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The Impact of Internet Usage on the Growth of Rural Household Income

-- An Analysis Based on CFPS Data

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Abstract

Employing the data from the 2020 China Family Panel Studies (CFPS), a comprehensive measurement of internet usage was conducted at the micro level using a composite indicator to investigate the influence and mechanism of internet usage on the income of rural households. The group regression method was adopted to analyze the differentiated effects of internet usage on the income of rural households in different groups. The research findings indicate that: (1) Internet usage promotes the increase in the income of rural households, with a more significant effect on enhancing the income of low-income groups; (2) The income-generating benefit of internet usage for the operational income of rural households is higher than that of wage income and property income. For rural households with a household head under 65 years old and a high level of internet usage, the effect of internet usage on income increase is more prominent; (3) Internet usage affects the income of rural households by influencing the educational level of farmers, interpersonal expenditures, job search channels, and the per capita financial assets of the household. Based on the above research conclusions, the following policy suggestions are proposed: (1) Consolidate the foundation for internet development and enhance the construction of digital infrastructure in rural areas; (2) Increase public education expenditure and improve the rural education system; (3) Construct an internet information platform to smooth the channels for employment and entrepreneurship.

Keywords

Internet usage; Rural household income; Human capital; Social capital; Wealth capital.

1. Introduction

The report of the 20th National Congress of the Communist Party of China proposed: "Comprehensively promote rural revitalization." The most arduous and onerous tasks in building a modern socialist country still lie in rural areas. Common prosperity is the essential requirement of socialism with Chinese characteristics and also a long-term historical process. The income level of rural households is an important indicator for measuring common prosperity and is also related to the realization of China's rural revitalization strategy goals.

The Internet is increasingly penetrating and influencing people's economic lives, greatly changing the way residents exchange information, reducing the time cost of information transmission, improving production efficiency, and increasing the overall social welfare level. According to the latest 54th "Statistical Report on the Development of China's Internet" released by the China Internet Network Information Center in 2024, the current number of Internet users in China is nearly 1.1 billion, with an Internet penetration rate of 78%. However, the number of rural Internet users is only 304 million, accounting for 27.7%, far lower than the number of urban Internet users. This indicates that there is a gap in Internet usage between

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rural and urban areas, which may widen the digital divide and the income gap between urban and rural areas, and is not conducive to the promotion of common prosperity. How should China's digital rural development strategy be further advanced? How can it play a more efficient role in promoting rural revitalization and accelerating the modernization process of agriculture and rural areas?

Based on the above questions, this paper explores the impact of Internet usage on rural household income, with the aim of providing implications for the digital rural development strategy to achieve common prosperity. Further research is conducted on the differentiated impact of Internet usage on income due to the heterogeneity of the farmer group, and an analysis is provided. On this basis, the mechanism by which Internet usage affects rural household income is explored, and scientific suggestions for digital rural development are provided.

The marginal contributions of this paper are as follows: First, in terms of indicator measurement; previous studies mostly used a single indicator to measure Internet usage (Zhu Shubin et al., 2022; Luo Mingzhong and Liu Ziyu, 2022). This paper selects the CFPS 2020 data and uses a composite indicator at the micro level to measure the Internet usage level of rural household heads, comprehensively studying the impact of Internet usage on rural household income; Second, in terms of research content; this paper empirically examines and analyzes the mechanism by which Internet usage increases rural household income, exploring how Internet usage affects rural household income through improving human capital, social networks, and wealth capital, enriching existing research in the aspect of influence mechanisms.

2. Theoretical Analysis and Research Hypotheses

2.1. Research on the Impact of Internet Usage on Rural Household Income

In existing studies, most have confirmed that Internet usage can increase residents' income levels (Krueger, 1993; Li Bo et al., 2024). Internet usage can improve the labor productivity of workers and also enhance the work efficiency of residents (Liu Shenglong et al., 2021), thereby improving residents' income levels. In addition, the Internet can drive the development of emerging industries and increase residents' income by providing job opportunities and entrepreneurial opportunities.

Regarding the research on the impact of Internet usage on farmers' income, it can be divided into two aspects: non-agricultural income (Yang Ningze and Zhou Jing, 2019) and agricultural income (Sun Huachen et al., 2021). First, the Internet integrates information resources through big data, promoting the dissemination and sharing of information. Rural households use the Internet as a medium for information search, obtaining target information, improving the matching efficiency between work and workers (He Yaping and Xu Kangning, 2019), reducing the time cost, human capital, and financial cost of residents' job search, lowering transaction costs, broadening employment channels, enhancing the employment ability of rural residents, increasing the employment rate, and achieving farmers' income growth. Second, the popularization of the Internet has provided numerous new job opportunities for society, increasing the probability of non-agricultural employment for farmers and effectively raising the labor force participation rate. This has enabled more production factors to enter the market and circulate effectively. Compared with families that do not use the Internet, those that do have a significantly higher probability of starting a business (Zhou Guangsu and Fan Gang, 2018). This is because the development of the digital financial industry, mediated by the Internet, can alleviate the financing difficulties of families (Hurst and Lusardi, 2004; Xie Xuanli, 2018), thereby increasing the probability of farmers starting businesses. At the same time, the development of digital finance can also enhance the inclusiveness and accessibility of finance, increasing the possibility for farmers to purchase financial products and increase their

