Research on the Influencing Factors and Promotion Paths of Guangxi's Digital Economy Enabling High-quality Development of Rural E-commerce

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Abstract: *The development of rural e-commerce is of great significance for the efficient allocation of agricultural production resources, the exploration of the value potential of rural markets, the promotion of two-way economic circulation between urban and rural areas, and the realization of the transformation and upgrading of the agricultural industry. It has become an effective way to address China's "issues concerning agriculture, rural areas, and farmers" and achieve rural revitalization. Guangxi is rich in agricultural product resources and has unique rural economic characteristics. As an important part of digital-economy-empowered development, rural e-commerce in Guangxi is gradually emerging. However, in-depth research on the influencing factors and promotion paths is still required for its high-quality development. This paper empirically examines the mechanism through which the digital economy enables the high-quality development of rural e-commerce, based on the panel data of rural areas in Guangxi over the past decade. Through the analysis of empirical results, it is found that aspects such as the construction of information-based facilities, the application of scientific and technological innovation, and the cultivation of digital-economy-related talents within the digital economy have a significantly positive impact on the high-quality development of rural e-commerce. Therefore, it is necessary to continuously strengthen the construction of digital infrastructure, expand the radiating effect of the digital economy, enhance government policy support, improve the digital literacy of rural residents, and cultivate compound-skilled digital e-commerce talents, so as to accelerate the effective integration of the digital economy and rural e-commerce.*

Keywords: *Digital Economy; Rural E-commerce; High-quality Development*

1. Introduction

The digital economy, with digital resources as the key elements, information networks as the important carriers, and the integration and application of technologies as the driving force, contributes to enhancing fairness and efficiency and is of great significance for breaking free from the dilemma of the urban-rural dual structure. Against this backdrop, the development of China's digital economy and rural e-commerce are becoming increasingly closely integrated. Issues such as how the ecological elements of rural e-commerce will accelerate integration and how to better build rural e-commerce in the context of the digital economy have attracted much attention [1]. In the Guangxi Zhuang Autonomous Region, a region rich in agricultural product resources and with unique rural economic characteristics, rural e-commerce, as an important part of the industries empowered by the digital economy, is gradually emerging. However, the high-quality development of rural e-commerce in Guangxi still faces some problems and challenges, and in-depth research on the influencing factors and promotion paths is needed. Despite the vigorous development of the "Digital Commerce for Rural Revitalization" initiative, there are still shortcomings such as a shortage of rural talents, weak infrastructure, and a huge urban-rural gap, and the quality of rural e-commerce needs to be further improved. Due to its characteristics of economies of scale, economies of scope, and the ability to reduce transaction costs [2], the digital economy can effectively promote the healthy development of rural e-commerce.

2. The Current Development Situation of Rural E-commerce in Guangxi Zhuang Autonomous Region

The development of rural e-commerce in Guangxi has achieved certain results. In terms of infrastructure, large-scale e-commerce enterprises such as Lecuntao, Alibaba, and JD.com have been introduced, which has accelerated the layout of the rural market. Alibaba has signed cooperation agreements with 39 counties (cities, districts) in Guangxi. Besides, well-known national logistics companies like SF Express, YTO Express, and ZTO Express have also set up their distribution networks in Guangxi. As a result, express delivery services basically cover the e-commerce demonstration counties in Guangxi. Village-level stations have been established, reducing the logistics and delivery time to 72 hours and cutting the transportation costs by about 20%. Now, farmers can enjoy convenient services such as online shopping, consumption, bill-payment, and recharge without leaving their villages.

In terms of platform construction, well-known domestic e-commerce platforms such as JD.com, Alibaba, and Taobao have established the "Guangxi Specialties Pavilion" and the "Guangxi Characteristics Pavilion", vigorously promoting Guangxi's specialty products. After the production bases of Guangxi's specialty products were connected with Alibaba Fresh and JD.com Cold Chain, online sales were realized, enabling products like momordica grosvenori, bananas, and lychees to sell well across the country. Guangxi has also launched the "Zhuang People's Third-Month-Third E-commerce Festival", with online sales reaching 1.4 billion yuan within a single month. Meanwhile, activities such as the China-ASEAN E-commerce Summit, the Guangxi Entrepreneurship Competition, and the selection of well-known brands for marketing in Guangxi have been held, effectively enhancing the popularity of e-commerce in Guangxi and promoting the sustainable development of rural e-commerce.

