probability of household farmland transfer-out. However, these studies only focus on whether internet use affects land transfer (especially land transfer-out), and more solid empirical studies are needed. As to the analysis above, this paper uses household survey data from China Labor Force Dynamics Survey (CLDS) 2016 to explore the relationship between the internet use and farmers' land transfer-in and its specific mechanism, to provide new opportunities for optimizing the rational allocation of land resources.

The marginal contribution of this paper mainly includes: First, the sample data of this paper are 8198 household surveys from 27 provinces in China, which is more representative, explanatory, and policy-oriented. Second, this paper further considers the self-selection problem of internet use and deals with endogeneity, and the empirical results are more reliable. Third, limited studies have focused on the relationship between internet use and land transfer (especially transfer-out), while less attention has been paid to land transfer-in. In addition, few studies have deeply analyzed the influence mechanism between the two. On this basis, this paper has conducted a deeper analysis of the mediation mechanism, which can enrich the related research to a certain extent.

2. Theoretical Analysis

The internet is a comprehensive economic system based on information technology, which is essentially a medium for information exchange and communication [28]. On the one hand, the internet can quickly and accurately integrate information from the land transfer market and provide information about agricultural activities, crop production technologies, and extension services. It helps farmers save time and cost in information search and helps farmers make optimal market decisions [25]. On the other hand, the internet can effectively reduce market friction and facilitate communication between the two parties in the transfer—those wanting to transfer in farmland and those wishing to transfer out farmland—thus improving bargaining power and encouraging land transfer activities [29]. Therefore, this paper proposes that there is a correlation between internet use and land transfer-in (Figure 1).

H1: *Internet use is positively correlated with land transfer-in.*

In actual production and life, different factors such as geographical location, resource endowment, and economic development may lead to heterogeneity in the impact of internet use on land transfer-in. First of all, as the scale of operation will affect household management decisions, farmers of different sizes may have different land transfer decisions. Secondly, the transfer of land by farmers is often accompanied by the flow of rent, and the income sources of households with different income levels vary [26], resulting in different land-transfer-in decisions. Third, regions with more developed geographical locations will have better social services and infrastructure [30]. Finally, different internet access methods may not have the same effect on household internet use, which may lead to differences in the impact of household internet use on land transfer.

H2: *The effect of internet use on land transfer-in will be heterogeneous according to household land size, income, geographical location, and internet access mode.*

Social capital is the social resources that farmers have when they maintain their livelihood, seek their development, and deal with risk impact. Its essence is the ability of an individual or organization to obtain resources through social networks built by trust, participation, and prestige [31]. As one of the vital application fields of the internet, instant messaging is not only conducive to the continuous maintenance of solid connections but also provides more possibilities for establishing more weak connections [24,32], which can broaden the information channels of both parties. In addition, individuals in a society of acquaintances tend to imitate the behavior of others. That is, the behaviors of farmers are not only influenced by some of their characteristics but also by the behaviors of other individuals in the group or social networks [33]. Therefore, farmers may follow suit when they learn about others' land transfer-in through the internet. Thus, H3 is proposed in this paper:

H3: *Rural households use the internet to facilitate their land transfer-in by expanding social networks.*

The internet not only changes people's lives but also changes people's employment mode and employment structure. First, employers can publish recruitment information and conduct online interviews through the internet [34], and employees can also choose telecommuting and online part-time work [35]. Both of them increase the participation rate of farmers in non-farm employment. Secondly, as an information medium, the internet can spread modern production and life concepts to rural residents. It not only improves the subjective initiative of farmers' non-agricultural employment [36] but also transmits more new knowledge and skills to farmers at a lower cost [37], thus improving the quality of farmers' employment. However, due to the limited amount of the family labor force, when the family labor force participates in the off-farm job steadily, the time for agricultural production will be crowded out, so the family tends to maintain or even reduce the scale of land operation. Therefore, this paper proposes H4:

H4: *Rural households use the internet to reduce land transfers-in by increasing off-farm employment stability.*

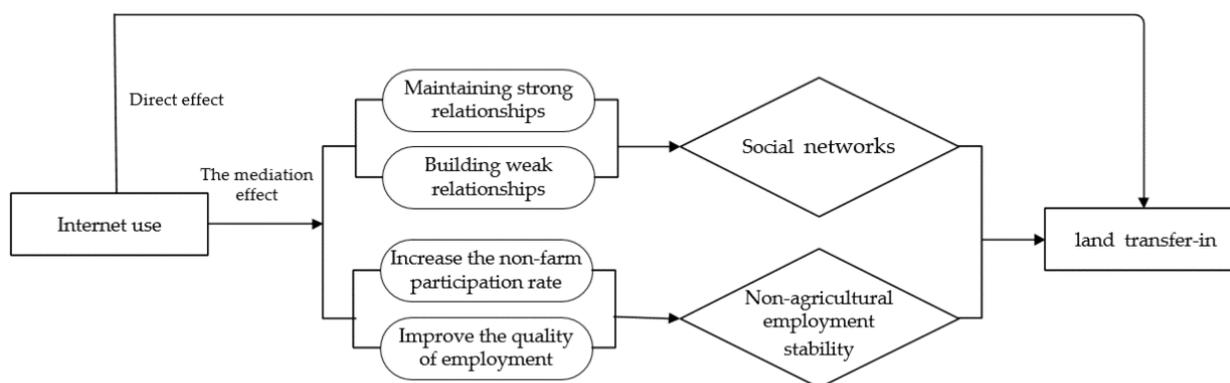


Figure 1. Theoretical analysis framework.