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household financial assets, thereby raising their income levels. Third, for farmers engaged in agricultural production, the popularization of the Internet helps them reduce information search costs, accurately grasp market demands, make optimal production decisions, and improve production efficiency (Liu Xiaoqian and Han Qing, 2018). It can also expand sales channels, enhance market bargaining power, and increase the value of agricultural products (Xu Zhuqing et al., 2013). The production of agricultural products enters a virtuous cycle, and farmers pay more attention to the quantity and quality of agricultural products, releasing the intrinsic growth potential of rural areas, and their income levels also increase accordingly.

Hypothesis 1: The use of the Internet can increase the income level of farmers.

2.2. The Mechanism by Which Internet Use Increases the Income of Rural Households

First, the continuous advancement of "Internet + Education" has broken down the barriers of regional educational resources, enhancing the availability and inclusiveness of digital educational resources. Rural residents can obtain more advanced educational resources through Internet platforms and take targeted online courses based on their own development needs. Moreover, the Internet has characteristics such as economies of scale (Liu Xueying, 2023), reducing the cost of online education for rural residents. Through online course learning, rural residents can promote the accumulation of human capital (Li Lili et al., 2022), thereby improving the quality of farmers and their work efficiency (Hou Zaikun et al., 2020), and ultimately increasing the income level of rural households.

Second, the existence of information asymmetry leads to inefficient matching between job seekers and positions in the labor market. Social capital helps workers obtain more employment information, improving employment efficiency and job quality. Internet-based social networking platforms can help farmers break through the constraints of traditional social circles, reducing communication costs for information exchange among farmers and transaction costs for entrepreneurial financing (Li Shengji and Lyu Kangyin, 2024), expanding the social boundaries of farmers and broadening their social networks, promoting the accumulation of social capital. As an important component of social capital, social networks can enrich the information sources of farmers, increase their employment options, stimulate their entrepreneurial enthusiasm, and increase the probability of entrepreneurial success, ultimately ensuring the increase in the income of rural households.

Finally, the influence of wealth capital on income can be divided into two paths: first, obtaining income from holding assets; second, using wealth capital for investment to obtain better educational resources, improve human capital, or engage in social activities to expand social networks, thereby obtaining better employment and entrepreneurial opportunities and increasing income. Traditional financial services are less accessible to farmers, but the combination of the Internet and traditional finance has expanded the service scope of the financial industry, increased financial accessibility, and enabled farmers to obtain financial services at a lower cost, optimizing the allocation of household financial assets. The per capita financial capital of households increases due to the use of the Internet, thereby increasing the income of rural households.

Hypothesis 2: The use of the Internet affects the income level of farmers through influencing their human capital, social capital, and wealth capital.

3. Data, Variables, and Model Construction

3.1. Data Sources

The CFPS data from the Center for Chinese Social Surveys at Peking University is a national and comprehensive social tracking survey project. The CFPS data now covers 31 provinces across

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the country and is widely used in various research fields, demonstrating strong representativeness. CFPS conducts a national survey every two years, and currently has six rounds of data. This paper mainly uses the 2020 CFPS data for research. After eliminating missing values and outliers of relevant data such as income and control variables, a total of 8,273 sample data were finally obtained.

3.2. Model Specification

3.2.1. Benchmark Regression Model

Firstly, this paper adopts the model specification form of Krueger to construct a regression model of the impact of internet usage on the income of rural households:

$$lnincome_i = \alpha + \beta inter_i + \sum \gamma x_i + \varphi_i + \epsilon_i \quad (1)$$

Table 1. Indicator system of Internet use

Level 1 indicators	Level 2 indicators	Level 3 indicators	Specific indicators	Description of specific indicators
Level of Internet usage	Digital access	Digital equipment	Access to mobile devices	"Whether to use a mobile phone to access the internet" is assigned a value of 1, and no is assigned a value of 0.
			Access to computer equipment	"Whether to use a computer to access the internet" is assigned a value of 1, while"No" is assigned a value of 0.
	The use and importance of numbers	Digital usage	Online learning	According to"Whether to learn online", is assigned to 1, no assignment to 0
			Social work on the Internet	According to"Whether to use wechat", is assigned to 1, no assignment to 0
			Online Entertainment	According to"Whether to play online games, watch short videos", is assigned to 1, no assignment to 0
			Business activities on the Internet	According to"Whether online shopping", is assigned to 1, no assignment to 0
		The importance of digital	The importance of the Internet to entertainment	Assign values 0-5 in order of importance.
			The importance of the Internet to learning	Assign values 0-5 in order of importance.
			The importance of the Internet for social interaction	Assign values 0-5 in order of importance.
			The importance of the Internet to work	Assign values 0-5 in order of importance.
			The importance of the Internet to life	Assign values 0-5 in order of importance.
			The importance of the internet for access to information	Assign values 0-5 in order of importance.