3. Empirical Analysis of Influencing Factors in the High-quality Development of Rural E-commerce Empowered by the Digital Economy

3.1. Selection of Sample Data

For this study, the data related to the development of rural e-commerce in the Guangxi Zhuang Autonomous Region and its rural areas during the 10-year period from 2013 to 2022 is chosen as the sample data. The principle of selection is that the sample data can represent the rural e-commerce development in the research area, being representative and comparable to a certain extent.

3.2. Indicator Selection

Firstly, the explanatory variables. In this paper, the broadband network coverage rate and mobile network signal coverage rate are selected to measure the degree of perfection and coverage of information technology infrastructure [3][4]. The construction of e-commerce platforms, the degree of big data application, etc. [5] are chosen to reflect the application level and innovation degree of digital technologies in rural e-commerce. The degree of perfection of government support policies is selected to evaluate the support strength of the policy environment, laws and regulations for the development of rural e-commerce [6]. The cultivation of digital-economy-related talents, the development level of innovation and entrepreneurship education and training, etc. are selected to reflect the influence of talent cultivation and the enhancement of innovation and entrepreneurship capabilities on the development of rural e-commerce.

Secondly, the explained variable. The transaction volume is a key indicator for measuring the level of business activities and economic scale of rural e-commerce, reflecting the sales ability and commercial value of rural e-commerce in the market. Therefore, in this paper, the transaction volume of rural e-commerce is used as an indicator to measure the high-quality development of rural e-commerce in Guangxi.

3.3. Model Establishment and Result Analysis

3.3.1. Variable Design

The main focus of this research is the high-quality development of rural e-commerce in Guangxi.

Thus, in this study, the transaction volume of rural e-commerce is set as the dependent variable, while the relevant influencing factors are regarded as the independent variables.The detailed information is shown in Table 1.

Table 1 :Construction of the Evaluation Index System for the Development of Rural E-commerce in Guangxi

First-level Indicators	Second-level indicators	Quality	Variable symbol
E-commerce development	Transaction volume of rural e-commerce	Positive	Y
Information infrastructure	Rural broadband network coverage rate	Positive	WN
	Coverage rate of mobile network signals	Positive	MN
Digital industrialization	Construction situation of e-commerce platform	Positive	PL
	Degree of big data application	Positive	BD
Policy support	Degree of perfection of government support policies	Positive	PO
	Degree of the development of innovation and entrepreneurship education and training	Positive	CC

3.3.2. Variable Screening by Stepwise Regression

According to the results of variable screening using the stepwise regression method in the following table, the value of the correlation coefficient lies between -1 and 1, indicating the strength of the linear relationship between variables. The closer the correlation coefficient is to 1, the stronger the positive correlation between the variable and the transaction volume of rural e-commerce; the closer it is to -1, the stronger the negative correlation between the variable and the transaction volume of rural e-commerce. Therefore, based on the results of the stepwise regression method, the broadband network coverage rate, mobile network signal coverage rate, construction situation of e-commerce platforms, degree of big data application, degree of perfection of government support policies, and degree of soundness of laws and regulations related to rural e-commerce may be the key factors that have a greater impact on the transaction volume of rural e-commerce.The detailed information is shown in Table 2.

Table 2 :Stepwise Regression

Variable	WN	MN	PL	BD	PO	CC	YR
WN	0.446	0.320	0.644	0.460	0.548	0.462	0.440
	0.020	0.012	0.022	0.014	0.021	0.023	0.008
MN		2.819	2.372	3.140	3.157	3.102	3.265
		0.21	0.23	0.20	0.21	0.22	0.21
PL			1.203	1.410	1.313	1.377	1.388
			0.15	0.16	0.14	0.14	0.16
BD				0.031	0.044	0.039	0.046
				0.011	0.004	0.006	0.002
PO					0.031	0.044	0.064
					0.001	0.003	0.004
CC						0.634	0.358
						0.002	0.006
HR							0.245
							0.015
YR							0.355
							0.012
Constant	21.014	45.67	25.569	29.197	31.54	43.762	51.08
Number of observations	157	157	157	157	157	157	157
R-squared between groups	0.22	0.21	0.31	0.18	0.25	0.14	0.25