3. Data and Methods

3.1. Data Sources

This paper uses survey data from the 2016 CLDS (China Labor Force Dynamics Survey)¹. This survey adopts a multi-stage, multi-level probability sampling method proportional to the size of the labor force. It uses questionnaires from three levels (village, family, and individual), covering many aspects such as labor-force structure, social participation, land and economy, and community environment and facilities. In the data processing, the data at the household level is first screened and then matched with the village questionnaire to obtain matching data at the village level. Finally, a sample of 8198 households from 262 administrative villages in 172 districts (counties) of 27 provinces was obtained.

3.2. Index Selection

3.2.1. Explained Variable

Whether households transfer into land is the dependent variable of this paper. The value is 1 when the family has land transfer-in, and 0 otherwise. The description and descriptive statistical analysis of variables involved in this paper are shown in Table 1.

3.2.2. Explanatory Variable

Whether the family uses the internet is the dependent variable in this paper. Based on the practice of Zhang and Zhang [26] and Zou et al. [27], this paper uses the internet usage of household heads as a measurement index of household internet utilization. Defined according to the questions “Do you go online by mobile?” and “Do you go online by the computer?” in the questionnaire. If the answer is no, the value of internet usage is defined as 0. Otherwise, it is 1.

3.2.3. Control Variable

Referring to the practice of Liu et al. [25] and Zou et al. [27], this paper introduces the characteristics of household head, family, and village as control variables. At the same time, to control regional differences, the province dummy variable is introduced. First, in the dimension of household-head characteristics, this paper focuses on household registration, gender, age, years of education, health degree, and whether the household head is a party member. Secondly, in the dimension of family characteristics, this paper mainly focuses on the population characteristics of the family, including seven variables: average age, health, education, income, the arable-land area of family members, the number of family members, and labor force. Finally, village characteristics also affect farmers’ land-transfer decisions. First, areas with a high level of economic development will have more non-farm employment opportunities, which may affect the management of family land.; Second, it is easier to use large-scale management in plain areas with relatively flat terrain than in mountainous areas and hills, which will affect whether households transfer to land. Therefore, this paper introduces temporary wages, village economic level, suburbs, and

topography to control the influence of this level of factors. Among them, the village economic level is expressed by the per capita net income of the village residents. The terrain is divided into plain, mountain, and hilly areas.

Table 1. Variable settings and descriptive statistics.

Variable	Code	Definition	Not Using the Internet (4630)		Using the Internet (3568)		Overall (8198)	
			Mean	SD	Mean	SD	Mean	SD
Land transfer-in	Transfer	Transferred in = 1; Not transferred in = 0	0.10	0.31	0.11	0.31	0.11	0.31
Internet use	Internet	Used = 1; Not used = 0	0.00	0.00	1.00	0.00	0.44	0.50
Head account	CH1	Non-agricultural Hukou = 1; Agricultural Hukou = 0	0.04	0.20	0.07	0.26	0.05	0.23
Age of head of household	CH2	Unit: year	58.89	12.72	50.51	11.64	55.24	12.95
Head of household gender	CH3	Male = 1; Female = 0	0.88	0.33	0.90	0.30	0.89	0.31
Whether the head of household is a party member	CH4	Party Member = 1; Non-Party Member = 0	0.08	0.27	0.09	0.29	0.09	0.28
The health of the head of household	CH5	Very healthy = 1; Very unhealthy = 5	2.77	1.09	2.28	0.99	2.56	1.07
Household head education	CH6	Unit: year	6.27	3.50	7.98	3.07	7.02	3.42
Arable land per capita	CH7	Unit: Mu/person	1.82	9.31	1.47	6.43	1.67	8.18
The average age of family members	CF1	Unit: year	45.24	14.93	36.49	9.98	41.43	13.71
Average health of family members	CF2	Very healthy = 1; Very unhealthy = 5	2.44	0.87	2.00	0.69	2.25	0.83
Average education of family members	CF3	Unit: year	5.76	6.10	7.61	6.26	6.57	6.24
Per capita net income of households	CF4	Unit: Yuan/person	6611.84	10,886.74	13,884.71	22,883.64	9777.20	17,544.53
Number of household labor force	CF5	Number of people aged 16–64 in the household	2.52	1.75	2.98	1.42	2.72	1.63
Number of family members	CF6	Number of family members	4.39	2.40	4.81	1.90	4.57	2.20
Temporary salary	CV1	Wages of temporary workers in the village (yuan/day)	123.51	44.81	138.6	61.16	130.08	53.08
Village economic level	CV2	The per capita net income of residents in this village (ten thousand Yuan)	1.17	4.11	1.17	1.44	1.17	3.23
Suburbs	CV3	Suburbs of large and medium cities = 1; suburbs of non-large and medium cities = 0	0.06	0.23	0.12	0.33	0.09	0.28
Plain	CV4	Plain = 1; Non-plain = 0	0.43	0.49	0.48	0.50	0.45	0.50
Hills	CV5	Hills = 1; Non-hill = 0	0.27	0.44	0.29	0.45	0.28	0.45
Mountains	CV6	Mountainous = 1; Non-mountainous = 0	0.31	0.46	0.23	0.42	0.27	0.45

