Green Energy, Environment and Sustainable Development
C. Wang et al. (Eds.)
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doi:10.3233/ATDE230339

Influence of Information Ability on E-commerce Behavior of Farmers and Its Spatial Dependence

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Abstract. This paper uses the Probit and Logit models to analyze how the information ability of farmers influences their e-commerce behavior based on a questionnaire survey with 378 farmers, and the Spatial Durbin Model (SDM) is used to verify the spatial dependence in the e-commerce behavior of farmers. The research results indicate that: the e-commerce behaviors of farmers are significantly influenced by the information awareness and information access in information ability and also by the educational degree, number of cell phone contacts, and size of online social groups in endowment differences. In addition, the e-commerce behavior of farmers is influenced by the information access of neighboring farmers. Estimates of the direct effects, indirect effects, and total effects of different variables on the e-commerce behavior of farmers show that the size of online social groups has the greatest influence on the e-commerce behavior of farmers and thus is an important factor in endowment differences that promotes the e-commerce behavior of farmers. The empirical results of this paper reveal the heterogeneity of endogenous drivers behind the e-commerce behavior of farmers and provide a reference and policy recommendations for offering targeted training on modern information skills to farmers and promoting the deepening development of agricultural e-commerce and the construction of digital villages.

Keywords. Information ability, e-commerce behavior, spatial dependence, endowment differences

1. Introduction

With the continuous improvement of information technology and the continuous integrated development of the Internet and traditional industries, China is undergoing a critical period of industrial restructuring and transformation. In May 2019, the General Office of the State Council issued the "Outline of Digital Village Development Strategy" [1], indicating that the development and transformation of agricultural and rural modernization, which is an inherent result of the application of network, information and digital technologies in the economic and social development of agriculture and rural areas and of the improvement of farmers' modern information skills, is both the strategic direction of rural revitalization and an important element of

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the initiative to build a digital China. In the context of "Internet+", can agricultural producers, especially small farmers in rural areas and traditional agricultural industries, use information technology to address the dull sales of agricultural products and thus increase their income? The academic community has been paying close attention to this issue. Some scholars argue that the Internet is a double-edged sword that brings both great convenience and challenges to agricultural production [2-4]. The penetration of information technology infrastructure, information literacy and the ability to use information technology are the primary factors limiting the e-commerce development of small farmers [5]. Therefore, the research on the influence of farmers' information ability on their behavior in e-commerce participation is important to improving the efficiency of agricultural e-commerce operated by farmers and promoting the development of e-commerce industry clusters in rural areas.

In recent years, with the increasing improvement of rural transportation and network infrastructure, the fast-growing penetration of Internet and smart phones, the continuous extension of logistics and express delivery systems in rural areas, and the rise of third-party e-commerce platforms, agricultural e-commerce channels have been expanding in areas with advantages in agricultural production in China that are suitable for developing e-commerce, promoting the rapid realization of modern agricultural product distribution [5-7]. In December 2018, the Spatial Planning Research Center of Nanjing University and the Alibaba Research Center For Rural Dynamics jointly released the "Development Report of Taobao Villages in China (2014-2018)" [8], indicating that rural elemental resources were fully used in rural areas to develop digital agriculture according to local conditions from 2014 to 2018, when the extensive integration of e-commerce with local special agricultural industries and farmers and the growth spurt of Taobao villages became economic geographical phenomena that were influential in the country. The rapid development of rural e-commerce in China is essentially the process of information technology and its applications spreading to agriculture, rural areas, and farmers. Therefore, researchers have begun to focus on how to strengthen the integration and application of information technology in agricultural production and how to improve the information ability of farmers. Many domestic and foreign scholars have conducted research on farmers' willingness to participate in e-commerce and their e-commerce behavior [6, 7, 9], and the research results show that social capital, information ability, and endowment characteristics are influencing factors. However, these studies generally ignore the variable of spatial dependence. Läpple and Kelley [10] found that the decision-making behavior of farmers changes with the behavior of the neighboring farmers with whom they are on good terms. Because Chinese farmers prefer internal information transfer, their production decisions are, to some extent, influenced by the neighboring farmers or their friends and relatives [11, 12]. Therefore, this paper intends to study the influence of information ability on the e-commerce behavior of farmers from the perspective of the farmers' own endowment differences and to test whether there is spatial dependence in the e-commerce behavior of farmers in order to provide basis and reference for the deepening development of agricultural and rural e-commerce.