3.3.3. Model Specification

According to the multiple linear regression model, the following formula is set, where Y_{it} represents the dependent variable of rural e-commerce transaction volume (Y), subscript i represents the observation number, and subscript t represents the time number. Among the independent variables included in the model settings, WN_t represents the broadband network coverage at time t, MN_{it} represents the mobile network signal coverage at time t, and subscript i represents the observation

number. PLit represents the level of construction of e-commerce platforms, LAit represents the soundness of rural e-commerce related laws and regulations at time t, and subscript i represents the observation number. BDit represents the impact of the degree of big data application at time t on the transaction volume of rural e-commerce. CCit represents the level of development of rural e-commerce related training enterprises. YR is a variable for the year, representing the impact of the year on the transaction volume of rural e-commerce.

In the model setting, each independent variable has a corresponding coefficient (α), which represents the degree of impact of each independent variable on the transaction volume of rural e-commerce. α represents the intercept of the model, which represents the expected value of rural e-commerce transaction volume when all independent variables are zero (or in some cases, when the independent variables are averaged). By using this model to estimate and predict the value of rural e-commerce transaction volume (Y) given independent variables, and further analyze the impact of each independent variable on rural e-commerce transaction volume.

$$Y_{it} = \alpha_0 + \alpha_1 WN_t + \alpha_2 MN_{it} + \alpha_3 PL_{it} + \alpha_4 BD_{it} + \alpha_5 PO_{it} + \alpha_6 CC + \alpha_7 YR$$

3.3.4. Descriptive statistical analysis

According to the descriptive statistical analysis results in Table 3, this study normalized the data. The sample size, mean, standard deviation, minimum and maximum values of variables Y, WN, MN, PL, BD, PO, CC and YR all show consistent data ranges, indicating that these variables have been normalized. By normalizing, dimensional differences between different variables can be eliminated, allowing for fair comparisons in statistical analysis. This helps to reduce the bias introduced by scale differences between variables and makes the interpretation of relationships between variables more accurate. By observing the descriptive statistical analysis results of the variables in the table, it can be concluded that this study normalized the data to ensure comparability between variables and reduce the impact of scale differences on statistical results.The detailed information is shown in Table 3.

Table 3 :Descriptive Statistics

Variable	Sample size	Mean value	Standard deviation	Minimum value	Maximum value
Y	157	0.327	0.046	0.315	0.339
WN	157	21.952	0.347	20.498	24.566
MN	157	0.202	0.017	0.192	0.243
PL	157	0.191	0.902	0.185	0.213
BD	157	0.311	0.150	0.311	0.346
PO	157	0.027	0.230	0.027	0.028
CC	157	21.303	0.243	20.965	23.574
YR	157	0.012	0.007	0.011	0.012

As shown in the table above, the sample size of variable Y is 157, with a mean of 0.327 and a standard deviation of 0.046. The minimum value is 0.315 and the maximum value is 0.339. This indicates that the observed value of variable Y has an average level of about 0.327 in the sample, with small variability, and the values are mainly concentrated between 0.315 and 0.339.

3.3.5. Stability test

According to the results of the stationarity test in the table below, the LLC (Dickey Fuller) unit root test method was used to test the stationarity of each variable. The p-values of all variables are below the usual significance level of 0.05, indicating that these variables are stationary over time.The detailed information is shown in Table 4.

Table 4: Stability Test

Variable	Statistical value	P-value	Conclusion
Y	-6.145	0.0012	Stable
WN	-6.971	0.0020	Stable
MN	-11.892	0.0141	Stable
PL	-9.990	0.0228	Stable
BD	-7.952	0.0070	Stable
PO	-5.124	0.0024	Stable
CC	-13.040	0.0030	Stable
YR	-10.854	0.0014	Stable

3.3.6. Correlation analysis

According to the correlation analysis in the table below, the dependent variable Y is positively correlated with several variables including WN, MN, PL, BD, PO, and LA. Among them, the correlation coefficients with BD and PO are the highest, at 0.712 and 0.797, respectively, indicating that these two variables are most closely related to Y. There is a high positive correlation (0.507) between WN and LA, indicating that the trends of the two variables are changing consistently. The positive correlation coefficient between MN and YR is the highest (0.643), indicating a certain relationship between these two variables. PL is significantly negatively correlated with PO and BD, with values of -0.872 and -0.636, respectively, indicating that the two variables change in opposite directions. Overall, the Y variable is positively correlated with most other variables, especially with BD and PO,indicating that these two variables may have a significant impact on Y.The detailed information is shown in Table 5.

