



Mechanism and Path Analysis of Rural E-Commerce on Rural Economic Resilience

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Abstract. Rural e-commerce is an important driving force to promote rural economic resilience and empower rural revitalization, aiming to provide a theoretical basis for the development of rural revitalization. Using the panel data of 30 provinces from 2000 to 2022, we choose the double fixed effect model and mediation test model to empirically analyze the impact and mechanism of rural e-commerce on rural economic resilience. Rural e-commerce has a positive promoting effect on rural economic resilience, and its promoting effect is more significant in the central and western part of the country and under the high education level, and the conclusion still holds after the robustness and endogeneity tests. Rural e-commerce indirectly enhances rural economic resilience through rural labor productivity and agricultural technology progress. Accordingly, suggestions are made to tailor the policy to the situation, strengthen the leadership of talents and accelerate the construction of network infrastructure.

Keywords: Rural e-commerce; rural economic resilience; agricultural labor productivity; agricultural technological progress

1 INTRODUCTION

The Twentieth Congress Report proposed to realize agricultural modernization. However, the development of rural modernization in China is challenged by a variety of risks, which indirectly leads to the difficulty of the rural economy to resist risks. Therefore, exploring the mechanism of factors affecting the ability of the agricultural economy to resist risks and the path of the operating mechanism is undoubtedly the focus of current attention. The Action Plan for the Construction of Digital Countryside (2022-2025) points out that it is necessary to cultivate the characteristic brands of rural e-commerce. Meanwhile, rural e-commerce, as an important driving force for modern rural development, is expected to become a new engine for promoting rural economic development. Then, it is crucial to study and analyze the relationship between rural e-commerce and rural economic resilience.

2 DATA SOURCES

Panel data from 30 provinces in China for the period 2000-2022 are used as the study object, with data from China Statistical Yearbook and China Rural Statistical Yearbook, missing values are added by linear interpolation.

2.1 Benchmark Regression Model

Drawing on Shujun Yao et al.^[1], a double fixed-effects model controlling for time region is used to verify the impact of rural e-commerce on the rural economy's resilience to risk:

$$Agr_{it} = \alpha_0 + \alpha_1 Index_{it} + \alpha_2 Ctrl_{it} + \eta_i + \delta_t + \varepsilon_{it} \tag{1}$$

Where: Agr_{it} and $Index_{it}$ are rural economic resilience and rural e-commerce, $Ctrl$ is the control variable, η_i is the area fixed effect, δ_t is the time fixed effect, and ε_{it} is the random disturbance term.

2.2 Models for Testing the Mechanism of Mediating Effects

Drawing on Wen Zhonglin et al.'s mediation test method ^[2], the mediation effect test model constructed is as follows:

$$Med_{it} = \beta_0 + \beta_1 Index_{it} + \beta_2 Ctrl_{it} + \eta_i + \delta_t + \varepsilon_{it} \tag{2}$$

$$Agr_{it} = l_0 + l_1 Index_{it} + l_2 Med_{it} + l_3 Ctrl_{it} + \eta_i + \delta_t + \varepsilon_{it} \tag{3}$$

Where: Med is rural labor productivity and agricultural technological progress, β_1 is the effect of rural e-commerce on the mediating variable, l_1 is the direct effect, l_2 denotes the effect of the mediating variable on rural economic resilience.

2.3 Explained Variables

Referring to the practice of Zhao Wei et al.^[3], The rural economic resilience is decomposed into the following four dimensions and measured using the entropy value method, and the results of the specific indicator system are shown in Table 1:

Table 1. Rural Economic Resilience Indicator System.

Level 1 indicators	Secondary indicators	unit (of measure)	direction of action	weights
ability resistance	Value added of primary sector/GDP	%	+	0.023
	Village consumption/social consumption employees in primary industry	%	+	0.011
	Per capita disposable income of rural residents	Yuan	+	0.054
	Gross output value of agriculture	billions	+	0.047
	Completed fixed asset investment in rural households	billions	+	0.050
				+

	Consumption expenditure per rural inhabitant	Yuan	+	0.046
	grain production	tons	+	0.046
	Effective irrigated area	thousand hectares	+	0.042
	Gross power of agricultural machinery	kilowatt	+	0.051
	Total sown area of crops	thousand hectares	+	0.035
resiliency	Number of village health centers	general	+	0.044
	Crops affected area	thousand hectares	-	0.049
	Soil erosion control area	thousand hectares	-	0.043
	Amount of plastic film per unit area	%	-	0.041
Updating capacity	Amount of fertilizer per unit area	%	-	0.016
	Amount of pesticide per unit area	%	-	0.042
	Amount of diesel fuel per unit area	%	-	0.050
	Amount of fiscal expenditure on agriculture	billions	+	0.054
innovation capacity	Rural labor force with specialized education and above	man	+	0.067
	Local finance expenditure on science and technology	billions	+	0.103
	Investment in fixed assets in agriculture	billions	+	0.050

2.4 Core Explanatory Variables

Referring to the practice of He Peijun et al.^[4], five indicators are selected to measure rural e-commerce, and the entropy method is applied to measure the weight of each indicator, and the specific results are shown in Table 2 below:

Table 2. Rural e-commerce indicator system.