3.3. Empirical Method

3.3.1. Baseline Regression

Since household-farmland transfer is a binary dummy variable, this paper refers to the empirical analysis model of Liu et al. [25] and Liu et al. [38]. It adopts the Probit model to study the influence of internet use on farmland transfer in (Equation (1)).

$$Transfer_i = \beta_0 + \beta_1 \times Internet_i + \beta_2 \times Con_i + \beta_3 \times P_j + \xi_i \quad (1)$$

Among them, $Transfer_i$ means land transfer-in, $Internet_i$ indicates internet usage. Con_i represents the control variable, P_j represents the province fixed effect of controlling for provincial differences, ξ_i is the residual term. β_0 , β_1 , β_2 , and β_3 are the parameters to be estimated for the benchmark regression model, respectively.

Whether or not a family transfers-in land is not a random decision, and there may be endogeneity problems caused by reverse causality or omitted variables. First, whether residents transfer-in land and whether they use the internet influence each other. Secondly, the living habits and psychological factors of the interviewed families are likely to affect the residents' internet use and land-transfer behavior at the same time, resulting in the problem of missing variables. Therefore, to overcome the endogeneity of variables, Deng et al. [14] selected "The percentage of farmers in the village who use the internet" as a tool variable for testing. This variable is chosen for the following reasons: First, this proportion is directly related to household internet use [18], which meets the correlation requirement. Second, as this variable is internet usage data at the village level, it will not directly affect the decision of the household, so it meets the exogeneity requirement. In terms of estimation methods, this paper adopts the conditional mixed estimation method (CMP) proposed by Roodman [39] for estimation. The estimation process starts with finding the exogenous variables of the dependent variable and estimating the correlation between them. Exogenous variables were substituted into the model for simultaneous likelihood estimation. When $atanhrho_12$ was significantly different from 0, the endogeneity problem exists in the model. In this case, CMP estimation results are used. Otherwise, the estimation results of the Probit model are used. This paper will use this method to estimate the internet-use equation and land-transfer-decision equation. The first step is to evaluate the impact of instrumental variables on internet use. The second step is to put the results in the land-transfer-decision equation to assess the effect of internet use on land transfer-in respectively.

3.3.2. Stepwise Regression Model

In this paper, referring to the research of Liu and Ling [40], stepwise regression was used to test the mediation effect, and the estimation formula was as follows:

$$Transfer_i = c Internet_i + \varepsilon_1 \quad (2)$$

$$Mediator_i = \alpha Internet_i + \varepsilon_2 \quad (3)$$

$$Transfer_i = c' Internet_i + b Mediator_i + \varepsilon_3 \quad (4)$$

In the formula, $Transfer_i$ means the dependent variable, $Internet_i$ means the independent variable, and $Mediator_i$ is a mediator variable. α , b , c , and c' are all parameters to be estimated for the model. Stata 16.0 is used for the realization of the whole model.

4. Results

4.1. Descriptive Statistical Analysis

As shown in Table 1, in the overall sample, 11% of farmers transferred land and 44% of farmers used the internet. Comparing the sample of internet-using and non-internet-using farmers, it was found that 11% of internet-using farmers transferred their land, while 10% of non-internet-using farmers transferred their land. In the control variables, in terms of household-head characteristics, 95% of the households have agricultural household registration. The average age of household heads is 55.24 years old; 89% are male; 9% are party members; the average health score is 2.56 points, and the average number of years of education is 3.07 years. Regarding family characteristics, the per capita arable-land area is 1.67 mu; the average age of family members is 41.43 years old; the average years of education is 6.57 years, and the average health score is 2.25 points. The average per capita net income of the family is 9777.20 yuan; the average number of the labor force is 2.72, and the average number of family members is 4.57. In terms of village characteristics, the average village temporary wage is 60.16 yuan; the average per capita net income of

village residents is 11,700 yuan, and 33% of farmers are located in the suburbs of large and medium cities.

4.2. Baseline Regression Analysis

The primary regression results are shown in Table 2. Model 1 and Model 3 used the Probit and CMP to estimate the influence of independent variables on dependent variables. In contrast, Model 2 and Model 4 added control variables and province dummy variables based on Model 1 and Model 3, respectively.

Table 2. Basic regression results.