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(1) Dependent Variable

The dependent variable in this paper is the individual annual income of the household head of rural households, including wage income, business income, property income, transfer income, and other income. Except for wage income, the rest are the average annual income of the household. The natural logarithm of the income is taken, and to eliminate the influence of outliers on the regression results, the top and bottom 1% of the income samples of rural households are trimmed.

(2) Independent Variable

The independent variable in this paper is the internet usage level of the household head of rural households. From a micro perspective, the principal component analysis method is used to construct the internet usage index of rural households. The common factors are extracted based on the principle that the characteristic root is greater than 1, and the data are subjected to KMO test and Bartlett test. The test results confirm that the necessary conditions for principal component analysis are met.

(3) Control Variables

Individual-level control variables include: gender($gender$), age(age), age squared(age^2), marital status($marriage$), political affiliation($party$), and health status($health$); household-level variables include: household size($familysize$) and dependency ratio(dep); city-level variables include: logarithm of per capita GDP of the region($lngdp$) and proportion of regional fiscal expenditure($edus$).

3.2.2. Mediation Effect Model

Furthermore, to explore the mechanism through which internet usage affects the income of rural households, this paper, following Jiang Ting (2022), constructs a mediation effect model based on the basic regression model:

$$med_i = \alpha + \beta \text{inter}_i + \sum \gamma x_i + \varphi_i + \epsilon_i \quad (2)$$

Among them, $med_i(phy_i; job_i; soc_i; fin_i)$ is the intermediary variable, where phy_i is human capital, which is measured by the years of education of farmers; soc_i is social capital, which is measured by the per capita expenditure on gifts and gifts of farmers' families; job_i as a job search channel, dividing the sample of job seekers who used"Employment agencies, job advertisements, self-advertising, or attending talent fairs/job fairs" into internet job seekers($job = 1$), the sample not using this channel is divided into non-internet job seekers($job = 0$); fin_i is wealth capital, measured using household per capita financial assets of farmers, and other symbols are consistent with the underlying model.

According to the education level of farmers, the education level of high school and above is divided into high education level($phy_level = 1$), and the education level below high school is divided into low education level($phy_level = 0$), On the basis of Model (2) , introduction of interaction terms between high/low education level and internet use:

$$lnincome_i = \alpha + \beta_1 inter_i + \beta_2 phy_level + \beta_3 phy_level \times inter_i + \sum \gamma x_i + \varphi_i + \epsilon_i \quad (3)$$

In summary, this paper analyzes the role of human capital, social capital and wealth capital in the impact of Internet use on farmers' household income according to the above regression model.

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3.2.3. Descriptive statistics

Table 2 is the descriptive statistics of the data used in the basic regression model and the mediation effect model.

Table 2. Descriptive statistics

Variables	sample size	mean	standard deviation	minimum	maximum
income	8273	26755.20	46741.22	2.00	1880000
lnincome	8273	9.07	1.86	3.91	12.35
inter	8273	-0.10	0.88	-1.24	1.50
age	8273	45.95	14.41	18.00	93.00
gender	8273	0.51	0.50	0.00	1.00
party	8273	0.08	0.27	0.00	1.00
health	8273	3.08	1.22	1.00	5.00
marriage	8273	0.83	0.37	0.00	1.00
familysize	8273	4.65	1.94	1.00	15.00
dep	8273	0.75	0.72	0.00	6.00
lngdp	8273	4.67	0.23	4.24	5.22
edux	8273	0.17	0.03	0.08	0.26
phy_level	8273	7.95	4.40	0.00	19.00
soc	8061	975.98	1720.03	0.00	60000.00
job	8273	0.04	0.19	0.00	1.00
fin	8099	20363.14	72938.43	0.00	3000000

4. Empirical Results

4.1. Basic regression

In this paper, stepwise regression is used. Table 3 is the regression results based on model (1) . Column (1) introduces only the core explanatory variables for regression, on this basis, columns (2) and (3) added individual control variables, family control variables and urban control variables in turn. Column (4) added provincial fixed effects on the basis of the above regression, and cluster the standard error to the provincial level to alleviate the impact of the correlation between individuals in the same province on the estimation results, and the regression results show that Internet use can increase the household income of farmers by 37.88% , which means that internet use can increase the household income of farmers by 37.88% , and significant at the level of 1% . The above regression results show that the level of Internet use can increase farmers' household income.

