Article

The Impact of Internet Use on Rural Women's Off-Farm Work Participation: Empirical Evidence from China

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Abstract: Promoting rural women's participation in off-farm work is an important way to increase their income and alleviate a shortage of off-farm labor supply. The widespread use of the Internet provides new opportunities to promote their participation in off-farm work. This paper draws on data from the 2020 China Family Panel Studies (CFPS) to analyze the impact of Internet use on rural women's off-farm work participation by using a logit model and propensity score matching method. The results show that, relative to groups who do not use the Internet, rural women who use the Internet demonstrate an eight-percentage point increase in their participation in off-farm work and a greater enhancement effect on the employed model than the self-employed model. Further analysis reveals that Internet use primarily affects rural women's participation in off-farm work in four aspects: increasing the efficiency of access to information; increasing human capital; increasing the accumulation of social capital; and changing the perception of gender roles. The heterogeneity analysis finds that when rural women are younger and more educated, Internet use will have a more pronounced effect on their off-farm work participation. As the number of minors in the household increases, Internet use has a more positive effect on rural women's off-farm work participation. Additionally, rural women in China's eastern and central regions are more likely to be positively impacted by Internet use than counterparts from the west. The findings provide new empirical evidence that contributes to the government's use of the Internet to promote rural female off-farm work participation.

Keywords: gender role perception; internet use; off-farm participation; rural women

1. Introduction

Poverty is a fundamental issue for human survival and development and female poverty reduction is not just an important part of human poverty reduction but is also a key part of female emancipation. Women's participation in the marketplace provides an important way to increase income sources and provide a social voice. However, in many low- and middle-income countries, and this is especially true in rural areas, the traditional division of labor prevails, in which the male manages the exterior and the woman attends to the interior. Women perform a large amount of domestic work in these areas, but their economic contribution to the household is not recognized and, as a result, they are often disadvantaged in resource allocation. The World Bank data released in 2022 indicated that the average female labor force participation rate in low- and middle-income countries will only be 33.39 percent in 2021. Increasing the market labor participation of women, and rural women in particular, is an urgent issue that must be addressed if female poverty reduction is to be advanced and achieved.

By the end of 2020, China was free from absolute poverty and attained the UN 2030 Agenda for Sustainable Development poverty reduction target a decade ahead of schedule, greatly contributing to the global poverty reduction cause. In seeking to further develop rural areas and achieve common prosperity, China proposed to implement a strategy to revitalize the countryside, which emphasized and prioritized the development

of agriculture and rural areas. The primary premise of rural revitalization is to ensure the adequate supply of factors of production, which includes the supply of labor factors [1]. As urbanization has accelerated in China in recent years, the rural population has moved to urban areas. An aging rural population, low levels of education, and outflows of young adults have become challenges that China must address in order to fully implement its rural revitalization strategy [2]. In addition, the 2021 Migrant Worker Monitoring Survey Report, which was published by China's National Bureau of Statistics, suggests the country currently has approximately 293 million migrant workers, with women migrant workers only accounting for 35.9 percent of this figure. When considered against a largely balanced male–female population structure in rural China, this reiterates that rural women, as the backbone of rural development, are a large human resource to be tapped. Guiding rural women to participate in off-farm work in an orderly way will provide an important way to alleviate China's shortage of rural labor supply and will also promote the prosperity and development of rural industries as part of a wider rural revitalization.

Exploring the factors that affect rural women's participation in nonfarm work will provide an important way to promote the transfer of women's nonfarm work from rural areas. Scholars have, in applying the traditional theory of human capital, tested the effects of demographic characteristics such as age, education, and health status on women's work outside of the agricultural sector [3–5]. When family factors are considered, it becomes clear that women's employment decisions are highly dependent on their families and it is similarly clear that factors such as child care, elderly care, and spousal income significantly impact rural women's off-farm labor supply [6–8]. In referring to the macro level, some scholars study how agricultural production risks, tax policies, and other factors impact women's employment status in rural areas [9,10]. The ongoing and extensive application of new technologies such as the Internet has not only changed the product market and social lives but has also profoundly impacted the labor market. In the first instance, combining Internet technology with the real economy has produced creative and substitution effects, leading to the elimination of a large number of industrial workers in traditional industries and the creation of a large number of new jobs in emerging industries [11]. Additionally, the popularization of the Internet has increased the efficiency of information dissemination and created an abundance of learning resources—this has not only increased individuals' human capital but has also reduced information frictions in the operation of the labor market [12]—this has in turn reduced the human capital mismatch in the labor market, optimized the employment structure, and improved the quality of employment [13].

Lisa J. Dettling engages the impact of Internet use on rural women's off-farm participation by using an instrumental variables method. In exploring the relationship between Internet use and married women's labor force participation, she finds this use produced a 4.1 percent increase in their participation [14]. Additionally, Yufei Mao and Qinying He, in addition to others, find that employment was the primary way that an increase in the likelihood of female labor force participation through the use of the Internet was achieved. In addition, this was also primarily achieved in informal employment, where labor is less regulated [15,16]. Scholars have, in referring to the intrinsic mechanism, tended to use information-seeking theory to explain the off-farm employment-enhancing role that Internet use performs in the case of women. Additionally, they propose that Internet use has led to an increase in the frequency of firm job advertisements by and in job searches by job seekers [17]—they observe that this has improved the efficiency of labor market operations and the quality of career matching. Some scholars also consider the influence of Internet use on rural women's personal behavior. In the first instance, the use of the Internet has expanded rural women's sources of information and access to knowledge; increased rural women's level of human capital and competitiveness in the workplace and decreased the amount of time rural women spend in the home and in agricultural production; and decreased their opportunity cost and increased their intention to work in off-farm occupations [18,19]. Xiliang Feng et al. refer to other important labor market issues related to Internet use and find that Internet use has a significant premium effect on migrant

workers' wage incomes and that Internet use can reduce the migrant workers' gender wage income gap for migrant workers [20]. Hailan Qiu et al., meanwhile, found that Internet use can reduce farmers' risk of poverty return by promoting off-farm employment [21]. This also further confirms the feasibility and need to study Internet use and rural women's non-farm employment when pursuing common prosperity.