Variable	Probit		CMP	
	Model 1	Model 2	Model 3	Model 4
Internet	0.004 (0.007)	−0.015 * (0.008)	−0.132 *** (0.017)	−0.206 *** (0.028)
CH1		−0.035 ** (0.016)		−0.030 * (0.018)
CH2		−0.000 (0.000)		−0.002 *** (0.000)
CH3		0.027 ** (0.012)		0.019 (0.014)
CH4		0.005 (0.012)		0.013 (0.013)
CH5		−0.001 (0.005)		−0.004 (0.005)
CH6		0.002 (0.001)		0.004 *** (0.001)
CH7		0.001 * (0.001)		0.001 *** (0.000)
CF1		−0.002 *** (0.000)		−0.003 *** (0.000)
CF2		0.003 (0.007)		−0.005 (0.008)
CF3		−0.000 (0.001)		−0.000 (0.001)
CF4 (take logarithm)		0.008 *** (0.002)		0.014 *** (0.003)
CF5		0.014 *** (0.003)		0.014 *** (0.004)
CF6		−0.006 ** (0.003)		−0.006 * (0.003)
CV1 (take logarithm)		−0.027 ** (0.013)		−0.022 (0.015)
CV2 (take logarithm)		−0.038 *** (0.011)		−0.029 ** (0.011)
CV3		−0.028 ** (0.014)		−0.025 (0.016)
CV4		0.007 (0.010)		0.015 (0.011)
CV5		0.003 (0.010)		0.011 (0.011)
Province dummy variables atanhrho_12	No	Yes	No 0.388 *** (0.040)	Yes 0.463 *** (0.060)
Number of samples	8198	8163	8198	8198

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively; the reported results are marginal effect results.

According to Model 3 and Model 4, the atanhrho_12 parameter test shows that the model rejects the assumption that endogeneity does not exist at the 1% level, so CMP is more

accurate for estimation. The results of Model 4 showed that, after considering endogeneity, households’ use of the internet harms their land transfer-in, with a marginal effect of 0.206, indicating that the estimation results of the Probit model (Model 2) had a downward bias to some extent. In addition, compared with Model 3, among the control variables: household registration, age of household head, the average age of family members, the number of family members, and village economic level also negatively affect land transfer-in. The education level of household head, net income per capita, arable-land area per capita and the number of the household labor force positively affect land transfer-in.

4.3. Heterogeneity Analysis

As mentioned above, there may be heterogeneity in the impact of household internet use on their land transfer-in. This paper conducts analysis from four perspectives: household land scale, income, geographical location, and internet-access mode.

First, in terms of land-scale heterogeneity, according to whether the per capita operating land scale is greater than the sample mean, the samples are divided into two parts: a low land-scale level and high land-scale level. The control variable of the per capita cultivated land area is removed here, and the model is estimated by the Probit and CMP methods, respectively (Table 3). The results show that: internet use negatively affects land transfer-in, and the negative effect of high land-scale level is more prominent. Specifically, when internet use increases by one unit, the probability of farmers transferring to land at the high and low land-scale levels will decrease by 13.9% and 20.1%, respectively.

Table 3. Land-size regression results.

Land Size	Low Land-Size Level		High Land-Size Level	
	Probit	CMP	Probit	CMP
Internet	−0.008 (0.008)	−0.139 *** (0.032)	−0.012 (0.020)	−0.201 *** (0.071)
atanhrho_12		0.388 *** (0.076)		0.335 *** (0.125)
Province dummy variables		Yes		Yes
Control variables		Yes		Yes
Number of samples	6193	6228	1967	1970

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively; the reported results are marginal effect results.

Secondly, in terms of income heterogeneity, per capita annual cash income was selected as the dividing standard to divide the sample into low, medium, and high levels. The control variable will be excluded from the regression and estimated by the Probit and CMP, respectively (Table 4). The results show that internet use negatively affects land transfer-in, and the negative effect decreases with the increase in income level. In other words, when internet usage increases by one unit, the probability of low-, middle-, and high-income farmers transferring to land will decrease by 23.1%, 21.9%, and 15.1%, respectively.

Table 4. Income-level regression results.

Income Level	Low-Income Level		Middle-Income Level		High-Income Level	
	Probit	CMP	Probit	CMP	Probit	CMP
Internet	−0.019 (0.014)	−0.231 *** (0.062)	−0.018 (0.013)	−0.219 *** (0.050)	−0.003 (0.013)	−0.151 *** (0.052)
atanhrho_12		0.495 *** (0.116)		0.467 *** (0.105)		0.378 *** (0.118)
Province dummy variables		Yes		Yes		Yes
Control variables		Yes		Yes		Yes
Number of samples	2639	2640	2794	2803	2722	2755

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively; the reported results are marginal effect results.

In terms of suburban heterogeneity, according to whether the sample is in the suburb of a medium-sized city, the sample is divided into two levels: non-medium-sized suburb and medium-sized suburb. The control variables of the suburbs are removed here, and the model is estimated by the Probit and CMP methods, respectively (Table 5). The results show that the internet use of households in the suburbs of non-large medium urban areas or large medium urban areas harms land transfer-in. However, the negative relationship between internet use and land transfer-in in large- and medium-sized urban areas is more significant. The possible reason is that the income of homes in the suburbs of large and medium urban areas is mainly non-agricultural, and the demand for land transfer-in is lower.