Level 1 indicators	Secondary indicators	unit (of measure)	weights
	GDP per capita	Billions of dollars/person	0.128
Agriculture	Internet broadband access subscribers	ten thousand houses	0.203
Village	Cell phone year-end subscribers	ten thousand houses	0.154
E-commerce	Value added of tertiary industry	billions	0.224
	Rural electricity consumption	billion kilowatt-hours	0.291

2.5 Mediating Variables

Drawing on Tang Hongtao et al.'s approach^[5], this paper selects rural labor productivity and agricultural technological progress as mediating variables: (1)Alp: value added of primary production/rural primary production of people; (2) Ate: the ratio of total food production to primary production of people.

2.6 Control Variables

Drawing on LU Zhaoyang et al.^[6], the control variables selected are (1) Ftd, the ratio of total imports and exports to GDP; (2) Eio, the ratio of fiscal expenditures to GDP; (3) Til, the ratio of mileage to area of highways; and (4) Ur, the ratio of the urban population to the resident population.

3 EMPIRICAL RESULTS AND ANALYSIS

3.1 Baseline Regression Analysis

The P-value of Hausman test result is 0.0000, that is, it is more appropriate to choose fixed effect analysis. The maximum value of VIF test result is 2.85, which is much smaller than 10, so there is no multicollinearity problem. Table 3 sequentially adding control variables after the R2 value becomes larger, that is, equation (1) fit is better, columns (2) ~ (5) sequentially adding control variables, the coefficient of rural economic toughness is still significantly positive, indicating that with the rural e-commerce effectively promote rural economic toughness. The possible reason is that rural e-commerce breaks the information occlusion and promotes the flow of information in the agricultural sector, increasing farmers' income and rural economic development. From the control variables, the estimated coefficient of economic intervention intensity is significantly positive, the possible reason is that the focus of the policy is beneficial to the development of rural e-commerce, which causes rapid economic growth and thus enhances rural economic resilience. The positive and insignificant urbanization rate indicates that its effect on boosting the development of agricultural economic resilience has not yet been realized, and the urbanization rate should be promoted in the future.

Table 3. Benchmark regression results.

variant	(1)	(2)	(3)	(4)	(5)
Index	0.198*** (15.7199)	0.1918*** (14.761)	0.1911*** (14.748)	0.192*** (14.759)	0.192*** (14.760)
Ftd		-0.009* (-1.694)	-0.007 (-1.326)	-0.0071 (-1.309)	-0.007 (-1.250)
Eio			0.005** (2.155)	0.004 (1.643)	0.004* (1.653)
Til				-0.003 (-0.759)	-0.005 (-1.146)
Ur					0.020 (1.273)
_cons	0.129*** (39.323)	0.132*** (36.152)	0.126*** (28.865)	0.128*** (26.942)	0.126*** (26.144)
N	0.198***	0.1918***	0.1911***	0.192***	0.192***
fixed time	YES	YES	YES	YES	YES
Area fixed	YES	YES	YES	YES	YES
R2	0.903	0.903	0.904	0.904	0.904

Note: ***, **, and * indicate significant at the 1%, 5%, and 10% levels; same below.

3.2 Robustness Analysis

A replacement for rural e-commerce indicators. Drawing on He Peijun et al.^[4], this paper transforms the measure of rural e-commerce, using total social retail goods as the explanatory variable, and the regression results are shown in column (1) of Table 4. Second change the sample period. Drawing on Tang Hongtao et al.^[5], Given that China's e-commerce is still in its infancy before 2010, and the impact of the Internet bubble and the financial crisis at that stage will inhibit the development of rural e-commerce, while e-commerce enters a stage of intense competition after 2010, and e-commerce is gradually expanding the scope of this paper, this paper chooses only the data from 2010 to 2022 to conduct a robustness test, and the regression results are shown in column (2) of Table 4. Three explanatory variables are lagged one period. Drawing on Zhao Wei et al.^[3]The regression results are shown in column (3) of Table 4. It is still significantly positive under all three tests, indicating that the findings are robust.

Table 4. Robustness test results.

variant	(1)	(2)	(3)
Index	0.314*** (17.090)	0.202*** (9.180)	0.219*** (17.980)
_cons	0.122*** (26.200)	0.162*** (29.970)	0.149*** (30.940)
control variable	Yes	Yes	Yes
fixed time	Yes	Yes	Yes
Area fixed	Yes	Yes	Yes
N	690	390	660
R2	0.919	0.857	0.929

3.3 Endogenous Issues

One Instrumental Variable Approach: the core explanatory variables with one period lag are instrumental variables. As shown in column (1) of Table 5. The first-stage regression results show that there is a high degree of correlation between instrumental variables and explanatory variables, and the weak identification test shows that the F-value is much larger than the critical value of 16.38, which rejects the hypothesis of weak instrumental variables; the second-stage regression results show that all the rural e-commerce effects on rural economic resilience are significantly positive, which further supports the robustness of the results of this paper. Second system GMM: The explanatory variables of one period lag are introduced and regressed using the system GMM method, as shown in column (2) of Table 5, the AR(2) is 2.20 and Hansen is 18.56, which meets the criteria. In summary, the endogeneity problem has little effect on the regression results, and the impact of rural e-commerce on rural economic resilience remains significant.