In summary, the research of the use of the Internet to promote off-farm participation by rural women has produced fruitful results. Most current studies, however, select samples from the rural workforce or women in general, with the result that specific research of rural female non-farm labor participation is lacking. In referring to differences in the level of rural and urban development in China and the specifics of the participation of rural women in the labor market, we come to question if it is scientifically rigorous to use available research findings to explain the impact of Internet use on rural female off-farm labor participation. Furthermore, in considering intrinsic mechanisms, we see most existing research focuses on Human Capital or Information Search Theory, lacks a systematic approach and ignores the impact of Internet use on rural women's employment behavior and specifically its effect on their perceptions of gender roles. In drawing on existing research findings, this paper provides a special study of the impact of Internet use on rural women's participation in non-agricultural labor. It takes gender role perceptions into account and then systematically analyzes the mechanism of the impact of Internet use on rural female off-farm participation before analyzing the heterogeneity of different groups of rural women. These different contributions enrich the relevant theoretical results.

2. Theoretical Analysis and Hypotheses

2.1. The Impact of Internet Use on Rural Women's Off-Farm Participation

Encouraging women in rural areas to engage in off-farm work is an effective method for raising the income levels of rural residents and helping rural industries to prosper [22]. Internet use is an important way to promote rural women's participation in non-farm work. The article discusses how Internet use impacts rural women's participation in non-agricultural work by drawing on an employment and self-employment perspective.

Traditional Labor Supply Theory maintains that a person's choice of work depends on the combination of work and leisure that maximizes her own utility in the time available to her. When personal time is decomposed into market work, family work, and leisure time, an individual's choice of market work depends on the utility derived from market work relative to the utility derived from engaging in family work or enjoying leisure time activities. The extensive application of Internet technology in smart homes, industrial production, and other areas significantly reduces the amount of time women spend on household tasks; this time will instead be committed to market work or leisure activities [23]. The decline in product prices and the expansion in firm scale caused by the rise in labor productivity produces an increase in worker incomes [24]. Increased leisure time and better-paid market work greatly increase rural women's willingness to engage in off-farm labor participation. In referring to Human Capital Theory, we see that the use of the Internet has contributed to a vast array of learning resources, causing re-education to be much less costly for women in rural areas [25]. Improving rural women's knowledge and developing new work skills, including the use of the Internet, may help to improve their ability to engage in non-agricultural work. In addition, emerging employment models, including online store owners and network anchors derived from Internet use, have reduced the physical demands on practitioners and restrictions on work hours and locations and this has in turn led to the birth of a number of new women-friendly occupations [26]. To summarize, Internet use produces a dual effect of increased leisure time and compensation for work. Increases in the level of human capital and the creation of new forms of employment have further contributed to conditions that encourage rural women to take up employment. Internet use promotes the participation of rural women in non-farm work in the form of employment.

With regard to entrepreneurial platforms and financial and social capital, Internet use has enabled rural women to access non-farm work through self-employment. Cost–benefit Theory posits that the virtual environment built up by the popularity of the Internet has lowered the transaction costs and operating costs of online entrepreneurship, which has greatly motivated rural women to engage with self-employment [27]. For a long time, cultural and institutional factors have resulted in the social network of rural Chinese women being mostly limited to the family or community level. The use of the Internet has helped rural women break with the traditional Chinese role and extend their social relationships to the social level and thereby build up more network resources in a wider range of domains [28]. High-quality social capital helps rural women to gain an advantage in a range of respects, including access to capital and customers. Information Effect Theory suggests the Internet is essentially a medium for information transmission that lowers the cost of information acquisition and helps women to increase market coverage at a lower cost and improve entrepreneurial success rates [29]. Online credit platforms also have the potential to alleviate the formal credit constraints of rural women (as a vulnerable group) and provide financial support that will enable rural women to engage with self-employment [30]. The increased levels of entrepreneurship platforms, social capital, and financial capital brought about by the Internet will provide opportunities for rural women to engage in off-farm work through self-employment. In other words, Internet use contributes to rural women's involvement in off-farm work through self-employment.

In overall terms, Internet use has a favorable effect on women's involvement in off-farm work in rural areas, whether through employment or self-employment. On this basis, this paper proposes Hypothesis One: Internet use is effective at increasing the likelihood that rural women will engage in off-farm work participation.

2.2. Gender Role Perceptions and Rural Women's Off-Farm Participation in the Internet Era

In recent years, the popularity of the Internet has increased and online media coverage has expanded; this has greatly impacted the traditional principle ("the exterior is managed by the male, the interior is managed by the female") that has historically governed gender roles in rural China. The Internet has contributed to the development of new media that has, in turn, provided it with an educative function. Content on online platforms such as novels and online video programs mitigate stereotypes of women and help women develop critical consciousness. These positive externalities are reinforced by the Internet's own low-cost, high-efficiency, instantaneous, interactive, and diffusive communicative properties [31]. In addition, new media platforms have, as a result of their interactive nature and low barriers, been able to bridge the gap between traditional media communicators and the public, provide new spaces and platforms for women in rural areas to express themselves and transform the Internet into a useful tool for the advancement of gender equity [32]. The literature in the field of cultural economics shows gender role perceptions are closely related to women's labor market performance [33]. China's traditional gender roles are likely to distort women's work in the family and directly inhibit their participation in the labor force [34]. When women believe they are equal, their expectations of their family roles are reduced and this in turn enhances their willingness to engage in social activities and promotes their off-farm work practices [35]. In overall terms, use of the Internet may encourage rural women to challenge traditional gender roles and this will in turn positively affect their participation in off-farm activities. On this basis, this paper proposes Hypothesis 2: The use of the Internet increases rural women's likelihood of engagement in off-farm work by changing their perceptions of gender roles.

## 3. Context of the Study Area in China

3.1. Domestic and International Comparison of Women's Labor Participation in China

The female labor force participation rate is an important indicator in the study of the status of female labor force participation and can reflect the relative size of the female labor force supply. The World Bank defines it as the proportion of the economically active

population aged 15 years and over. Figure 1 refers to World Bank calculations based on the relevant ILO database that shows the change in China's labor force participation rate between 1990 and 2021. In referring to it, we see that, in the period since 1990, China's female labor force participation rate has been lower than the counterpart male rate and that a difference of 12–14 percent has been sustained over this period. China's female labor force participation rate has shown a downward trend since 1990 and by 2010 dropped to 63.63 percent, falling from the 73.02 percent recorded in 1990. Although the rate of decline slowed after 2010, there are still no signs that the downward trend will be reversed.

Chinese researchers have provided three explanations for the decline in female labor force participation in China. First, the rapid development of higher education in China since 1990 has delayed the entry of most young women into the labor market (as a result of them being in the education system for longer), resulting in a lower female labor force participation rate.