Table 5. Suburban regression results.

Suburbs	Non-Large Or Medium Urban Suburbs		Large and Medium Urban Suburbs	
	Probit	CMP	Probit	CMP
Internet	−0.012 (0.008)	−0.203 *** (0.031)	−0.029 (0.027)	−0.514 *** (0.110)
atanrho_12		0.453 *** (0.064)		1.397 *** (0.382)
Province dummy variables		Yes		Yes
Control variables		Yes		Yes
Number of samples	7492	7492	530	706

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively; the reported results are marginal effect results.

Finally, in terms of the heterogeneity of internet access, according to the different internet-access methods, the internet-access methods are divided into mobile internet access and computer internet access. “The proportion of farmers who use mobile phones to access the internet” and “the proportion of farmers who use computers to access the internet” are respectively used as instrumental variables for estimation (Table 6). The results show that the impact of computer internet access on land transfer-in is significantly negative. In contrast, the effect of mobile-phone internet access on land transfer-in is quite positive, and the marginal effect is 0.206.

Table 6. Regression results of internet access mode.

Internet Access	Computer Online		Mobile Internet	
	Probit	CMP	Probit	CMP
Computer online	−0.015 * (0.008)	−0.206 *** (0.028)		
Mobile internet			0.015 * (0.008)	0.206 *** (0.028)
atanrho_12		0.463 *** (0.060)		−0.463 *** (0.060)
Province dummy variables		Yes		Yes
Control variables		Yes		Yes
Number of samples	8163	8198	8163	8198

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively; the reported results are marginal effect results.

4.4. Mechanism Analysis

The regression results of the mediating mechanism of social networks are shown in Table 7. China is a “relational” society. As an accompaniment of human interaction, gift money represents the scale of social networks to a certain extent [24]. Previous studies have also mainly analyzed gift expenditure as a proxy variable for social networks [41,42]. Therefore, this paper takes the logarithm of gift expenditure last year as a proxy variable for social networks to analyze the mediating role of social networks in the internet use

and land transfer-in. The results show that an increase in internet usage by one unit can increase farmers’ gift expenditure by an average of 5.1%. At the same time, it is found that there is a correlation between social networks and farmers’ land transfer-in, with a marginal coefficient of 0.005. In addition, internet use was still significantly associated with land transfer-in, suggesting that social networks are part of the mediator. This shows that internet use can be correlated with land transfer-in by influencing farmers’ social networks (Mechanism 1), where the indirect effect of social networks is 0.026%.

Table 7. Mechanism analysis results of social networks.

Variable	Mechanism 1					
	Transfer		Ln (Gift Expense)		Transfer	
	Probit	CMP	OLS	CMP	Probit	CMP
Internet	−0.015 *	−0.206 ***	0.491 ***	0.051 ***	−0.017 **	−0.212 ***
	(0.008)	(0.028)	(0.089)	(0.011)	(0.008)	(0.028)
Ln (gift expense)					0.005 ***	0.005 ***
					(0.001)	(0.001)
atanhrho_12		0.463 ***		−0.123 ***		0.474 ***
		(0.060)		(0.035)		(0.060)
Province dummy variables			Yes			
Control variables			Yes			
Number of samples	8163	8198	8198	8198	8163	8198

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively; the reported results are marginal effect results.

Table 8 shows the mediating-mechanism results of non-farm employment stability. Drawing on the practices of Mao et al. [43], this paper judges whether non-agricultural employment is stable from three indicators: signing a contract, work unit, and working hours. The value is 1 if the labor force has signed an agreement or works in a government unit, public institution, or enterprise unit, and the working time per week is more than 30 h. Otherwise, it is 0.

Table 8. Mechanism analysis results of non-agricultural employment stability.

Variable	Mechanism 2					
	Transfer		Stable Employment		Transfer	
	Probit	CMP	Probit	CMP	Probit	CMP
Internet	−0.015 *	−0.206 ***	0.043 ***	0.102 ***	−0.023 ***	−0.232 ***
	(0.008)	(0.028)	(0.005)	(0.020)	(0.006)	(0.021)
Stable employment					−0.058 ***	−0.050 ***
					(0.015)	(0.015)
atanhrho_12		0.463 ***		−0.219 ***		0.472 ***
		(0.060)		(0.060)		(0.044)
Province dummy variables			Yes			
Control variables			Yes			
Number of samples	8163	8198	13,170	13,170	13,130	13,170

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively; the reported results are marginal effect results.

In terms of regression results for mechanism 2, an increase in the rate of internet usage by one unit can lead to a 10.3% increase in the stability of non-farm employment. Stable off-farm employment will negatively affect land transfer-in, and the marginal coefficient is 0.051, indicating that the more stable the off-farm employment is, the less willing it is to transfer land. In addition, internet use remains significantly associated with the land transfer-in, meaning that non-farm employment stability is a partial mediator. This

meant that internet use could affect land transfer-in by affecting the stability of off-farm employment, and its indirect effect is 0.51%.