2. Analysis on Influence Mechanism of E-commerce Behavior of Farmers and Research Hypotheses

Paul Zurkowski first proposed "Information Literacy" to describe information ability

[11, 13]. Later, information ability was refined as the ability to effectively discover one's information demand and then to search for, acquire and make use of the desired information. Shannon [4], the founder of the Information Theory, argued that information can eliminate randomness and uncertainty and is measurable. Information is not knowledge but a concept or idea that enters the perceptual field of humans to influence their actions [14]. Farmers are both communicators as well as recipients and users of information, and as the development of information technology is deepening in rural areas, the information ability of farmers plays an important role in their production and operation [15]. Neuroeconomic findings show that human behavior is triggered by the human brain mechanism, and the activities in the human brain are essentially processes of information processing [16, 17]. Farmers discover their information demand from their production and operation practice, then collect, analyze and process relevant agricultural information, and finally use the information to inform their decision-making on agricultural production and operation. Existing literature has shown that the information ability of farmers plays an important role in their agricultural production [15, 17]. The decision-making behavior of farmers is influenced by their technological and information knowledge and their information ability, and effective external information transfer is an important way to improve yields. Chinese scholars have drawn on roughly similar research conclusions on information ability. Most studies quantify external behaviors such as information demand, information access and information use based on the structural theory of information literary process [18]. Information demand is not only the logical starting point of information behavior, but also the guide to lead information behaviors of farmers, such as information access and information use. When farmers develop the information awareness, they will discover their information demand and trigger further information behaviors. Scholars have found in field research that farmers, as entities of economic profits, mainly demand guiding information about yield increase, and information use relates to the ability of farmers to solve practical problems based on the acquired information [18]. Information use is the ultimate purpose of information access, and only when the information is put into use, will its value be truly realized. Based on this, the research hypothesis H1 is proposed.

H1: Information ability significantly and positively influences the e-commerce behavior of farmers.

Lewin [19] argued that human behavior and the environment constitute an interdependent and interactive dynamic whole, and he regarded behavior as a function of the interaction between individuals and the environment. Likewise, the information behavior of farmers is the result of the interaction between their individual endowment and the information environment. The information ability of an individual is built on his or her basic qualities and knowledge structure. The extent of these basic qualities and knowledge structure largely determines the level of information ability. With the changes of time and the economic and social development, the principal characteristics of farmers are also changing. In other words, their individual endowment factors such as gender, age, and educational degree are obviously different, which will inevitably lead to differences in information ability and decision-making behavior [11]. Due to low educational degrees and poor scientific and academic foundations, farmers generally show blind information behavior [12]. In general, communication and exchange with their friends and relatives are the primary channel for farmers to acquire agricultural information, and they turn to agricultural marketing departments, television, and Internet resources only when their information demand cannot be satisfied by the

primary channel [12, 20]. Therefore, the information ability and e-commerce behavior of farmers are influenced by the number of their cell phone contacts, the number of information tools available to them, and the number of online social groups [6, 20]. Based on this, the research hypothesis H2 is proposed.

H2: Endowment differences significantly influence the e-commerce behavior of farmers.

With deeper and deeper application of New Economic Geography in the New Growth Theory in the 1990s, more and more scholars have begun to pay attention to the spatial dependence in farmers' willingness and behavior. Spatial dependence refers to the behavioral changes of individuals in the same group caused by the behavioral change of their social group. In other words, the behavior of an individual tends to influence the decision-making behavior of others in the same group, as reflected in the similar behavioral choices made by farmers in close proximity [10]. Existing research shows that the behaviors of neighboring farmers are not independent of each other but space-dependent [10]. Moreover, mutual communication between neighboring farmers and between farmers and their friends and relatives is the primary information access for Chinese farmers [12]. Therefore, the influence of information ability on the e-commerce behavior of farmers may be more space-dependent. Based on this, the research hypothesis H3 is proposed.

H3: There is spatial dependence in the e-commerce behavior of farmers.