Chinese universities have slowed the pace of expansion since 2010, which is consistent with the results produced by the data [36]. Second, in referring to a maximizing household utility perspective, we see that as income levels increase, the increase in household wealth causes part of the working-age population to drop out of the job market [37]. Third, as China's population ages, the workload of women who care for the elderly has increased and this has also accelerated the decline in China's female labor force participation rate [38].
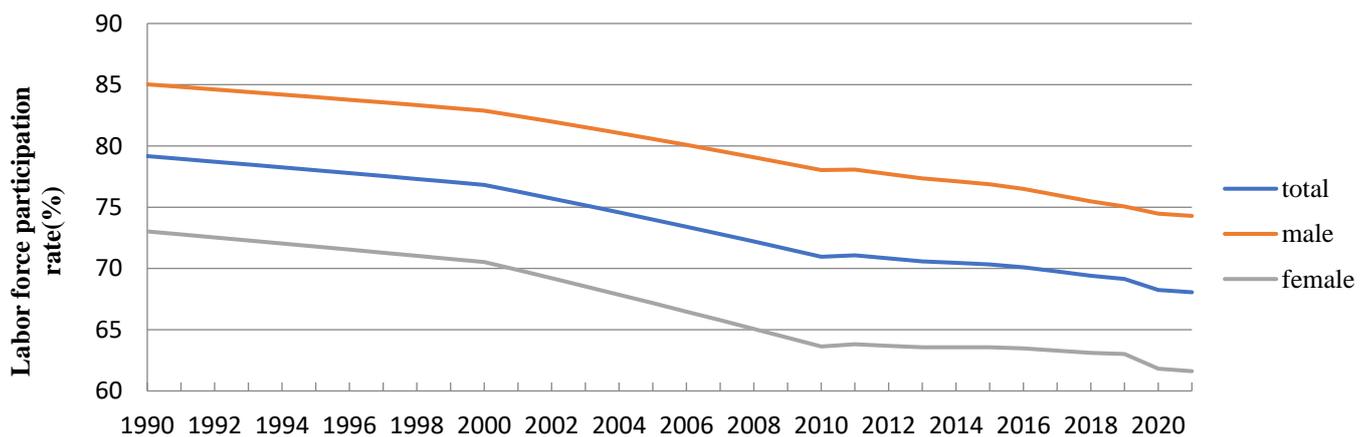
Figure 1. Changes in China's labor force participation rate, 1990–2021.

Figure 2 shows the World Bank's calculation of female labor force participation rates for China and other selected countries that are based on the relevant ILO database. Figure 2 shows that, although China's female labor force participation level has shown a declining trend, it is still higher than the world average and other countries in 2021. This may be related to the policy of uniform distribution of employment during the planned economy. With the exception of the US, where the female labor force participation rate fluctuates up and down, the rate in the EU, Japan, and Korea show an upward trend. The rise in female labor force participation was more pronounced in Korea and the EU, where it (respectively) rose by 6.67 percent and 6.06 percent over a 21-year period.
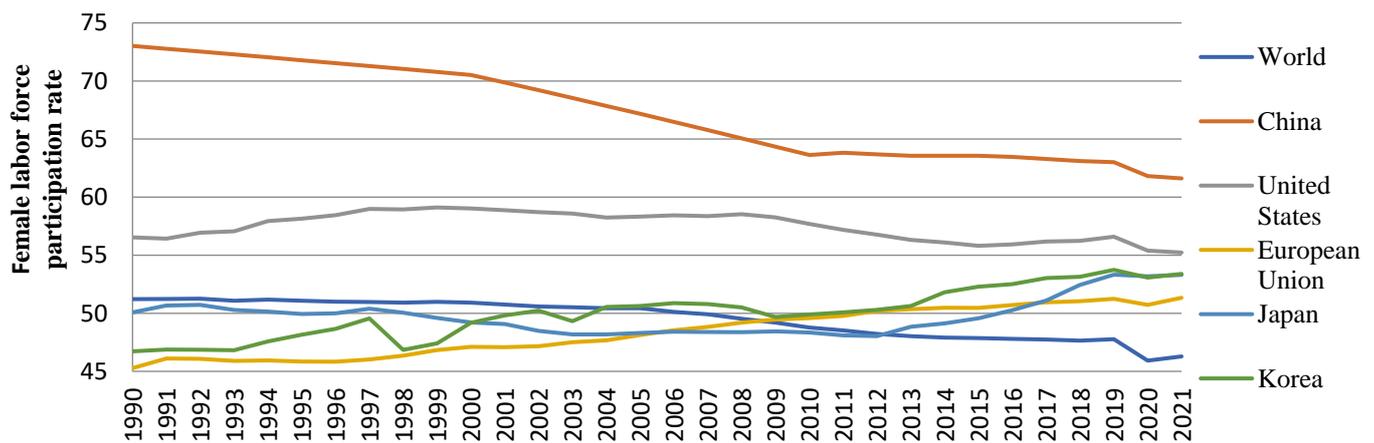
Figure 2. Changes in female labor force participation rates in China and selected other countries, 1990–2021.

3.2. Female Off-Farm Labor Participation in Rural China

Engaging in off-farm work is an important way to raise the income levels of farmers, which promotes the development of off-farm industries. China's National Bureau of Statistics release the previous year's migrant worker monitoring survey report every year. This article collates the relevant data released by the Bureau in the period 2014–2021. The government officially defines a migrant worker as a worker whose household registration is still in the rural area and who has been engaged in non-agricultural industries (whether locally or outside) for six months or more over the year. Figure 3 shows the huge number of migrant workers in China (292.51 million in 2021) is expected to increase over forthcoming years. Almost two-thirds (65 percent) of migrant workers are men and just over one-third (35 percent) are women. However, the number of female migrant workers has shown a clear upward trend in recent years; this is due to the increased education level of rural women and the development of non-agricultural industries such as the digital economy.
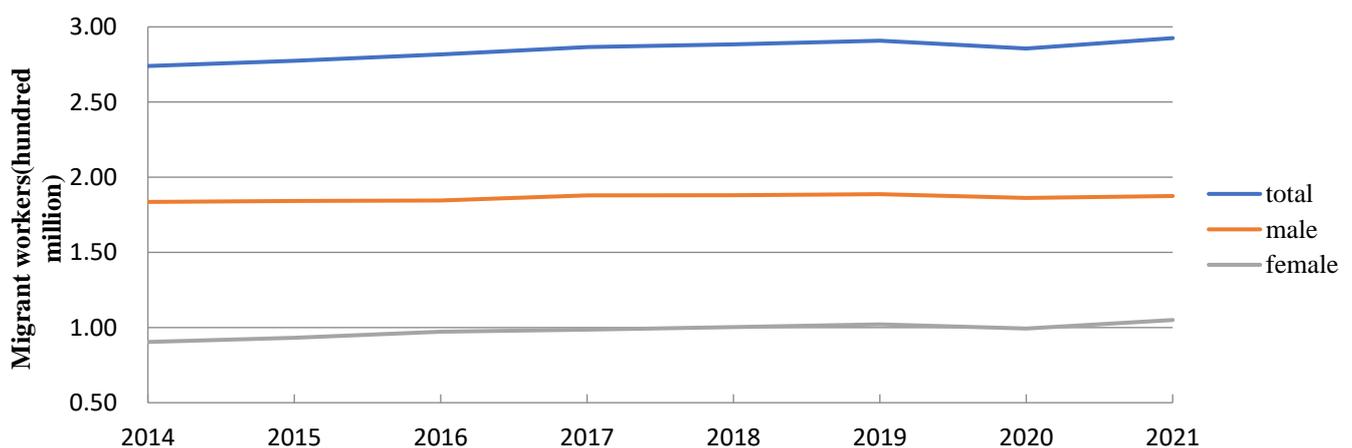
Figure 3. Changes in the number of migrant workers in China, 2014–2021.