5. Discussion

First, the underlying regression results are contrary to hypothesis 1. The possible reasons for this are as follows: first, from the perspective of the division of labor within families, the research implicitly pays attention to the nuclear family and ignores gender and the intergenerational division of delivery to a certain extent, while the employment of family labor is often characterized by the joint decision-making of families [44]. Whether farmers transfer-in land and the characteristics of family operation depend on the initial land resources owned by families, the working ability of family workers, and the comprehensive comparative interests between agriculture and non-agriculture, etc. [45]. Although the internet can help more farmers achieve off-farm employment, women and the elderly choose to continue to cultivate the land due to a lack of skills or knowledge. Because of their limited capacity, they often decide to acquire only their land instead of carrying out land transfer-in. Therefore, the two are negatively correlated. Second, from the perspective of land resource endowment, the fragmentation degree of arable-land resources in China is high, which seriously restricts farmers' production investment and the improvement of agricultural production efficiency [46], and also affects farmers' land transfer-in to a certain extent. Some of the results of heterogeneity analysis are consistent with H2. There is no significant heterogeneity in land scale, income, or suburb status, while there is heterogeneity in internet-access mode. Specifically, computer internet access negatively affects land transfer-in, while mobile-phone internet access positively affects land transfer-in. The possible reasons for this are: firstly, the penetration rate of computers is relatively low, and desktops are spatially fixed [39]. Because computer internet access requires higher skills for users and because most of these groups have a higher education level, they tend to prefer non-agricultural jobs. Therefore, the internet use of computer users is negatively related to land transfer-in. Secondly, land income is one of the main sources of income for the rural elderly and women. Compared with computer internet access, the threshold for mobile internet access is lower, and elderly and women are the main users of mobile internet access in rural areas. Therefore, mobile internet access is positively correlated with land transfer-in. In addition, internet use can affect social networks and the stability of labor off-farm employment, which is consistent with Zhang et al. [27]. The results also verify H3 and H4, that social networks and off-farm employment stability have a mediating effect on internet use and land transfer-in.

Interestingly, although internet use is negatively correlated with land transfer-in, it provides a new idea for policy enlightenment. In recent years, the proportion of land transfers in China has been growing slowly and even declining [3]. However, the Chinese government has vigorously promoted "digital rural construction," and the internet penetration rate has been increasing yearly. Therefore, the negative correlation between the two is also in line with reality. As a kind of technological progress, the internet can bring market information such as product prices to farmers, broaden social networks, increase employment opportunities, and bring about lifestyle innovation. Therefore, it is necessary to strengthen internet infrastructure construction in rural areas. Secondly, the heterogeneity analysis results show that the use of the internet can be promoted in various ways. One is to conduct internet-use training for the household workforce or to rely on the internet to conduct more training in agricultural technology to enhance the capacity of farmers themselves. Second, the use of internet social software to help farmers expand social networks can help them achieve the sharing of information on the internet. Third, we should encourage and guide farmers to use the internet in various ways, such as giving full play to the functions of the village library and cultivating farmers' awareness of the internet. Finally, it would be good to standardize the land transfer market, further guide the agricultural land transfer activities relying on the internet, promote the moderate-scale operation of agriculture, and contribute to the development of rural areas.

6. Conclusions

Using the 2016 CLDS survey data, this study explores the relationship between farmers' internet use and land transfer-in and its mechanism, and the main conclusions are as follows:

(1) There was a significant negative correlation between internet use and land transfer-in, and the marginal effect was 0.206.

(2) Internet use can affect land transfer-in through social networks and the stability of off-farm employment. Among them, social networks have a positive mediating effect, which is 0.026%, and the non-agricultural employment stability of the labor force has a negative mediating effect, which is 0.51%.

(3) The heterogeneity analysis shows that there is no significant heterogeneity in the scale of land management, income, or suburb status, but there is heterogeneity in the way of surfing the internet. The negative effect of internet use on land transfer-in is more significant for farmers with large land scales and low incomes and who are located in the suburbs of large- and medium-sized cities. Computer internet access negatively affected land transfer-in, while mobile internet access positively affected land transfer-in.

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Notes

¹ See the official website of CLDS data: <http://css.sysu.edu.cn>, accessed on 12 January 2021.