3. Data Sources and Model Specifications

3.1. Data Sources

The research team was composed of the postgraduates and undergraduates of the College of Economics and Management, Shenyang Agricultural University, who surveyed the farmers engaged in strawberry plantation and sales in Liaoning Province from January to April 2018. China has the most distributed strawberry plant species in the world, with a strawberry plantation area of 2 million mu, an annual output of about 2 million tons, and output value of about RMB 30 billion, Donggang City in Dandong, Liaoning Province, is known as "the No. 1 county of strawberry in China". As a high value-added fresh agricultural product, strawberry has become one of the most competitive products among the fresh agricultural products on the e-commerce sales platforms on the Internet. The samples in this paper cover 430 farmers from 14 villages in 9 towns in Donggang City (under the jurisdiction of Dandong), Xinmin City, Zhuanghe City (under the jurisdiction of Dalian), and Huludao City in Liaoning Province. Members of the research team had one-on-one questionnaires and interviews with the respondent farmers, distributing 430 questionnaires and recovering 378 of them. The questionnaire recovery rate was 87.9%.

3.1.1. Basic Statistics about Respondent Farmers

Among the respondent farmers, males accounted for 60.6% and females accounted for 39.4%; those aged between 31 and 40 accounted for 31.9% and those aged between 41 and 50 accounted for 37.5%; the farmers were poorly educated, with 71.7% receiving education below junior high school and only 28.3% receiving education above high school. The basic information about the respondent farmers is shown in Table 1. The

complete samples included 378 farmers, and 218 of them were engaged in e-commerce sales.

Table 1. Basic information about respondent farmers.

Variable		Percentage (%)	Variable		Percentage (%)
Gender	Male	60.5	Educational degree	Primary school and below	20.4
	Female	39.4		Junior high school	51.3
Age	18-30	7.1		High school, secondary school, or vocational school	21.6
	31-40	31.9		Junior college	4.4
	41-50	37.5		College and university	2.3
	51-60	17.7			
	Over 60	5.8			

3.1.2. Variable Settings and Descriptive Statistics

For the purpose of this research, "endowment" is defined in this paper as the innate qualities and the acquired resources at the disposal of economic decision makers, including the innate gender and age and the acquired educational experience, number of contacts in information tools and number of online social groups. Among them, information tools include fixed-line phones, cell phones, and computers; online social groups refer to the groups that use information tools such as the Internet for social purposes, including family members, neighbors, friends, peers in the plantation industry, professionals, township/corps farm cadres, and Internet friends. With reference to previous research on the information ability of farmers [5, 16], this paper measures the information ability of farmers in four dimensions: information awareness, information demand, information access, and information use. Based on the theoretical analysis above, this paper focuses on considering how the information ability and endowment differences of farmers influence their e-commerce behavior and tests the spatial dependence in the e-commerce behavior of farmers. The specific assignment method is shown in Table 2.

3.2. Model Settings

3.2.1. Influence of Endowment Differences and Information Ability on E-commerce Behavior

In this paper, the explained variable, e-commerce behavior of farmers (Y), is a discontinuous dichotomous variable of 0-1. The common analysis method is using binary models such as Probit and Logit. The difference between the two regression models lies in the distribution functions used. The Probit model assumes that random variables obey normal distribution, while the logit model assumes that random variables obey logistic probability distribution. In this paper, the Probit regression model is selected for empirical analysis, and the logit model is also selected for stability test.

In the Probit model, the probability of the e-commerce behavior of farmers $(Y=1)$ can be expressed as:

$$P(Y_{\mathrm{i}}=1/X)=\Phi(\beta_{0i}+\beta_i X_i) \tag{1}$$

where L_i is the farmers, i=1-n. Y is the explained variable, representing the e-commerce behavior of farmers; X_i is the independent and control variable in this paper, as shown in Table 2; β_0 is the regression intercept; $\beta_1 \sim \beta_9$ are the estimated coefficients of the corresponding explanatory variables; ε_i is the random variables that are independent of each other and obey normal distribution, namely $\varepsilon_i \sim N(0, \sigma^2)$.

Table 2. Definitions of variables and descriptive statistics.