4. Sampling and Study Design

4.1. Sampling and Data Sources

The data that this paper uses are extracted from the China Family Panel Studies (CFPS) annual survey conducted in 2020. The data were selected on the basis of the following considerations. First, the survey adopts an implicitly stratified, multi-stage, multi-level, probability sampling method proportional to the population size, which covers 25 provinces/municipalities/autonomous regions in the country, (Tibet, Qinghai, Xinjiang, Ningxia, Inner Mongolia, Hainan, Hong Kong, Macau, and Taiwan are excluded) almost

all (95 percent) of the population, and a sample size of 14,960 households that is highly representative and authoritative. The CFPS database also includes a survey that asks if the respondents use the Internet and includes data from the individual, household, and community levels that fit with this paper's theme. The study focuses on the rural female labor force, so only women with rural household registration ages of 16–55 were retained in the screening process. After missing values for key variables and other data that did not meet the conditions were excluded, a final valid sample of 3219 participants was obtained.

4.2. Model Setting and Variable Selection

The logit model is a method of multiple regression analysis that is used to investigate the relationship between dichotomous or multinomial classification outcomes of the dependent variable and certain influential factors and is applied to discrete choice models with qualitative explanatory variables. On this basis, the logit model can be applied to the analysis of rural women's engagement in off-farm work. In drawing on Jianfeng He [39], this paper constructs a binary logit model of rural female off-farm participation. The model is expressed in Equation (1):

$$ln\left(\frac{P_{work=1}}{1 - P_{work=1}}\right) = \Phi(\alpha + \beta Internet + \gamma X_i + \varepsilon_i) \tag{1}$$

The dichotomous variable *work* in Equation (1) indicates that surveyed women participate in the off-farm labor force. This variable was generated by using the questionnaire item "Nature of work in one's most current/most recently completed job", which assigned a value of 1 to off-farm work and 0 to agricultural work and no work. The variable *Internet* indicates if the Internet is being used. This variable is generated using the question "Do you use a mobile phone/computer to access the Internet?" and is assigned a value of 1 for the use of a cell phone or computer to access the Internet and is otherwise assigned a value of 0. In Equation (1), X_i indicates control variables at the individual, household, and area and ε_i indicates the random error term.

In order to further explore the impact of Internet use on rural women's participation in non-agricultural work, the types of rural women's jobs were divided into three categories, specifically agricultural work (including not working), self-employed off-farm work, and employed off-farm work. This paper uses agricultural work as a reference group to construct a multinomial logit model. The model is expressed in Equations (2) and (3). The equations follow:

$$ln\left(\frac{P(jobclass = 1)}{P(jobclass = 0\ )}\right) = \Phi(\alpha + \beta Internet + \gamma X_i + \varepsilon_i) \tag{2}$$

$$ln\left(\frac{P(jobclass = 2)}{P(jobclass = 0\ )}\right) = \Phi(\alpha + \beta Internet + \gamma X_i + \varepsilon_i) \tag{3}$$

In Equations (2) and (3), the multivalued variable *jobclass* denotes the job type, where 0 indicates farm work or no work; 1 indicates self-employed off-farm work; and 2 indicates off-farm work in employment.

In order to control other factors that could impact rural women's participation in non-farm activities, a number of characteristic variables are introduced into the model that are derived from the interviewee characteristics, including those that relate to them, their household, and the region they live in. The main variables selected for this paper are reported in Table 1. The individual characteristic variables include age, age squared, education, marriage, ethnicity, and health status. Of these, human capital levels will be influenced by age and health status. However, educational attainment differences often mean there are differences in the level of work skills that individuals can acquire. Additionally, individual perceptions of employment will be influenced by cultural differences between ethnic groups and those who enter into marriage will assume more family responsibilities and their employment decisions will be influenced. The household characteristics variables

include the size of the household and the number of children under 16. The model control variables also include household size and the number of children under 16 years-of-age—in reality, women do most of the child-rearing and family-care work, so family work is likely to crowd out their time in the labor market. In turning to regional characteristics, the model introduces the 2020 GDP per capita in each respondent province as a regional characteristic variable because regional economic development impacts the jobs available to women. Additionally, four dummy variables (east, middle, west, and northeast regions) were set on the basis of provinces where the respondents were located.

Table 1. Summary statistics.

Variables	Unit	Full Sample	Internet Use	No Internet Use
Off-farm work	Off-farm work = 1; Agricultural work and non-work = 0	0.4278 (0.4948)	0.5250 (0.4995)	0.2184 (0.4134)
Types of work	Agricultural work and non-work = 0; Self-employed off-farm work = 1; Employed off-farm work = 2	0.8378 (0.9495)	1.0246 (0.9552)	0.436 (0.801)
Use of the Internet or not	Yes = 1; No = 0	0.6828 (0.4655)		
Age	Actual age at the time of the survey	39.2352 (10.3856)	35.9736 (9.7673)	46.2566 (7.9077)
Age^2	Age × Age	1647.225 (807.0262)	1389.457 (734.8067)	2202.145 (663.5889)
Educational attainment	Illiterate/semi-literate = 1; Primary education = 2; Junior middle education = 3; Senior middle education = 4; Specialty = 5; Undergraduate college = 6; Master = 7	2.6424 (1.3108)	3.0232 (1.2822)	1.8227 (0.9461)
Marital Status	Unmarried/divorced/widowed =0; In Marriage/Cohabitation = 1	0.8882 (0.3152)	0.8617 (0.3453)	0.9452 (0.2278)
Ethnicity	The Han Nationality =1; Others = 0	0.8851 (0.3190)	0.9026 (0.2965)	0.8472 (0.3600)
Health status	Totally healthy = 1; Very healthy = 2; Pretty healthy = 3; Healthy = 4; Unhealthy = 5	2.8754 (1.1916)	2.7798 (1.1035)	3.0813 (1.3395)
Family size	Based on the actual number of members of the household at the time of the survey	4.7931 (2.0585)	4.8462 (2.0660)	4.6787 (2.0385)
Number of children under 16	Based on the number of children under 16 in the household at the time of the survey	1.6080 (1.5288)	1.6551 (1.4969)	1.5064 (1.5914)
Regional economy	Per capita GDP per province as of 2020 (CNY ten thousand)	5.7101 (2.2530)	5.7378 (2.3414)	5.6505 (2.0498)
Location	Eastern region = 1; Middle region = 2; Western region = 3; Northeast region = 4	2.3566 (0.9682)	2.3371 (0.9881)	2.3986 (0.9229)
Sample size		3219	2198	1021

Note: The data in the table are sample means and the data in parentheses are standard deviations.