4.2. Quantile regression

In order to explore whether the impact of Internet use on household income is different among different income groups, this paper draws on the grouping method of Huang Yanghua et al. (2023) , this paper empirically examines the impact of Internet use on household income at 25% , 50% , 75% and 95% quantiles. Table 4 regression results show that Internet use has a significant role in promoting household income at all quantiles, and it is significant at the 1% level. According to the coefficient difference, internet use has the highest income-increasing effect on low-income farmers, and the income-increasing effect decreases with the increase of

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farmers' income level, indicating that internet use can narrow the income gap between farmers, it is conducive to alleviating income inequality and promoting social equity.

Table 3. Basic regression

	(1)	(2)	(3)	(4)
	Explained variable： *lnincome*			
inter	0.7308***	0.4378***	0.3875***	0.3788***
	(0.0435)	(0.0443)	(0.0325)	(0.0338)
age		0.0656***	0.0528***	0.0536***
		(0.0096)	(0.0096)	(0.0094)
age^2		-0.0935***	-0.0832***	-0.0843***
		(0.0097)	(0.0093)	(0.0090)
gender		0.8725***	0.8668***	0.8644***
		(0.0580)	(0.0566)	(0.0553)
party		0.1188	0.1775**	0.1931***
		(0.0788)	(0.0694)	(0.0681)
health		0.0805***	0.0844***	0.0848***
		(0.0194)	(0.0179)	(0.0162)
marriage		-0.0199	0.1298**	0.1361**
		(0.0619)	(0.0568)	(0.0569)
familysize			-0.1013***	-0.0975***
			(0.0095)	(0.0091)
dep			-0.0355	-0.0390
			(0.0324)	(0.0306)
lngdp			1.4325***	1.2443***
			(0.1777)	(0.2797)
edus			-0.0340	2.6820**
			(1.0470)	(1.1360)
Constant terms	9.1423***	7.5791***	1.5880*	2.2735
	(0.0899)	(0.2443)	(0.9226)	(1.5741)
Province fixed	No	No	No	Yes
Sample size	8,273	8,273	8,273	8,273
R^2	0.1193	0.2107	0.2570	0.2669

Note: * * * , * * and * are significant at 1% , 5% and 10% level, respectively. The same applies to the following tables.

4.3. Robustness test

4.3.1. Changing the way Internet usage is measured

In this paper, the principal component analysis method is used to measure the level of farmers' Internet use. There may be errors in the results due to different measurement methods. Therefore, this paper changes the measurement method, the coefficient of variation method is used to measure the level of farmers' Internet use. Using the coefficient of variation method to calculate the level of farmers' Internet use, the regression coefficient of internet use level to farmers' household income is still positive, and it is significant at the 1% level, this eliminates

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the estimation error caused by different measurement methods, and verifies the robustness of the regression results again.

Table 4. Quantile regression

	(1)	(2)	(3)	(4)
	Explained variable： *lnincome*			
	P25	P50	P75	P95
inter	0.5457***	0.3669***	0.2636***	0.2386***
	(0.0414)	(0.0241)	(0.0134)	(0.0205)
age	0.0352***	0.0616***	0.0615***	0.0362***
	(0.0121)	(0.0077)	(0.0054)	(0.0081)
age^2	-0.0665***	-0.1037***	-0.0964***	-0.0622***
	(0.0116)	(0.0082)	(0.0063)	(0.0089)
gender	1.0672***	0.8360***	0.6515***	0.4961***
	(0.0562)	(0.0329)	(0.0201)	(0.0283)
party	0.3097***	0.1279***	0.0696**	0.0635
	(0.0929)	(0.0446)	(0.0273)	(0.0419)
health	0.0868***	0.0946***	0.0726***	0.0280**
	(0.0221)	(0.0137)	(0.0081)	(0.0114)
marriage	0.3093***	0.1888***	0.0915***	0.0981**
	(0.0643)	(0.0494)	(0.0282)	(0.0487)
familysize	-0.1586***	-0.0629***	-0.0238***	-0.0137*
	(0.0178)	(0.0103)	(0.0062)	(0.0081)
dep	-0.0553	-0.1071***	-0.0992***	-0.0871***
	(0.0341)	(0.0253)	(0.0184)	(0.0214)
lngdp	1.5662***	0.9937***	0.8601***	0.9934***
	(0.2319)	(0.1194)	(0.0719)	(0.1575)
edus	3.6911**	2.5028***	1.9480***	2.3453***
	(1.7806)	(0.9662)	(0.5612)	(0.8374)
Constant terms	-0.0309	3.6948***	4.8368***	5.4624***
	(1.6227)	(0.9331)	(0.4711)	(0.8932)
Province fixed	Yes	Yes	Yes	Yes
Sample size	8,273	8,273	8,273	8,273

4.3.2. Replacement of measures of Internet use

This paper divides Internet use into four aspects according to“Whether to play online games", Whether to shop online", “Whether to watch short videos", “Whether to learn online", and “Whether to use wechat" in the questionnaire: Online Learning, online social work, online entertainment, and online business activities, and online shopping activities, alternative measurement of Internet use using principal component analysis. According to the regression coefficient, the effect of using the internet on income varies with the use of the Internet, the use of the Internet for e-learning and online social networking has a higher effect on increasing farmers' income than the use of the internet for online entertainment and online business activities.