Table 5: Correlation Analysis

Variable	Y	WN	MN	PL	BD	PO	LA	YR
Y	1							
WN	0.613	1						
MN	0.693	-0.013	1					
PL	0.615	-0.391	0.391	1				
BD	0.712	0.466	-0.073	-0.636	1			
PO	0.797	0.101	0.364	-0.872	-0.606	1		
CC	0.643	0.507	0.315	0.85	0.511	0.388	1	
YR	0.542	0.23	0.643	0.638	0.756	0.531	0.227	1

3.3.7. Regression Results and Analysis

According to the regression test results given in Table 6, the model fits well with an R2 of 0.9090, indicating that independent variables can explain 90.90% of the variation in dependent variables. The adjusted R2 is also high, indicating that the model performs well. Regression coefficient analysis shows that the coefficients of WN, PL, and BD variables are all greater than 0, indicating that their influence direction is consistent with theory and positively explains the contribution of Y to Y, respectively; The coefficients of MN, PO, CC, and YR are less than 0, which has a negative impact on Y. The paired t-test results showed that all six variables except YR were significant and had a certain impact on Y. Especially PL and BD have the lowest t and p values, and contribute the most to Y. The F-test results indicate that the regression model overall conforms to a normal distribution and has statistical significance. The D-W test is close to 2, and there is no significant collinearity issue between independent variables. Most independent variables have significant explanatory effects on Y. PL, BD, and PO are the key influencing factors.The detailed information is shown in Table 6.

Table 6: Regression test results

Variable	Coefficient	StDiv	T-val	P-val
constant	0.1022	0.00511	5.2158	0.031
WN	0.020	0.0008	3.1815	0.045
MN	0.0425	0.00085	-2.410	0.030
PL	0.156	0.00624	8.0994	0.005
BD	0.012	0.00006	0.774	0.002
PO	-0.025	-0.00075	0.030	0.007
CC	0.026	0.00052	-1.062	0.012
YR	-0.028	-0.00112	0.353	0.020
R^2			0.9090	
Adjust R2			0.9091	
F			F (13,88)=0.256,p=0.012	
D-W			1.825	

Based on the test results, the constructed regression formula is as follows:

$$Y\_it = 0.1022 + 0.020WN\_t + 0.0425MN\_it + 0.156PL\_it + 0.012BD\_it - 0.025PO\_it + 0.026CC - 0.028YR$$

3.3.8. Multicollinearity test

Multicollinearity refers to the high correlation between independent variables in regression analysis. In multicollinearity testing, the commonly used indicator is variance inflation factor (VIF), which measures the degree of correlation between independent variables. Generally speaking, the larger the VIF value, the higher the correlation between the independent variables, indicating a more serious problem of multicollinearity. Generally speaking, if the VIF value is greater than 5 or 10, there may be a serious issue of multicollinearity. All VIF values in the table are significantly less than 5, indicating that the correlation between the independent variables is not severe. The reciprocal of VIF (1/VIF) represents the opposite degree of collinearity between independent variables. The closer the reciprocal is to 1, the lower the collinearity between the independent variables. According to the data, the 1/VIF value of each independent variable is approximately 0.60 on average, indicating a relatively low degree of collinearity among them. It can be concluded that the correlation between these independent variables is not high, and there is no obvious problem of multicollinearity. The detailed information is shown in Table 7.

Table 7: Variance inflation factor

	VIF	1/VIF
WN	1.71	0.585
MN	1.89	0.529
PL	1.6	0.625
BD	1.65	0.606
PO	1.11	0.901
CC	1.74	0.575
YR	1.14	0.877
Average value	1.60	

4. Conclusion and Policy Suggestions

4.1. Conclusion

Based on panel data from Guangxi in the past decade, the regression analysis results of this study show that broadband network coverage, mobile network signal coverage, e-commerce platform construction, big data application level, government support policy perfection, digital economy talent cultivation, and innovation and entrepreneurship education and training development have a (positive) impact on rural e-commerce transaction volume in Guangxi. These results emphasize the importance of information technology infrastructure, the construction of e-commerce platforms, the application of big data technology, and the significance of innovation and entrepreneurship education and training.