5. Empirical Results and Analysis

5.1. Impact of Internet Use on Rural Women's Off-Farm Work Participation

This paper used a logit model to perform a regression analysis of Internet use and female nonagricultural work participation behavior in rural areas. The relevant empirical findings are reported in Table 2. The empirical results show that Internet use increases the likelihood of rural female off-farm labor force participation by 8 percentage points after relevant variables are controlled. Additionally, the impact of Internet use on rural female participation in nonfarm work through employment is slightly larger than the impact of nonfarming participation through self-employment. The empirical results are statistically significant at the 1 percent level and it can therefore be concluded that Internet use can effectively increase the likelihood of rural female off-farm participation. On this basis, Hypothesis 1 is verified.

Table 2. Impact of Internet use on rural women off-farm participation.

Variables	Off-Farm Work	Self-Employed Off-Farm Work	Employed Off-Farm Work
Internet use	0.0803 *** (0.0188)	0.0385 *** (0.0129)	0.0439 ** (0.0196)
Age	0.0130 * (0.0067)	0.0079 * (0.0046)	0.0098 (0.0067)
Age^2	−0.0003 *** (0.0001)	−0.0001 (0.0001)	−0.0003 *** (0.0001)
Educational attainment	0.0808 *** (0.0069)	0.0132 *** (0.0040)	0.0694 *** (0.0068)
Marital Status	−0.0842 *** (0.0281)	0.0514 ** (0.0233)	−0.1398 *** (0.0274)
Ethnicity	0.0920 *** (0.0252)	−0.0120 (0.0155)	0.1084 *** (0.0265)
Health status	−0.0075 (0.0067)	−0.0029 (0.0039)	−0.0083 (0.0067)
Family size	−0.0105 ** (0.0043)	0.0016 (0.0026)	−0.0148 *** (0.0042)
Number of children under 16	−0.0100 * (0.0060)	0.0013 (0.0037)	−0.0078 (0.0059)
Location	−0.0286 *** (0.0090)	−0.0091 * (0.0054)	−0.0224 ** (0.0089)
Regional economy	0.0335 *** (0.0042)	0.0020 (0.0021)	0.0304 *** (0.0040)
Waldχ^2	17.9 ***	22.83 ***	

Notes: (1) The data reported in the table are marginal effects. (2) Robust standard errors in parentheses. (3) *** $p < 0.01$.** $p < 0.05$.* $p < 0.1$.

Other elements may affect rural women's off-farm labor force participation. As they become more educated, rural women are more likely to engage in off-farm work. The positive age effect and negative age-squared effect imply that the related probability will increase with age but will fall to a lower likelihood once a certain age is reached. With regard to marital status, rural women who get married assume more family responsibilities. As a result, self-employed off-farm jobs with flexible working hours and free workplaces are becoming increasingly popular among women in rural areas. However, strenuous household labor still negatively impacts rural women's overall non-farm labor participation. Ethnic factors also have a significant positive impact on rural women's overall participation in off-farm work and the health status variables fail the significance test. On the household side, increases in household size and the number of children substantially decrease the probability that rural women will participate in off-farm activities. With regard to regional characteristics, women in rural areas are more likely to be employed in off-farm work when they live closer to the eastern region and the GDP per capita of their 'home' province is higher.

5.2. Analysis of the Mechanism of the Impact of Internet Use on Rural Women's Participation in Off-Farm Work

The reinforcing effect of Internet use on rural female participation in non-agricultural work has been tested, but this leaves the question of the mechanism that regulates the effect of the Internet on rural women's off-farm work participation. The empirical results cannot provide an answer. The existing theories suggest the Internet is essentially a medium for transmitting information and has greatly enhanced the efficiency of information retrieval. Learning and social activities conducted over the Internet can also help users enhance their

human and social capital. This paper accordingly introduces three different Internet use behaviors (information acquisition, learning, and social interaction) into the benchmark regression model with the aim of testing whether Internet use impacts rural women's participation in off-farm work. In doing so, it refers to three channels, specifically improving the efficiency of information seeking, the rise in human capital levels, and the rise in social capital accumulation. It is also possible that rural women's perceptions of gender roles, which in turn are closely related to their employment choices. This paper therefore draws on the mediating effect model proposed by Zhonglin Wen et al. [40] to introduce rural women's perceptions of traditional gender roles ("The exterior is managed by the male, the interior is managed by the female") into the baseline model with the aim of generating corresponding mediating variables. It does this to test if Internet use impacts rural women's non-farm participation by changing gender role perceptions.

Table 3 reports the impact of different modes of Internet use on rural women's non-farm labor participation. The results show that after new variables are added to the model at the 1 percent significance level, the three marginal effects of Internet use (behaviors of information acquisition, learning, and social interaction) are all positive. The manner in which the Internet is used for learning purposes to enhance personal human capital has the largest marginal impact on women's participation in rural nonfarm work (up to 7.71 percent), followed by social interaction (2.45 percent). Meanwhile, access to information shows the least marginal improvement (only 2.24 percent). With regard to the impact of the off-farm participation mode, all three Internet use behaviors passed the significance test and showed a positive effect; all showed a larger increase for off-farm work in employment than for self-employment in off-farm work.

Table 3. Impact of different Internet use behaviors on rural women's non-farm participation.