Variable		Specific definition and assignment	Mean	Standard Deviation	Expected Impact
E-commerce behavior		1=Yes; 0=No	0.5767	0.4947	
Endowment differences	Gender	Genders of the respondent farmers	0.6058	0.4893	+/-
	Age	18-30=1; 31-40=2; 41-50=3; 51-60=4; over 60=5	2.8333	0.994	-
	Educational degree	Primary school and below=1; junior high school=2; high school, secondary school, or vocational high school=3; junior college=4; college and university=5	2.1693	0.8818	+
	Number of cell phone contacts	How many contact numbers are there in your cell phone?	137.7143	123.2648	+
	Size of online social groups	How many members are there in the online social groups that you have joined?	204.418	312.2441	+
Information ability	Strongly disagree=1; Disagree=2; Neutral=3; Agree=4; Strongly agree=5				
	Information awareness	Do you often actively collect information about e-commerce sales of agricultural products through various channels?	3.6984	1.0474	+
	Information demand	Will you actively ask for advice and learn from others around you who have ventured into e-commerce sales?	3.5212	1.0758	+
	Information access	Does your family have extensive contacts and many information access channels?	3.5476	0.8825	+
	Information use	Can you independently operate e-commerce sales based on the information you acquire?	3.7196	0.8653	+

Since the model is nonlinear, the maximum likelihood (MLE) method can be used to estimate the model parameters and the derivative with respect to the independent variable X can be further solved for the probability $P(Y_i = 1)$ as follows:

$$\frac{\partial P(Y_i = 1)}{\partial X} = \varphi(X\beta)\beta \tag{2}$$

where $\varphi(X)$ is the density function corresponding to the cumulative probability function $\varphi(X)$ under normal distribution. It can be seen that the marginal influence of the independent variable X on probability is not equal to the coefficient β, and X in $P(Y_i = 1)$ varies consistently with β.

In the Logit model, the probability of farmers' willingness to choose e-commerce $(Y = 1)$ can be expressed as:

$$P(Y_i = 1/X) = \frac{e^{f(x)}}{1 + e^{f(x)}}, (i = 1 \sim n) \tag{3}$$

$$f(X) = \alpha_0 + \alpha_i X_i + \mu_i \tag{4}$$

where i is the farmers, i=1-n. Y is the explained variable, representing the e-commerce behavior of farmers; X_i is the independent and control variable in this paper, as shown in Table 2; α_0 is the regression intercept; β_i is the estimated coefficient of the corresponding explanatory variable; μ_i is the stochastic disturbance.

3.2.2. Examination of Spatial Dependence in the E-commerce Behavior of Farmers

The spatial auto-regressive (SAR) model of the traditional Probit model is set as follows:

$$y^* = \rho W y^* + X\beta + \varepsilon, \quad \varepsilon \sim N(0, \sigma^2 I_n) \tag{5}$$

where y* is the potentially unobserved n×1 dimension variable related to the e-commerce behavior of farmers. If y*≥0, then the 0-1 binary variable Y=1, or Y=0. X is the exogenous variable of vector, and β is the parameter vector. W is the spatial weight matrix with n×n orders, and ε is the residual term, $\varepsilon \sim N(0, \delta^2 I_n)$, in which I_n is the identity matrix in n dimension. The explanatory variables have direct and indirect effects on the explained variables, and their sum is the total effect. After transposition of equation (5), there is the following equation:

$$(I_n - \rho W) y^* = X\beta + \varepsilon \tag{6}$$

When $s(\rho) = (I_n - \rho W)^{-1}$, we substitute it into equation (6):

$$y^* = s(\rho)(X\beta + \varepsilon) \tag{7}$$

We differentiate equation (7) into:

$$\frac{\partial y^*}{\partial X_i'} = s(\rho) I_n \beta \tag{8}$$

Equation (8) expresses the influence of a specific explanatory variable on the e-commerce behavior of farmers, namely the direct effect. Also let:

$$\eta = s(\rho) I_n \beta X \tag{9}$$

We take the derivative of the cumulative normal distribution function $F(\eta)$ with respect to I_j (I is a neighboring farmer), and there is the equation:

$$\frac{\partial F(\eta)}{\partial X_I} = \left(\frac{\partial F(\eta)}{\partial \eta} \Big| \eta_i \right) s(\rho) \beta \tag{10}$$

Equation (10) represents the indirect effect, namely, the spatial dependence [21].