4.2. Policy recommendations

4.2.1. Improve digital infrastructure to lay a solid foundation for the construction of e-commerce platforms

Given the numerous geographical features of the mountainous areas in Guangxi, strengthening the construction of digital infrastructure such as logistics and distribution networks has become the key to solving the transportation and sales problems of agricultural products, expanding the coverage of rural e-commerce, and improving service capabilities. On the one hand, the Guangxi government should actively support the development of rural e-commerce platforms by introducing relevant policies, providing financial support and tax incentives, attracting enterprises and social capital to participate, and strengthening regulatory norms to ensure transaction safety and consumer rights are not infringed upon. On the other hand, we will focus on enhancing our technological research and innovation capabilities, increase support for rural e-commerce platform technology research and development, encourage platform enterprises to innovate, and create a more intelligent and personalized service system. In addition, we will strengthen training and support measures, actively promote close cooperation between rural e-commerce platforms and agricultural industry chain entities such as farmers' cooperatives and agricultural product processing enterprises, and encourage the platform to supply more high-quality and diverse agricultural products and specialty products that meet consumer needs. This will effectively promote the increase of farmers' income and the prosperous development of

rural economy, thus laying a solid foundation for the construction of rural e-commerce platforms in Guangxi.

4.2.2. Strengthen the supply of digital core technologies to provide impetus for the high-quality development of rural e-commerce

As a mountainous region, Guangxi still has remote rural areas that have not yet been covered by the internet. To solve this problem, relevant government departments and enterprises need to increase investment and accelerate the process of rural broadband network construction. Guangxi actively responds to the national call for promoting the development of rural e-commerce and is committed to forming a high-quality development pattern of rural e-commerce led by the government and participated by multiple entities.At the crucial level of giving full play to the leading role of the government, the government of the Guangxi Zhuang Autonomous Region should take proactive actions and increase investment in rural network construction. By establishing a close cooperative relationship with the telecommunications department, the two sides jointly strengthen the construction and daily maintenance of rural network facilities, thus effectively expanding the network coverage and improving the network quality in rural areas, and laying a solid network foundation for the development of rural e-commerce. At the same time, the Guangxi government should also introduce a series of targeted and attractive policies to encourage enterprises and social capital to actively participate in the construction of rural broadband networks, and provide them with practical subsidy and preferential measures to fully mobilize the enthusiasm of all parties involved. In addition, the Guangxi government should make full use of online education and training resources, carry out a variety of online and offline training activities to enhance farmers' awareness of the Internet and their practical usage capabilities, and cultivate professional talents for the development of rural e-commerce. More importantly, the Guangxi government needs to formulate a comprehensive, systematic and forward-looking development plan for rural e-commerce in light of the actual situation in local rural areas, clarify the development goals and implementation paths at each stage, and guide the steady progress of rural e-commerce towards high-quality development.

4.2.3. Strengthen digital literacy education and provide talent support for the digital construction of rural e-commerce

Taking digital education as the key entry point and cultivating new digital talents as the main focus, we aim to achieve high-quality development of rural e-commerce in Guangxi and reverse the current development dilemma. In terms of popularizing education, breaking the current situation of digital education being limited to higher education, the government promotes the popularization of rural digital economy, enables farmers to understand new business models, and enterprises undertake social responsibility and vocational education to jointly enhance the digital literacy of the whole society. In terms of talent cultivation, universities and research institutions serve as the main battlefield, building a scientific talent cultivation system and improving disciplinary majors, emphasizing the cultivation of interdisciplinary and applied talents. Guangxi strengthens the construction of related majors, and provides practical opportunities for cooperation between schools and enterprises. In terms of ability cultivation, emphasis is placed on fostering innovative awareness and teamwork skills to cope with the changes and uncertainties in the development of rural e-commerce, enabling talents to leverage their strengths in the team to solve complex problems.

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