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Table 5. Robustness test

	(1)	(2)			
	Replace the measurement method	Replace metrics			
		Online learning	Social Networking	Online Entertainment	Business activities on the Internet
dig	1.1258***				
	(0.0981)				
$inter1$		0.4832***			
		(0.0636)			
$inter2$			0.4964***		
			(0.0455)		
$inter3$				0.3489***	
				(0.0413)	
$inter4$					0.3405***
					(0.0503)
age	0.0570***	0.0448***	0.0449***	0.0447***	0.0485***
	(0.0097)	(0.0094)	(0.0091)	(0.0091)	(0.0098)
age^2	-0.0873***	-0.0880***	-0.0801***	-0.0837***	-0.0888***
	(0.0091)	(0.0089)	(0.0089)	(0.0089)	(0.0091)
$gender$	0.8676***	0.8925***	0.8661***	0.8701***	0.9129***
	(0.0558)	(0.0536)	(0.0537)	(0.0542)	(0.0529)
$party$	0.1775**	0.2375***	0.2550***	0.2981***	0.2827***
	(0.0683)	(0.0753)	(0.0693)	(0.0704)	(0.0689)
$health$	0.0866***	0.0891***	0.0875***	0.0888***	0.0902***
	(0.0161)	(0.0157)	(0.0165)	(0.0160)	(0.0160)
$marriage$	0.1421**	0.1615**	0.1245**	0.1248**	0.1255*
	(0.0570)	(0.0604)	(0.0600)	(0.0599)	(0.0618)
$familysize$	-0.0971***	-0.1020***	-0.0991***	-0.0998***	-0.1021***
	(0.0090)	(0.0094)	(0.0092)	(0.0093)	(0.0091)
dep	-0.0408	-0.0376	-0.0375	-0.0361	-0.0478
	(0.0308)	(0.0309)	(0.0312)	(0.0308)	(0.0322)
$lngdp$	1.2284***	1.3392***	1.3016***	1.3317***	1.3136***
	(0.2756)	(0.2902)	(0.2958)	(0.3033)	(0.3004)
$edus$	2.6452**	2.7418**	2.9015**	2.9500**	2.8629**
	(1.1460)	(1.1580)	(1.1422)	(1.1790)	(1.1337)
Constant terms	1.8226	2.3028	1.9362	2.0810	2.1619
	(1.5720)	(1.5917)	(1.6484)	(1.6636)	(1.6560)
Province fixed	Yes	Yes	Yes	Yes	Yes
Sample size	8,273	8,273	8,273	8,273	8,273
R^2	0.2681	0.2553	0.2597	0.2553	0.2547

4.4. Endogeneity test

There may be a reverse causality between the level of Internet use by the head of a rural household and the income of the rural household. First, Internet use can help rural households obtain more information resources and make use of them, improve the employment, entrepreneurship, etc. , and then improve the household income of farmers; second, the family

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residents with higher household income have economic conditions to contact the internet, and then the level of Internet use is higher. In view of the above, this paper draws on the practice of Liu Mingzhong and Liu Ziyu (2022) to use the average internet use of the district and county where the head of the household is located as a surrogate variable. First, the average Internet use in districts and counties is not directly related to the income level of residents, which meets the exogenous requirements. Second, there is a correlation between the use of the internet by individuals other than the individual in the county where the rural residents live and the individual residents. Regression results for the two-stage least squares (2SLS) are reported in columns (1) and (2) of Table 6. From the results of the first stage of column (1) , the instrumental variables are significantly positively correlated with the level of farmers' Internet use, which confirms that the instrumental variables meet the correlation hypothesis. (2) as the second stage of regression results, consistent with the benchmark regression results, farmers' internet use level can significantly increase residents' income. The Cragg-Donald Wald f-value for the first stage of instrumental variables was 194.29, and the Kleibergen-Paap R K Wald f-value was 81.86, excluding the weak instrumental variable problem. The results confirm the robustness of the conclusion that the level of farmers' Internet use has a promoting effect on farmers' household income.

Table 6. Endogeneity test

	(1)	(2)
	IV	
	inter	*lnincome*
inter		1.4213***
		(0.2154)
inter_m	0.2862***	
	(0.0316)	
age	-0.0391***	0.0978***
	(0.0051)	(0.0159)
age^2	0.0004	-0.0866***
	(0.0048)	(0.0111)
gender	0.0707***	0.8013***
	(0.0187)	(0.0662)
party	0.3485***	-0.1684**
	(0.0290)	(0.0722)
health	0.0108*	0.0735***
	(0.0059)	(0.0182)
marriage	-0.0065	0.1122***
	(0.0250)	(0.0419)
familysize	-0.0119***	-0.0785***
	(0.0034)	(0.0083)
dep	0.0075	-0.0376
	(0.0121)	(0.0300)
lngdp	0.2141**	0.8863***
	(0.1006)	(0.2723)
edus	0.5733	1.9344
	(0.4713)	(1.2759)
Constant terms	0.6206	2.2840
	(0.4912)	(1.5189)
Province fixed	Yes	Yes
Sample size	7,922	7,922
R^2	0.4578	0.1209