4. Results and Discussion

4.1. Empirical Results of the Influence on E-commerce Behavior of Farmers

The statistical software stata14.0 is used to estimate the factors influencing the

e-commerce participation behavior of farmers with the Probit and logit models. The estimate results are shown in Table 3. The regression results of the main control variables obtained with the Probit and logit models are basically consistent, indicating that the models are robust. In order to ensure the validity of the regression results, this paper first examines the multicollinearity among the independent variables. All the results obtained through multicollinearity diagnosis have a Condition Index less than 10 and deny multicollinearity among the independent variables. As shown in Table 3, the original hypothesis that the estimated coefficient is zero is rejected by the fact that the values of LRchi2 (10) in the model reach the significance level of 1%, and the Pseudo R2 values are 0.6212 and 0.6413, respectively, indicating that the independent variables in the model have some explanatory power to the changes in the dependent variables.

Table 3. Factors influencing the e-commerce behavior of farmers.

Variable		Probit				Logit	
		Coefficient	Z Value	Marginal Effect	Z Value	Coefficient	Z Value
Endowment differences	Gender	-0.1339	-0.65	-0.0202	-0.65	-0.3728	-0.97
		(0.2073)		(0.0313)		(0.3852)	
	Age	-0.3132**	-2.25	-0.0472**	-2.29	-0.6121***	-2.6
		(0.1392)		(0.0206)		(0.2355)	
	Educational degree	0.2302	1.14	0.0347	1.44	0.4733**	2.04
		(0.1602)		(0.0240)		(0.2317)	
	Number of cell phone contacts	0.0047**	2.36	0.0007**	2.43	0.0080***	3.03
		(0.0019)		(0.0003)		(0.0027)	
	Size of online social groups	0.0073***	6.36	0.0011***	7.48	0.0153***	4.54
		(0.0011)		(0.0001)		(0.0034)	
Information ability	Information awareness	0.0712**	0.53	0.0407*	0.54	0.1442**	0.81
		(0.0238)		(0.0301)		(0.0714)	
	Information demand	0.0462	0.36	0.0069	0.36	0.1455	0.68
		(0.1279)		(0.0193)		(0.2141)	
	Information access	0.3398***	2.28	0.0513**	2.34	0.6041**	2.57
		(0.1489)		(0.0219)		(0.2351)	
	Information use	0.0442	0.30	0.0067	0.30	0.1446	0.60
		(0.1493)		(0.0225)		(0.2427)	
Constant term			-2.4966***	-2.90	-	-	-4.7772***
			(0.8608)				(1.3034)
Log likelihood			-97.5605				-92.3737
LRchi^2(10)/ Waldchi^2(10)			319.96				56.58
Prob>chi^2			0.0000				0.0000
Pseudo R^2			0.6212				0.6413
Number of samples			378				378

Note: * represents a significance level of 10%; ** represents a significance level of 5%; *** represents a significance level of 1%.

The estimate results shown in Table 3 indicate that only the information awareness and information access in the information ability of farmers pass the significance test. In other words, information awareness and information access significantly and

positively influence the e-commerce behavior of farmers, possibly because information awareness is reflected in the farmers' sensitivity to information and recognition of its importance. Farmers with strong information awareness are able to recognize the importance of information to agricultural production and consciously pay attention to the information related to their own agricultural production. Therefore, having stronger information awareness is more likely to motivate farmers to participate in e-commerce. Information access refers to the ability of farmers to acquire the desired information through information tools and relevant information channels. Generally speaking, as "rational-economic men", farmers aim to maximize their economic income in their agricultural production and operation [4]. The e-commerce behavior is simply a rational behavioral decision made by farmers based on their own ability and accessible resources in order to maximize their own profits. Therefore, only when farmers have access to sufficient and clear information and knowledge related to e-commerce sales, will they decide whether to participate in e-commerce or not. In endowment differences, age, the number of cell phone contacts and the size of online social groups all pass the significance test. In other words, farmers who have more cell phone contacts and join more extensive online social groups are more likely to participate in e-commerce. Therefore, the research hypotheses H_1 and H_2 in this paper are verified.