References

- Xu, D.; Deng, X.; Guo, S.; Liu, S. Labor migration and farmland abandonment in rural China: Empirical results and policy implications. *J. Environ. Manag.* **2019**, *232*, 738–750. [\[CrossRef\]](#)
- Xu, D.; Yong, Z.; Deng, X.; Zhuang, L.; Qing, C. Rural-Urban Migration and its Effect on Land Transfer in Rural China. *Land* **2020**, *9*, 81. [\[CrossRef\]](#)
- Management Station System and Information Department of Ministry of Agriculture. Transfer and Dispute Settlement of Rural Household Contracted Farmland in 2016. *Rural Manag.* **2017**, *8*, 40–41.
- Xu, D.; Guo, S.; Xie, F.; Liu, S.; Cao, S. The impact of rural laborer migration and household structure on household land use arrangements in mountainous areas of Sichuan Province, China. *Habitat Int.* **2017**, *70*, 72–80. [\[CrossRef\]](#)
- Jiang, L.; Yu, W. On Willingness of Rural Land Circulation and Securitization in Central Regions of China. *Asian Agric. Res.* **2014**, *6*, 36–41. [\[CrossRef\]](#)
- Yang, H.; Huang, K.; Deng, X.; Xu, D. Livelihood Capital and Land Transfer of Different Types of Farmers: Evidence from Panel Data in Sichuan Province, China. *Land* **2021**, *10*, 532. [\[CrossRef\]](#)
- Wang, W.; Gong, J.; Wang, Y.; Shen, Y. The Causal Pathway of Rural Human Settlement, Livelihood Capital, and Agricultural Land Transfer Decision-Making: Is It Regional Consistency? *Land* **2022**, *11*, 1077. [\[CrossRef\]](#)
- Deng, X.; Xu, D.-D.; Zeng, M.; Qi, Y.-B. Does labor off-farm employment inevitably lead to land rent out? Evidence from China. *J. Mt. Sci.* **2019**, *16*, 689–700. [\[CrossRef\]](#)
- Xie, H.; Lu, H. Impact of land fragmentation and non-agricultural labor supply on circulation of agricultural land management rights. *Land Use Policy* **2017**, *68*, 355–364. [\[CrossRef\]](#)
- Qian, L.; Lu, H.; Gao, Q.; Lu, H. Household-owned farm machinery vs. outsourced machinery services: The impact of agricultural mechanization on the land leasing behavior of relatively large-scale farmers in China. *Land Use Policy* **2022**, *115*, 106008. [\[CrossRef\]](#)
- Kung, J.K.S. Off-Farm Labor Markets and the Emergence of Land Rental Markets in Rural China. *J. Comp. Econ.* **2002**, *30*, 395–414. [\[CrossRef\]](#)