Variables	Information Acquisition			Learning			Social Interaction		
	Off-Farm Work	Self-Employed Off-Farm Work	Employed Off-Farm Work	Off-Farm Work	Self-Employed Off-Farm Work	Employed Off-Farm Work	Off-Farm Work	Self-Employed Off-Farm Work	Employed Off-Farm Work
Internet use	0.0561 *** (0.0198)	0.0267 ** (0.0125)	0.0293 (0.0206)	0.0738 *** (0.0189)	0.0360 *** (0.0130)	0.0366 * (0.0197)	0.0364 * (0.0207)	0.0244 * (0.0142)	0.0135 (0.0215)
Information acquisition	0.0224 *** (0.0063)	0.0114 *** (0.0039)	0.0130 ** (0.0065)						
Learning				0.0771 *** (0.0251)	0.0292 ** (0.0138)	0.0888 *** (0.0244)			
Social interaction							0.0245 *** (0.0049)	0.0081 *** (0.0028)	0.0172 *** (0.0048)
Control variables	Control	Control	Control	Control	Control	Control	Control	Control	Control
R^2	0.2137	0.1841	0.1841	0.2131	0.1846	0.1846	0.2161	0.1854	0.1854
Sample size	3218	3218	3218	3219	3219	3219	3215	3215	3215

Notes: (1) The data on the three variables of information acquisition, learning, and social interaction were generated based on three questions in the questionnaire: "the importance of the Internet as an information channel," "whether to learn online", and "frequency of sharing in wechat moments". (2) The sample size is slightly different because of missing values for the treatment variables. (3) The rest of the table notes are the same as in Table 2.

Table 4 shows the results of the regression after the mediating variable of perceptions of gender roles were entered into the model. In estimating the model for self-employment in nonagricultural work, the regression analysis results fail to pass the test for mediation effects. In contrast, in the model of participation in off-farm work and off-farm employment, Internet use can significantly reduce rural women's identification with the traditional gender role. The effect of Internet use on rural women's participation in nonagricultural work declines from 8.03 percent to 6.2 percent and the mediating effect of the change in gender role perceptions is 1.76 percent, or about one-fifth of the overall effect size. The impact of Internet use on rural female participation in off-farm work in employment declines from 5.25 percent to 3.6 percent and the mediating effect of changing perceptions

of gender roles is 1.58 percent, accounting for approximately one-third of the overall effect. Both the Sobel and Bootstrap tests indicated the mediating effect of the change in perceptions of gender roles is valid. Therefore, it can be concluded that Internet use will change rural women's perceptions of gender roles and increase the likelihood they will participate in off-farm work. On this basis, Hypothesis 2 is verified.

Table 4. Results of the mediating effect model for changing gender role perceptions.

Variables	Off-Farm Work			Self-Employed Off-Farm Work			Employed Off-Farm Work		
	(1) Logit	(2) OLS	(3) Logit	(1) Logit	(2) OLS	(3) Logit	(1) Logit	(2) OLS	(3) Logit
Internet use	0.0803 *** (0.0188)	0.9637 *** (0.0481)	0.0620 *** (0.0189)	0.0449 *** (0.0132)	0.9637 *** (0.0481)	0.0433 *** (0.0132)	0.0525 *** (0.0192)	0.9637 *** (0.0481)	0.0360 * (0.1933)
Gender Role Perception			0.0485 *** (0.0060)			0.0047 (0.0041)			0.0433 *** (0.0060)
Control variables	Control	Control	Control	Control	Control	Control	Control	Control	Control
Sobel test			0.0176 ***			0.0017			0.0158 ***
Bootstrap test			(0.0115, 0.0249)			(−0.0011, 0.0053)			(0.0094, 0.0224)
Sample size	3218	3218	3218	3218	3218	3218	3218	3218	3218

Notes: (1) Logit regression results reported in the table are marginal effects. (2) Data on gender role identity variables were generated based on the questionnaire's "division of labor between men and women". (3) The number of Bootstrap tests is 500. (4) The rest of the table notes are the same as in Table 2.

This analysis suggests Internet use will increase the likelihood of rural women participating in off-farm work by operating through four channels, specifically improving the efficiency of information seeking; increasing levels of human capital; increasing the accumulation of social capital; and changing perceptions of gender roles.

5.3. Heterogeneous Analysis of the Impact of Internet Use on Rural Women's Participation in Off-Farm Work

The impact of Internet use on rural women's off-farm labor participation and its mechanisms of action have been tested by considering all rural women as a homogenous group. However, there is a clear heterogeneity in rural women's realities and this raises the question of if the elevating effects that Internet use has on rural women's off-farm labor participation are moderated by individual characteristics. In attending to this question, this paper performs group regressions on four characteristics (age, educational attainment, the number of children in the household, and area) and it does this with the intention of exploring heterogeneity in the impact of Internet use on rural women's participation in non-agricultural work.

Table 5 shows the results of the heterogeneity analysis. With regard to age, when rural women are younger, the Internet will have a greater impact on participation in off-farm work—this is especially so for young rural women aged 16–30 years old, where Internet use increased the likelihood of participation in non-farm work by almost 13 percent. As rural women age, their ability to learn diminishes and family responsibilities become an ever-greater burden. This, coupled with market discrimination against older and middle-aged groups in the labor market and the relative absence of off-farm jobs, means Internet use has a smaller effect on the participation of older rural women in non-farm work. With regard to educational attainment, Internet use positively affects engagement in off-farm work for rural female groups with low and moderate education levels. Internet use has a more pronounced effect on nonfarm work participation in employment than on self-employment in nonfarm work and this is particularly true of the middle-educated group where the marginal increase in off-farm work participation in employment is 9.67 percent. In the case of the highly educated group of rural women, the results did not pass statistical significance testing; this was because of the small sample size.

Table 5. Heterogeneity analysis for age, education, number of children under 16, and region.

	Off-Farm Work	Self-Employed Off-Farm Work	Employed Off-Farm WORK	Sample Size
Age 16–30	0.1269 ** (0.0511)	0.0499 (0.0517)	0.0565 (0.0614)	780
Age 31–45	0.0873 *** (0.0325)	0.0415 * (0.0218)	0.0558 * (0.0338)	1291
Age 46–55	0.0585 ** (0.0237)	0.0270 ** (0.0136)	0.0370 (0.0231)	1148
Low educational level	0.0714 *** (0.0219)	0.0282 ** (0.0115)	0.0422 * (0.0217)	1514
Medium education level	0.1187 *** (0.0368)	0.0288 (0.0263)	0.0967 ** (0.0389)	1388
High education level	−0.0400 (0.0817)	0.0321 (0.0608)	−0.0519 (0.0898)	317
The number of children under 16 = 0	0.0762 ** (0.0338)	0.0339 (0.0208)	0.0459 (0.0341)	837
The number of children under 16 = 1	0.0222 (0.0339)	0.0263 (0.0215)	−0.0071 (0.0354)	924
The number of children under 16 = 2	0.1093 ** (0.0419)	0.0708 ** (0.0351)	0.0465 (0.0434)	767
The number of children under 16 ≥ 3	0.1295 *** (0.0437)	0.0274 (0.0287)	0.1020 ** (0.0470)	691
Eastern China	0.0864 ** (0.0376)	0.0482 (0.0317)	0.0420 (0.0415)	797
Central China	0.0876 ** (0.0394)	0.0825 ** (0.0324)	0.0061 (0.0421)	819
Western China	0.0682 ** (0.0293)	0.0340 * (0.0161)	0.0384 (0.0293)	1261
Northeast China	0.0710 (0.0582)	−0.0364 (0.0316)	0.1306 ** (0.0629)	342

Notes: (1) Elementary school and below are low education level; middle school and high school are medium education level; college and above are high education level. (2) The rest of the table notes are the same as in Table 2.