4.2. Test of Spatial Dependence in E-commerce Behavior of Farmers

First, the software MATLAB (R2014b) is used in this paper to create a spatial weight matrix based on adjacency, and the spatial weight matrix is standardized. Then, the Spatial Durbin Model (SDM) is used to test the spatial dependence in the e-commerce behavior of farmers. It is generally believed that the states of two things that are spatially close to each other are interrelated, which means that they should not be considered as being independent of each other, and the closer they are, the more strongly their states are correlated. (Tobler, 1970). In order to test this spatial dependence, the Moran's I method is used in this paper. The Moran's I test results are shown in Table 4, and the p value is 0.051, indicating significant test results. The value of Moran's I is 0.005, which means positive spatial dependence in the e-commerce behavior of farmers, indicating that similar behaviors of farmers are clustered.

Table 4. Moran's I test rest results of e-commerce behavior of farmers.

	Moran's I Value	**Expected Value**	**Standard Deviation**	**Z Value**	**P Value**
E-commerce behavior	0.005	-0.003	0.001	1.639	0.051

The software Stata14.0 is used in this paper for SDM estimate, and the estimate results are shown in Table 5. As the coefficient estimates of the SAR model do not directly reflect the probability of the effect of the explanatory variables on the e-commerce behavior of farmers, the direct effects, indirect effects and total effects are reported in Table 5.

The estimate results shown in Table 5 indicate that: Firstly, the SAR coefficient $\rho(0.747)$ is positive and statistically significant, which means that neighboring farmers are spatially interdependent and make similar decisions regarding participation in e-commerce. The Chinese rural society is a typical "acquaintance society", and farmers acquire agricultural information primarily through internal channels, which means that they are self-taught or rely on communication and exchange with their friends and

relatives [20]. The behaviors of other neighboring farmers may, to some extent, influence their decisions. Farmers who are the first to participate in e-commerce will serve as role models to encourage other farmers.

Table 5. SDM estimate results of the e-commerce behavior of farmers.

Variable		Coefficient	Direct Effect	Indirect Effect	Total Effect
SAR coefficient ρ		0.7471**	-	-	-
Endowment differences	Gender	0.0321	0.0151	0.0225	0.0376
		(0.1125)	(0.1036)	(0.1232)	(0.1245)
	Age	0.0659**	0.0298**	0.0413**	0.0711**
		(0.0577)	(0.0526)	(0.0631)	(0.0543)
	Educational degree	0.0438	0.0236	0.0185	0.0421
		(0.2885)	(0.2313)	(0.29844)	(0.2276)
Information ability	Number of cell phone contacts	0.0197***	0.0077***	0.0117***	0.0194***
		(0.000)	(0.000)	(0.000)	(0.000)
	Number of online social groups	0.2641**	0.0959**	0.1126**	0.2085**
		(0.0491)	(0.0413)	(0.048)	(0.0437)
	Information awareness	0.0528	0.0327	0.0215	0.0542
		(0.3527)	(0.3633)	(0.3562)	(0.3226)
	information demand	0.0969	0.0572	0.0347	0.0919
		(0.7215)	(0.7318)	(0.6694)	(0.7224)
	Information access	0.3698***	0.0868***	0.0915***	0.1783***
		(0.000)	(0.000)	(0.000)	(0.000)
	Information use	0.0211	0.0068	0.0102	0.017
		(0.3081)	(0.316)	(0.2757)	(0.2534)
Constant term		0.7535**			
		(0.4145)			

Note: * represents a significance level of 10%; ** represents a significance level of 5%; *** represents a significance level of 1%. The probability (p) based on the Bayes' Theorem is shown in brackets.