Table 5. Results of endogeneity test.

variant	(1)		(2)
	Phase I	Phase II	System GMM
L. Index	1.002*** (99.770)		
Index		0.206*** (15.380)	0.133*** (2.810)
L. Agr		-	4.193*** (7.970)
control variable	Yes	Yes	Yes
fixed time	Yes	Yes	Yes
Area fixed	Yes	Yes	Yes
_cons	-0.029*** (-2.920)	0.069*** (5.310)	17.014 (1.380)
N	660	660	660
R2		0.967	-

3.4 Mechanism of Action Analysis

Mediation model based on equations (2) and (3).I Rural labor productivity. The regression results are shown in columns (1) to (2) of Table 6, where rural e-commerce indirectly promotes rural economic resilience by enhancing rural labor productivity. Rural labor productivity in column (2) positively contributes to the resilience of the rural economy, probably because e-commerce facilitates the scaling up of digital production, which contributes to the improvement of rural labor productivity and economic efficiency. However, it is reduced compared to the value in column (1), i.e., the mediating effect is about 0.008, which accounts for about 29.6% of the total effect. II. technological progress in agriculture. The test results are shown in columns (3) and (4) of Table 6. Rural e-commerce indirectly enhances the rural economy by promoting agricultural technological progress. The reason may be that the introduction of e-commerce technology promotes the improvement of farmers' returns in the agricultural economy. That is, rural e-commerce indirectly promotes rural economic resilience through the two channels of promoting rural labor productivity and agricultural technological progress.

Table 6. Results of the mediation effect test.

variant	(1)	(2)	(3)	(4)
	Alp	Agr	Ate	Agr
Index	3.211*** (7.050)	0.174*** (13.170)	1.548*** (2.980)	0.182*** (14.360)
Alp		0.005*** (4.960)		

				0.006***
Ate				(6.420)
_cons	0.773***	0.122***	0.558***	0.123***
	(4.500)	(25.340)	2.880)	(26.060)
control variable	Yes	Yes	Yes	Yes
fixed time	Yes	Yes	Yes	Yes
Area fixed	Yes	Yes	Yes	Yes
N	0.865	0.915	0.670	0.917
R2	690	690	690	690

3.5 Heterogeneity Analysis

A regional heterogeneity: Drawing on the study of LU Zhaoyang et al.^[6] the 30 provinces are divided into eastern, central, and western regions, and the regression results are shown in Table 7. After the analysis, rural e-commerce promotes rural economic resilience the most in the provinces in the central region, followed by those in the western region, and lastly in the eastern region provinces. The possible reason for this is that the development of industries in the central and western regions depends on the implementation of relevant government policies, which prompts the rapid development of agriculture and then enhances the economy of the central and western regions.

Second education level heterogeneity: Drawing on the method of Qin Fang et al.^[7] The median level of human capital is selected, and the sample is divided into high human capital and low human capital for each analysis, and the results are shown in columns (4) to (5) of Table 7. According to the results of the analysis, all levels of education can significantly contribute to rural economic resilience, but there is a difference in the degree of impact, with the promotion of rural economic resilience being more significant under high levels of education. The possible reason for this is that higher levels of education are more likely to e-commerce rural factors and realize a knowledge-based economy.

Table 7. Heterogeneity regression results.

variant	(1) the east	(2) central section	(3) western part	(4) high level of education	(5) Low level of education
Index	0.192*** (8.880)	0.506*** (14.890)	0.252*** (7.410)	0.255*** (10.620)	0.197*** (12.420)
_cons	0.147*** (15.920)	0.184*** (22.040)	0.104*** (11.930)	0.084*** (11.490)	0.146*** (22.000)
control variable	Yes	Yes	Yes	Yes	Yes
fixed time	Yes	Yes	Yes	Yes	Yes
Area fixed	Yes	Yes	Yes	Yes	Yes
N	230	138	253	345	345
R2	0.907	0.984	0.926	0.924	0.921

4 MAIN CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

Through empirical analysis, this study finds that rural e-commerce has a significant positive promoting effect on rural economic resilience, and realizes its impact through improving rural labor productivity and agricultural technology progress. In the future, we should continue to deepen the research on rural e-commerce and explore more effective policies and measures to promote the healthy development of rural e-commerce and thus help rural revitalization.

4.2 Recommendations

1. The standardization system of agricultural products should be established and improved, and the quality and standardization of agricultural products should be improved to provide better product support for the development of rural e-commerce. 2. Theoretical research on rural e-commerce should be strengthened, and its operating mechanism, influencing factors and development laws should be deeply discussed to provide more solid theoretical support for practice. 3. The research should pay more attention to the diversified development of rural e-commerce and adopt more abundant research methods, such as quantitative research and mixed method research, so as to have a more comprehensive and in-depth understanding of the development status and trend of rural e-commerce.

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