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4.5. Heterogeneity analysis of the impact of Internet use on farmers' household income

4.5.1. Differences in the nature of income

According to the nature of income, this paper divides income into three types: wage income; operating income (the sum of agricultural operating income and individual private income) ; property income. From Table 7, it can be seen that Internet use has a significant impact on farmers' wage income, operating income and property income, among which the promotion effect on operating income is the highest. This may be because: first, the use of the Internet provides opportunities for farmers to start their own businesses. Farmers are limited by insufficient funds and credit constraints, and can not carry out entrepreneurial activities. Traditional financial services rely on digital technology to develop digital finance, it provides more entrepreneurial opportunities for rural households and has a positive role in promoting entrepreneurial income (Wang Yongcang et al. , 2021) ; second, the Internet can help the transformation of traditional agricultural operations and the development of rural e-commerce, reduce the circulation link, widen the information channel, optimize the management decision-making, raise the agricultural product sale price, increase the economic efficiency.

Table 7. Differences in the nature of revenue

	(1)	(2)	(3)
	Wage income	operating income	property income
inter	0.1747***	0.2518***	0.1240**
	(0.0298)	(0.0483)	(0.0535)
age	0.0630***	0.0493***	0.0105
	(0.0083)	(0.0142)	(0.0160)
age^2	-0.0914***	-0.0621***	-0.0094
	(0.0113)	(0.0153)	(0.0144)
gender	0.5959***	0.1978***	-0.0757*
	(0.0348)	(0.0409)	(0.0399)
party	0.1171**	-0.0093	0.3376**
	(0.0437)	(0.0930)	(0.1580)
health	0.0432***	0.0416	0.0367
	(0.0110)	(0.0260)	(0.0336)
marriage	0.1340**	0.3252***	-0.1460
	(0.0508)	(0.0818)	(0.1187)
familysize	0.0071	-0.0520***	-0.1111***
	(0.0066)	(0.0176)	(0.0231)
dep	-0.0545**	-0.0149	-0.1153
	(0.0247)	(0.0416)	(0.0772)
lngdp	0.6964***	1.1075**	1.4714
	(0.1924)	(0.4279)	(1.1408)
edus	1.9443	2.1530	1.7429
	(1.2194)	(3.7950)	(6.2785)
Constant terms	5.0315***	2.8875	0.6674
	(1.0486)	(2.4322)	(6.4103)
Province fixed	Yes	Yes	Yes
Sample size	4,214	3,337	1,635
R^2	0.2558	0.2427	0.4569

4.5.2. Age differences and internet use

In order to verify the reliability of the grouping regression results, this paper conducts a heterogeneity analysis of groups with different ages and internet use levels by grouping regression, in this paper, Fischer combined test was used to test the difference of coefficients

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between groups. First, familiarity with internet use varies greatly by age among different groups. According to the age of the head of the household, this paper divides the sample into two groups: those under 65 and those over 65. The results show that the household income of farmers under the age of 65 is significantly improved by the positive impact of Internet use, while Internet use has no significant impact on the household income of farmers over the age of 65, the P value of Fischer's test was 0.048, indicating that the test for difference in coefficients between groups was passed. This may be because the ability of the elderly to accept and use new things is not as good as that of young residents due to the increase of age. At the same time, the young group in the family is more likely to engage in non-agricultural employment, and most of them move to live in the city, older adults do not have access to younger family members to help them access or use the internet (Feng Lübing and Guo Dongjie, 2023) , so older adults' incomes do not benefit from Internet use.

Table 8. Differences in age and Internet use

	(1)	(2)	(3)	(4)
	Age		Level of Internet usage	
	Under 65	over 65	High	Low
$inter$	0.3704***	0.2073	0.7503***	0.2493***
	(0.0357)	(0.1514)	(0.0889)	(0.0457)
age	0.1112***	-0.6033***	0.1257***	0.0126
	(0.0132)	(0.1632)	(0.0102)	(0.0182)
age^2	-0.1544***	0.3834***	-0.1691***	-0.0448***
	(0.0150)	(0.1086)	(0.0127)	(0.0158)
$gender$	0.9273***	0.3556***	0.8823***	0.8529***
	(0.0578)	(0.0843)	(0.0583)	(0.0687)
$party$	0.2396***	0.1147	0.1956*	0.1235
	(0.0730)	(0.1885)	(0.0969)	(0.1179)
$health$	0.0823***	0.1026***	0.0440	0.1162***
	(0.0188)	(0.0301)	(0.0297)	(0.0207)
$marriage$	0.0440	0.6089***	-0.0513	0.3076***
	(0.0742)	(0.1087)	(0.0822)	(0.0644)
$familysize$	-0.0919***	-0.1603***	-0.0761***	-0.1226***
	(0.0098)	(0.0409)	(0.0098)	(0.0111)
dep	-0.0299	-0.1034	0.0018	-0.1102***
	(0.0366)	(0.0623)	(0.0471)	(0.0306)
$lngdp$	1.2285***	1.1508***	1.1037***	1.2538***
	(0.2823)	(0.3624)	(0.2767)	(0.3287)
$edus$	3.0153**	1.9088	1.8770	3.9244**
	(1.1091)	(3.2856)	(1.1695)	(1.6318)
Constant terms	1.2374	26.1567***	1.4184	4.4238**
	(1.6606)	(6.5287)	(1.4286)	(2.0350)
Province fixed	Yes	Yes	Yes	Yes
Sample size	7,303	970	4,136	4,137
R2	0.2259	0.2089	0.1720	0.2358
Empirical p-value	0.048		0.000	