Secondly, endowment differences influence the e-commerce behavior of farmers. Age has a significant negative effect on the e-commerce behavior of farmers, which means that the direct effect accounts for 8.68% of the probability of increased e-commerce behavior of farmers, while the indirect effect accounts for 9.15% and the total effect accounts for 17.83%. Clearly, as farmers age, they are less likely to participate in e-commerce (direct effect), and this also reduces the probability of neighboring farmers to participate in e-commerce (indirect effect). Likewise, it can be found that the number of cell phone contacts and the size of online social groups have positive direct and indirect effects on the e-commerce behavior of farmers. In other words, the direct effect accounts for 7.7% of the probability for the number of cell phone contacts to increase the e-commerce behavior of farmers, while the indirect effect on neighboring farmers accounts for 11.7%; the direct effect accounts for 9.59% of the probability for the number of online social groups to increase the e-commerce behavior of farmers, while the indirect effect on neighboring farmers accounts for 11.26%. This confirms the existence of spatial dependence.

Thirdly, information ability influences the e-commerce behavior of farmers. The SDM estimate results show that the estimate result of information awareness is insignificant, indicating that the influence of information awareness on the e-commerce

behavior of farmers, though significant, is not space dependent. This is contrary to our expectation that farmers with stronger information awareness are more likely to participate in e-commerce. In fact, farmers with information awareness may also learn more about the advantages and disadvantages of e-commerce behavior, and therefore they are aware of uncertainties and risks. Thus, the varying information awareness of neighboring farmers results in this uncertain influence: it may or may not encourage the e-commerce behavior of farmers. Information access has a significant positive effect on the e-commerce behavior of farmers. In other words, farmers with better information access are more likely to participate in e-commerce and increase the probability of neighboring farmers to actively participate in e-commerce. Based on these estimate results, the research hypothesis H_3 in this paper is verified.

5. Conclusion and Policy Recommendations

This paper uses the Probit and Logit models to analyze the influence of information ability on the e-commerce behavior of farmers and tests its spatial dependence. The results show that: Firstly, information awareness, information access, educational degree, the number of cell phone contacts and the size of online social groups significantly influence farmers' decision on e-commerce participation. Stronger information awareness and better information access will increase the probability of farmers to participate in e-commerce. Farmers who have more cell phone contacts and who join more extensive online social groups are more inclined to show e-commerce behavior. Secondly, farmers are spatially interdependent and make similar decisions on e-commerce behavior. In other words, farmers have crowd mentality. If more neighboring farmers participate in e-commerce, farmers themselves will be more likely to make the same decision. Thirdly, estimates of the direct effects, indirect effects, and total effects of different variables on the e-commerce behavior of farmers show that the size of online social groups has the greatest influence on the e-commerce behavior of farmers, followed by information access. This indicates that personal online information resources in endowment differences and information access in information ability are important factors promoting the development of e-commerce in rural areas. The empirical results of this paper reveal different driving factors behind e-commerce participation behavior and provide reference and basis for offering targeted training on modern information skills to farmers and promoting the deepening development of agricultural e-commerce and the construction of digital villages.

Based on the research conclusion given in this paper, the following policy recommendations are proposed: Firstly, government departments should strengthen the integration, sharing and utilization of information resources through beneficial platforms, enhance farmers' information awareness, broaden their information channels, and guide farmers to actively participate in e-commerce. At the same time, rural children, women and the elderly left behind should be better educated to improve their Internet literacy. The First Secretaries of the Party Committee, members of village task forces, college-graduate village officials, and sci-tech special commissioners should play a due role in strengthening the training on modern information skills for farmers. Secondly, the construction and development of broadband communication networks, mobile Internet and digital TV networks in rural areas should be accelerated. E-commerce is "novelty" to farmers, and the construction of network infrastructure and the spread of network information knowledge are particularly essential to its

development. Thirdly, the establishment of e-commerce demonstration villages and households can provide farmers with wider and faster access to relevant information and communication opportunities, thereby further deepening the comprehensive demonstration effect of e-commerce in rural areas. Fourthly, rural e-commerce programs shall be implemented by classification while giving consideration to the different endowment characteristics of farmer. Supporting inclusive finance policies in terms of Internet payment and Internet credit should be issued to benefit farmers who have sufficient personal network information resources and the ability to operate e-commerce, so as to provide them with convenient information technology services right in their villages. Farmers who are willing to start e-commerce should be provided with necessary training and guidance, so that they can benefit from technical support and protection in their e-commerce endeavors.

Acknowledgements

This work was supported by 18YJA790084 (Research on Social Trust, Risk Perception and Farmers' Pesticide Application Behaviour).

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