In turning to the number of children in the household, we find significant positive marginal effects for each subgroup (with the exception of the subgroup regression results for one child, which fail the significance test). Additionally, the effect of Internet use on women's engagement in off-farm work in rural areas increases in accordance with the number of children in the household. When there are two children in the household, the marginal increase (the impact of Internet use on rural female participation in off-farm labor) has been as high as 10.93 percent, much higher than the national average. With regard to specific employment patterns, Internet use has a stronger effect on increasing participation in self-employment off-farm work when rural women have two underage children in the household; and this effect on increasing participation in employed off-farm work is even stronger when there are three or more children in the household. As the number of children increases, the role of Internet use in reducing the workload of rural women's families becomes apparent and the increased financial burden on the family means rural women are more likely to earn more family income by undertaking off-farm work.

In regional terms, Internet use has a greater than average effect on the probability that rural women will participate in off-farm work in east and central China, which contrasts with the smaller effect in western China. The statistical results were not significant in Northeast China because of the small sample size. These results are broadly related to the level of regional economic development. The higher level of economic development in east and central China and the deeper integration of Internet technology and related industries means rural women in these areas may have more flexible non-agricultural

jobs. The small proportion of secondary and tertiary industries in western China, the slow development of digital economy-related industries, and the relatively poor construction of digital infrastructure cause it to be difficult to exploit the effect of Internet use on rural female participation in non-farm work.

5.4. Endogeneity and Robustness Checks

5.4.1. Propensity Score Matching Estimation

The model has a possible self-selection problem: Internet use does not only affect female off-farm labor participation in rural areas, but women's own personal characteristics also influence their Internet use behavior. For this reason, this paper adopts the propensity score matching method for processing and selects three matching methods, specifically kernel matching, radius matching, and k-nearest neighbor matching. There is a balance between the two samples of rural women who use the Internet and those who do not need to be tested before the results of the test. After matching, the results of the balance test revealed that the proportion of bias was less than 10 percent for most variables; the bias was only above 10 percent in the case of regional feature variables; and the *p* value was above 0.05 for most variables. It can therefore be concluded there is no significant systematic difference in the explanatory variables between the two groups of variables, which means that the sample, after matching using PSM, passes the balancing test.

The results of the propensity score matching estimates are presented in Table 6. The ATT values in the kernel matching, ray matching, and nearest neighbor matching results with a k value of 4 are in the 0.0832–0.0876 range. This is generally consistent with the results of the previous benchmark model and the t-values show the test results are all statistically significant at the 1 percent level. The endogeneity test results therefore provide evidence that Internet use does indeed increase the likelihood that rural women will engage in off-farm work participation.

Table 6. Results of propensity score matching.

	ATE	ATU	ATT	T Value
Near neighbor matching k = 4	0.0722	0.0488	0.0832 ***	2.58
Kernel matching	0.0778	0.0602	0.0861 ***	2.76
Radius matching	0.0799	0.0636	0.0876 ***	2.82

Notes: (1) For radius matching, the radius is chosen to be 0.01. (2) The kernel matching defaults to a quadratic kernel with a bandwidth of 0.01. (3) *** $p < 0.01$.

5.4.2. Regression Estimation of Replacement Variables

In order to further examine the robustness of the main model results, the core explanatory variable is replaced with "hours per day of Internet access" and the regression is re-run, and the core explanatory variable is tested for biased estimation by adding other variables that may affect the explained variable. Generally speaking, Mandarin proficiency and good memory skills may help individuals perform better in off-farm work. Being habituated to reading may enhance the cognitive level, which will in turn increase the level of personal human capital. Additionally, the perception that hard work will be rewarded affects individuals' willingness and motivation to participate in non-farm work. The four variables of "Mandarin use", "memory ability", "reading status", and "work perception" are therefore selected to be included in the baseline regression.

The results are shown in Table 7. Model (1) shows that after the original core explanatory variable is replaced with "Internet access hours per day, the model results still show a significant positive effect. In models (2)–(5), possible omitted variables are added and the results reveal the core explanatory variable "Internet use" still has a significant positive effect on rural female off-farm work participation and indicate that the marginal effect coefficient does not change significantly. With the exception of job perceptions, which did not produce any significant statistical results, all the other possible omitted variables are in

the predicted direction of influence. In sum, the facilitating effect of Internet use on rural female participation in non-agricultural work is robust and plausible.

Table 7. Estimation results for replacing core explanatory variables and adding possible omitted variables.

Variables	(1)	(2)	(3)	(4)	(5)
Internet use		0.0789 *** (0.0187)	0.0785 *** (0.0189)	0.0733 *** (0.0189)	0.0801 *** (0.0188)
Daily Internet hours	0.0004 *** (0.0000)				
Mandarin Use		0.0386 ** (0.0165)			
Memory ability			0.0113 * (0.0059)		
Reading status				0.0680 *** (0.0188)	
Work perception					−0.0177 (0.0117)
Control variables	Control	Control	Control	Control	Control
Waldχ^2	38.37 ***	17.34 ***	16.69 ***	14.43 ***	17.31 ***
Sample size	3219	3217	3209	3219	3213

Notes: (1) The three variables of daily time spent on the Internet, reading status, and work perception are based on the questions of "time spent on the Internet on mobile phones/computers", "whether or not I read", and "whether or not I think hard work will be rewarded", respectively. (2) The variable "Mandarin use" is extracted from interviewer observations. (3) The sample size is slightly different because of missing values for the treatment variables. (4) The rest of the table notes are the same as in Table 2.

5.4.3. Regression Estimation for Replacement Dataset

This article explores the robustness of the conclusions by using propensity score matching estimation and variable replacement. However, the paper's dataset is drawn from 2020, when a public health emergency was ongoing. The pandemic has obliged the government to introduce control measures that have had a pronounced economic impact [41]. In order to eliminate the effect of the pandemic on the paper's overall conclusions, we select data from the 2018 CFPS and rerun the regression analysis on Internet use on rural women's choices of off-farm labor force participation.