Note: Test P value is obtained by Bootstrap 1000 times.

Secondly, in order to verify whether there are differences in the improvement of farmers' household income with different levels of internet use, this paper divides the sample into two groups according to the median of Internet use level, and makes regressions respectively. The results show that in the sample with high level of Internet use, the effect of Internet use on the increase of household income is significantly higher than that in the sample with low level of Internet use, and the P value of Fischer test is 0.000, the results showed that the difference of

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coefficients between groups was tested. The results verify that the higher the level of Internet use, the more significant the increase in income due to Internet use.

4.6. Mechanism analysis

According to the above empirical research results, Internet use has a positive role in promoting household income. Next, this paper will discuss the mechanism of Internet use affecting farmers' household income from the perspectives of human capital, social capital and wealth capital.

First, human capital. The regression results of column (1) in table 9 show that Internet use has significantly increased the education level of rural households by 1.5396, indicating that Internet use can increase the accumulation of human capital by improving the education level of residents. After introducing the interaction term, the coefficient of the interaction term is positive, which indicates that the household income of farmers with high education level has been higher promoted by the use of the Internet, and the robustness test is carried out, according to the level of education, it is divided into high human capital and low human capital, and it is confirmed that the marginal benefit of high human capital from Internet use is higher than that of low human capital. It can be seen that the use of the Internet provides human capital protection for improving the household income of farmers.

Table 9. Mechanism analysis-human capital

	(1)	(2)	(3)	(4)
	eduy	*lnincome*	*lnincome*	*lnincome*
			High human capital	Low human capital
inter	1.5396***	0.3101***	0.3934***	0.3123***
	(0.0961)	(0.0308)	(0.0812)	(0.0319)
phy_level		0.2685***		
		(0.0440)		
phy_level × *inter*		0.1623**		
		(0.0639)		
age	-0.2288***	0.0690***	0.1457***	0.0548***
	(0.0430)	(0.0111)	(0.0181)	(0.0113)
age^2	0.1223**	-0.0978***	-0.1929***	-0.0830***
	(0.0454)	(0.0105)	(0.0207)	(0.0107)
gender	1.1713***	0.8600***	0.7354***	0.9055***
	(0.1913)	(0.0554)	(0.0644)	(0.0651)
party	2.0260***	0.1270*	0.1438	0.1247
	(0.1257)	(0.0666)	(0.0863)	(0.0768)
health	0.0506*	0.0885***	0.1111**	0.0827***
	(0.0256)	(0.0159)	(0.0496)	(0.0177)
marriage	0.2434***	0.1544**	0.1764*	0.0958*
	(0.0751)	(0.0560)	(0.0995)	(0.0509)
familysize	0.0028	-0.0960***	-0.0871***	-0.1028***
	(0.0276)	(0.0086)	(0.0194)	(0.0104)
dep	0.0087	-0.0412	-0.0161	-0.0593
	(0.0741)	(0.0305)	(0.0557)	(0.0386)
lngdp	2.2255***	1.1755***	1.2280***	1.1023***
	(0.7778)	(0.2660)	(0.2385)	(0.2912)
edus	3.3844	2.5311**	0.7480	3.2938**
	(4.9300)	(1.0982)	(1.0909)	(1.3895)
Constant terms	4.5254	2.0801	0.1516	3.6027**
	(4.1623)	(1.5243)	(1.5606)	(1.6053)
Province fixed	是	是	是	是
Sample size	8,273	8,273	2,129	6,144
R^2	0.4610	0.2718	0.2239	0.2405
Empirical p-value			0.074	

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Second, social capital. Column (1) of Table 10 shows that Internet use can increase the per capita favor expenditure of rural households, confirming that Internet use provides new social channels for rural households to enhance daily communication and helps rural households to break through the shackles of traditional social circles, broaden social networks, so as to improve human expenditure, and promote the accumulation of farmers' social capital. The results of column (2) show that Internet use increases the probability of farmers' using online job search and broadens their employment channels. The Internet can expand the social boundaries of farmers, expand social networks, accumulate social capital, weaken the negative impact of Information asymmetry, enrich the employment methods of farmers, and improve the quality of employment, and then increase the household income of farmers.