12. Verdegem, P.; Verhoest, P. Profiling the non-user: Rethinking policy initiatives stimulating ICT acceptance. *Telecommun. Policy* **2009**, *33*, 642–652. [[CrossRef](#)]
13. Chu, M. Research on problems and countermeasures of high-quality development of agricultural producer Services under Digital economy. *J. Theory* **2020**, *8*, 64–69.
14. Deng, X.; Xu, D.; Zeng, M.; Qi, Y. Does Internet use help reduce rural cropland abandonment? Evidence from China. *Land Use Policy* **2019**, *89*, 104243. [[CrossRef](#)]
15. Zhou, W.; Qing, C.; Deng, X.; Song, J.; Xu, D. How does Internet use affect farmers' low-carbon agricultural technologies in southern China? *Environ. Sci. Pollut. Res.* **2022**, 1–12. [[CrossRef](#)] [[PubMed](#)]
16. Zhang, F.; Bao, X.; Guo, S.; Deng, X.; Song, J.; Xu, D. Internet use and land transfer in: Empirical evidence from China's rural panel data. *Environ. Sci. Pollut. Res.* **2022**, 1–14. [[CrossRef](#)]
17. Wang, H.; Ding, L.; Guan, R.; Xia, Y. Effects of advancing internet technology on Chinese employment: A spatial study of inter-industry spillovers. *Technol. Forecast. Soc. Chang.* **2020**, *161*, 120259. [[CrossRef](#)]
18. He, J.; Qing, C.; Guo, S.; Zhou, W.; Deng, X.; Xu, D. Promoting rural households' energy use for cooking: Using Internet. *Technol. Forecast. Soc. Chang.* **2022**, *184*, 121971. [[CrossRef](#)]
19. Ogotu, S.O.; Okello, J.J.; Otieno, D.J. Impact of Information and Communication Technology-Based Market Information Services on Smallholder Farm Input Use and Productivity: The Case of Kenya. *World Dev.* **2014**, *64*, 311–321. [[CrossRef](#)]
20. Zhu, X.; Hu, R.; Zhang, C.; Shi, G. Does Internet use improve technical efficiency? Evidence from apple production in China. *Technol. Forecast. Soc. Chang.* **2021**, *166*, 120662. [[CrossRef](#)]
21. Birke, F.M.; Lemma, M.; Knierim, A. Perceptions towards information communication technologies and their use in agricultural extension: Case study from South Wollo, Ethiopia. *J. Agric. Educ. Ext.* **2019**, *25*, 47–62. [[CrossRef](#)]
22. Wolfert, S.; Ge, L.; Verdouw, C.; Bogaardt, M.-J. Big Data in Smart Farming—A review. *Agric. Syst.* **2017**, *153*, 69–80. [[CrossRef](#)]
23. Zanello, G.; Srinivasan, C.S. Information Sources, ICTs and Price Information in Rural Agricultural Markets. *Eur. J. Dev. Res.* **2014**, *26*, 815–831. [[CrossRef](#)]
24. Zhou, G.; Fan, G. Internet Use and Family Business Choice: Verification from CFPS data. *Econ. Rev.* **2018**, *5*, 134–147. [[CrossRef](#)]
25. Liu, Z.; Xin, X.; Lv, Z. Does Internet access to agricultural information promote farmers' land transfer. *J. Agrotech. Econ.* **2021**, *2*, 100–111.
26. Zhang, J.; Zhang, X. Effect of Internet Use on farmland transfer decision and its mechanism: Microscopic evidence from CFPS. *Chin. Rural. Econ.* **2020**, *3*, 57–77.
27. Zou, B.; Mishra, A.K. How internet use affects the farmland rental market: An empirical study from rural China. *Comput. Electron. Agric.* **2022**, *198*, 107075. [[CrossRef](#)]
28. Wyckhuys, K.A.G.; Bentley, J.W.; Lie, R.; Nghiem, L.T.P.; Fredrix, M. Maximizing farm-level uptake and diffusion of biological control innovations in today's digital era. *BioControl* **2017**, *63*, 133–148. [[CrossRef](#)]
29. Aker, J.C. Information from Markets Near and Far: Mobile Phones and Agricultural Markets in Niger. *Am. Econ. J. Appl. Econ.* **2010**, *2*, 46–59. [[CrossRef](#)]
30. Michailidis, A.; Partalidou, M.; Nastis, S.A.; Papadaki-Klavdianou, A.; Charatsari, C. Who goes online? Evidence of internet use patterns from rural Greece. *Telecommun. Policy* **2011**, *35*, 333–343. [[CrossRef](#)]
31. Dorogovtsev, S.; Mendes, J.F. Evolution of networks. *Adv. Phys.* **2002**, *51*, 1079–1187. [[CrossRef](#)]
32. Granovetter, M.S. The Strength of Weak Ties. *Am. J. Sociol.* **1973**, *78*, 1360–1380. [[CrossRef](#)]
33. Meng, J.; Zhao, L.; Liu, Y.; You, W. Social learning, herd mentality and stock market participation decision making. *Financ. Res.* **2013**, *7*, 153–165.
34. Shahiri, H.; Osman, Z. Internet Job Search and Labor Market Outcome. *Int. Econ. J.* **2015**, *29*, 161–173. [[CrossRef](#)]
35. Dettling, L.J. Broadband in the Labor Market: The Impact of Residential High-Speed Internet on Married Women's Labor Force Participation. *ILR Rev.* **2016**, *70*, 451–482. [[CrossRef](#)]
36. Ma, J.; Ning, G. Internet and non-agricultural employment of rural labor in China. *Sci. Financ. Econ.* **2017**, *7*, 50–63.
37. Bentley, J.W.; Van Mele, P.; Barres, N.F.; Okry, F.; Wanvoeke, J. Smallholders download and share videos from the Internet to learn about sustainable agriculture. *Int. J. Agric. Sustain.* **2019**, *17*, 92–107. [[CrossRef](#)]
38. Liu, H.; Lv, J.; Han, X. Research on the Influence of Internet Use on the willingness of household garbage sorting and Disposal: Data analysis from CLDS. *Res. Agric. Mod.* **2021**, *42*, 1–11. [[CrossRef](#)]
39. Roodman, D. Fitting Fully Observed Recursive Mixed-process Models with cmp. *Stata J.* **2011**, *11*, 159–206. [[CrossRef](#)]
40. Liu, S.; Ling, Q. Multiple mediation model and its application. *Psychol. Sci.* **2009**, *32*, 433–435+407.
41. Yang, R.; Chen, B.; Zhu, S. A Study on Farmers' Private Lending Demand Behavior Based on the Perspective of Social Network. *Econ. Res.* **2011**, *46*, 116–129.
42. Yin, J.; Shi, S. Analysis of the mediating role of social network embeddedness on low-carbon household behaviour: Evidence from China. *J. Clean. Prod.* **2019**, *234*, 858–866. [[CrossRef](#)]
43. Mao, Y.; Zeng, X.; Zhu, H. Internet use, employment decision-making and employment quality: Empirical evidence based on CGSS data. *Econ. Theory Econ. Manag.* **2019**, *1*, 72–85.
44. Wang, W. Micro-basis analysis of farmers' non-farm employment decisions: A case study of FeiCheng City, Shandong Province. *Chin. Rural. Econ.* **2010**, *3*, 45–54+59.

-
45. Huang, K.; Deng, X.; Liu, Y.; Yong, Z.; Xu, D. Does off-Farm Migration of Female Laborers Inhibit Land Transfer? Evidence from Sichuan Province, China. *Land* **2020**, *9*, 14. [[CrossRef](#)]
 46. Ye, Z.; Xia, X.; Chen, Z.; Zhong, Z. Confirmation of farmland rights, farmland fragmentation and agricultural production efficiency. *Resour. Environ. Arid Reg.* **2021**, *35*, 30–36.