After processing the data for 2018, a sample of 3304 rural women was obtained (see Table 8). After controlling for relevant variables, it was found that Internet use increases the probability that rural women will choose off-farm labor participation by 12.38 percent, which is 4 percentage points higher than the regression result for 2020 (8.03 percent). This could be related to the impact of the pandemic on the society's overall employment level in 2020. With regard to the impact on different off-farm labor participation patterns, Internet use boosts the employed employment pattern much more than the self-employed counterpart. In summary, the regression results for the 2018 data are largely consistent with those for 2020 and the boosting effect of Internet use on rural female off-farm labor participation is found to be robust and plausible.

Table 8. Estimation results after replacing the dataset.

Variables	Off-Farm Work	Self-Employed Off-Farm Work	Employed Off-Farm Work
Internet use	0.1238 *** (0.0165)	0.0227 ** (0.0113)	0.0893 ** (0.0177)
Individual characteristics variables	Control	Control	Control
Household characteristics variables	Control	Control	Control
Regional characteristic variables	Control	Control	Control
Waldχ^2	53.36 ***		42.43 ***

Notes:(1) The data reported in the table are marginal effects. (2) Robust standard errors in parentheses. (3) *** $p < 0.01$.** $p < 0.05$.

6. Discussion

It is important to obtain an improved understanding of the impact of Internet use on rural women's non-farm work participation as this will help to improve rural women's incomes. Many studies have extensively researched the impact of Internet use on labor market issues such as labor supply, the gender wage gap, and poverty vulnerability. However, few studies have focused specifically on Internet use behavior and the non-farm labor participation of rural female groups. The first contribution of this study is to fill a gap in the current literature by using micro data to verify the facilitative effect of Internet use on rural female nonfarm labor participation. Second, it examines the impact of Internet use on different non-farm labor participation patterns. After taking into account the inhibitory effect of the stronger ideology in rural areas and acknowledging its potential impact on rural female labor participation, it introduces the mediating effect of changing gender role perceptions into the analysis of the impact mechanism; this enriches the existing literature on the impact mechanism of Internet use on labor supply. Finally, differences in the effects of Internet use on the off-farm work participation of different rural female groups are examined and this improves the reliability of the findings and provides an improved reference value for relevant policy formulation.

This study has limitations. First, the limited data means it mainly adopts the information about "whether or not to use the Internet" when measuring Internet use and does not explore the intensity and quality of Internet use in sufficient depth. There is a need to further expand the meaning of Internet use in the future and find available data that will cause it to be possible to further explore the impact of Internet use on rural female non-farm work participation. Furthermore, although the paper provides a short analysis on the effect of the COVID 19 pandemic on the non-farm work participation promotion effect of Internet use by using the 2018 data (see the robustness testing section), this is clearly not sufficient. The COVID-19 pandemic has been shown to exacerbate gender-related vulnerabilities (including those related to health) and further exacerbate persistent inequalities [42]. For example, Yueping Song et al. found that the pandemic reduced the likelihood that female migrants would return to urban areas for paid work [43]. This raises the question: could the use of the Internet partially offset the impact of the COVID-19 pandemic on rural women's participation in non-farm work? Additionally, if so, what are the precise mechanisms by which it works? This is a topic worthy of further research.

7. Conclusions and Policy Recommendations

In the wider context of China's rural revitalization, encouraging rural women to participate in non-agricultural work offers an important way to alleviate the problem of inadequate rural labor supply and help rural industries to thrive and develop. This paper draws on a theoretical analysis, data from the 2020 China Family Panel Studies (CFPS), and a variety of methods (including the Logit Model and Propensity Score Matching Method) to explore the issues of Internet use and female participation in non-agricultural work in rural areas. It offers the following conclusions:

(1) The use of the Internet is effective in increasing the likelihood of rural female participation in non-agricultural work and the increase in engagement with off-farm employed work is more pronounced than in the off-farm self-employment counterpart.

(2) Women's use of the Internet in rural areas for information browsing, learning, and socialization increases the efficiency of personal information acquisition, the level of human capital, and the level of social capital; this in turn promotes rural women's off-farm work participation.

(3) Modern social concepts have been disseminated through the use of the Internet and this has reduced rural women's identification with traditional gender roles ("The exterior is managed by the male, the interior is managed by the female") and promoted off-farm market work for rural women outside of domestic work.

(4) Individual characteristics regulate the promotional effect of Internet use on rural female non-agricultural labor participation. A range of factors (the younger the age; the higher the level of education; the larger the number of children to be raised; the more economically developed the region of residence) increase the likelihood that the Internet will have a greater promotive effect on women's off-farm participation in rural areas.

In drawing on these findings and seeking to provide full play to the role of Internet use in promoting rural women's non-agricultural work participation and mitigate the problem of inadequate rural labor supply in China in the wider context of rural revitalization, this paper offers five propositions:

(1) The government is expected to strengthen the infrastructural development of the Internet in rural areas of China (especially in western China and remote rural areas) and to promote better Internet broadband performance and lower costs in rural areas, in the expectation that this will increase the penetration and convenience of the Internet for rural women.

(2) By taking into account the characteristics of regional industries and economies, the government will be able to provide targeted e-learning resources to rural women in the areas of job skills and basic education. In doing so, it will take full advantage of the role of Internet use in enhancing human capital.

(3) The government should guide and support businesses in rural areas with the aim of helping them to establish Internet-based recruitment platforms that are responsive to the use patterns of women in rural areas. It should encourage enterprises to implement new work forms such as flexible work, telecommuting, and home-based work and improve the employment service and social security systems by introducing new employment forms.

(4) The government should formulate special support policies for rural women's entrepreneurship, such as financial subsidies, tax breaks, and loan supports, and should do this with the intention of encouraging and supporting rural women who are in a position to participate in non-farm work through self-employment.

(5) The government should take advantage of the Internet's high efficiency and low threshold in information dissemination and should do so with the aim of actively promoting values such as gender equality. It should encourage rural women to actively use the Internet for learning, socializing, and entrepreneurial activities and promote their involvement in off-farm work.

Author Contributions: Conceptualization, W.W.; methodology, W.W. and S.Z.; software, S.Z.; data curation, S.Z.; writing—original draft preparation, W.W. and S.Z.; writing—review and editing, W.W. and S.Z. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by Ethics Committee of Biomedical Ethics Committee, Peking University (protocol code IRB00001052-14010).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on http://www.isss.pku.edu.cn/cfps/ (accessed on 30 May 2022).

Conflicts of Interest: The authors declare no conflict of interest.

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