Third, wealth capital. The results in column (3) of Table 10 show that Internet use increases the per capita financial capital of farm households. The Internet has promoted the digital transformation of the traditional financial service industry, alleviated the adverse selection and moral hazard problems in financial transactions, and reduced Information asymmetry, moreover, the low cost of obtaining financial products ensures the accessibility and convenience of farmers to purchase financial products, thereby improving the household financial assets of farmers and providing financial security for farmers' production and life (Luo Qianfeng and Zhao Qifeng, 2022) , thus raising the household income of farmers.

Table 10. Mechanism analysis-social capital and wealth capital

	(1)	(2)	(3)
	Social capital		Wealth capital
	soc	job	fin
$inter$	0.2784***	0.0123***	0.7562***
	(0.0352)	(0.0026)	(0.1116)
age	0.0402***	-0.0089***	0.0114
	(0.0103)	(0.0009)	(0.0207)
age^2	-0.0392***	0.0074***	0.0008
	(0.0102)	(0.0008)	(0.0201)
$gender$	-0.0900***	-0.0074**	-0.0046
	(0.0281)	(0.0035)	(0.1051)
$party$	0.1196	0.0058	-0.0133
	(0.0793)	(0.0095)	(0.2400)
$health$	-0.0131	0.0003	0.0646
	(0.0225)	(0.0017)	(0.0574)
$marriage$	0.1748*	-0.0282***	0.2844*
	(0.0867)	(0.0051)	(0.1482)
$familysize$	-0.0802***	-0.0028***	-0.0586**
	(0.0164)	(0.0009)	(0.0252)
dep	-0.2159***	-0.0011	-0.1939**
	(0.0612)	(0.0032)	(0.0926)
$lngdp$	0.5501	0.0358***	-0.1984
	(0.3866)	(0.0128)	(0.9238)
$edus$	-2.4638	-0.0678	-3.0209
	(5.2290)	(0.1214)	(6.5170)
Constant terms	3.7942*	0.2602***	9.7704*
	(1.9430)	(0.0838)	(5.6598)
Province fixed	Yes	Yes	Yes
Sample size	8,061	8,273	8,099
R^2	0.1181	0.0649	0.0797

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5. Conclusions and Policy Recommendations

Based on the micro-survey data of CFPS in 2020, this paper conducts an empirical test to analyze the impact of Internet use on farmers' household income. The empirical analysis results show that: firstly, Internet use will significantly increase farmers' household income, the robustness test is carried out by changing the measurement method and measurement standard of Internet use, and the endogeneity problem is solved by using instrumental variables, and the conclusion is still valid. At the same time, quantile regression shows that the use of the internet is inclusive and has a more significant effect on the income of low-income farmers, which helps to narrow the income gap between farmers and achieve common prosperity. Secondly, the effect of Internet use on farmers' household income is different among different groups. The heterogeneity test finds that the impact of Internet use on farmers' operating income is higher than that of other types of income, groups under 65 years of age with high levels of Internet use benefit more from internet use than groups over 65 years of age and with low levels of Internet use. Finally, Internet use mainly affects the education level, human expenditure, online job search and family financial assets of farmers' families, and then affects the income of farmers' families.

According to the above research conclusions, in order to further exert the income-increasing effect of Internet use, this paper puts forward the following policy recommendations: (1) consolidate the foundation of Internet development and strengthen the construction of rural digital infrastructure. The state should actively promote the implementation of"Broadband China" strategy and improve the internet penetration in rural areas. At the same time, relevant policies have been issued to carry out rural Internet use technology training, help rural residents learn advanced Internet use technology, and improve the level of Internet use by residents. Accelerate the building of an inclusive digital internet environment for the elderly, provide more intelligent and aging-friendly products and services, and take measures to solve the problems encountered by the elderly when using the internet, we will strengthen Internet learning technology training for the elderly, provide facilitation services for them, and facilitate their access to digital dividends. (2) increase public expenditure on education and improve the rural education system. Support the integration of the Internet and educational resources, realize the sharing of educational resources, carry out online education and training, reduce the cost of education for rural families, and improve the accumulation of human capital of residents, in order to rural residents get better employment, entrepreneurship, career promotion and other opportunities. (3) build an internet information platform and smooth channels for employment and entrepreneurship. First of all, the construction of the information platform will help to broaden the social network of rural residents, increase the ways of obtaining employment information, break the barriers of employment information, and encourage residents to have multi-way employment and high-quality employment. Secondly, promote the digital transformation of traditional financial services and provide more financing channels for farmers' entrepreneurship. Finally, we should deepen the combination of the internet and agricultural products, support rural residents' entrepreneurship, open up the online sales channels of agricultural products, enhance the bargaining power of rural residents, and increase the household income of farmers.

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