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Study on the Impact of E-commerce Development on Farmers' Income in Shanxi

Shao Chuting*

Guangxi Normal University, No. 1 Yanzhong Road, Yanshan District, Guilin, Guangxi Province, China

**Corresponding author: 1953057790@qq.com*

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Abstract: The three rural issues involve political security, economic development and social stability. Shanxi province has a large rural population, and e-commerce plays an important role in promoting farmers' income, but there are still problems such as lack of professionals and imperfect infrastructure. A regression model is constructed on the basis of theoretical analysis, and the results show that the development of e-commerce in Shanxi has a significant impact on farmers' income and the regression coefficient is positive, indicating that e-commerce has a positive effect on farmers' income. Granger causality test also shows that there is a causal relationship between the two. Therefore, it is necessary to take measures to promote the development of rural e-commerce in Shanxi, such as increasing policy support and improving infrastructure, in order to realize farmers' income and prosperity.

1. Introduction

The speed and quality of farmers' income growth is a key indicator of China's stable and healthy economic development. How to guide farmers to become rich in the context of rural revitalization is a challenge that must be solved in all regions.

In recent years, the application of Internet technology and network sales platform, between farmers and the modern market to build an efficient communication platform, expanding the sales channels of agricultural products, e-commerce has gradually become an important channel to promote farmers to increase income and wealth.

In recent years, the rapid development of e-commerce in Shanxi Province, greatly promoting farmers to increase income. E-commerce driven by farmers to increase income in the end how big is the magnitude? E-commerce development is how to drive farmers in Shanxi Province to increase income? What are the obstacles in the process? How to crack? This series of questions still need to be studied. Therefore, the article adopts the data of relevant variables in Shanxi Province to study the impact of e-commerce on farmers' income in Shanxi Province and provide feasible suggestions for the development of rural economy in Shanxi Province.

2. Mechanisms for the impact of e-commerce development on farmers' incomes

According to the concept of farmers' income and the theory of transaction costs, the impact mechanism of e-commerce on farmers' income can be analyzed from the two aspects of increasing employment opportunities and directly increasing farmers' income as well as improving the logistics system, reducing transaction costs and indirectly promoting income increase.

2.1. Providing employment opportunities and promoting farmer employment and entrepreneurship.

First of all, the development of e-commerce makes it more convenient for farmers to obtain market information, and through the model of "a cell phone + an ID account", farmers can sell their agricultural products through webcasting without leaving their homes (Liu Na, 2024)[1].Farmers become integrated producers and sellers, which reduces the difficulty of employing farmers and stimulates their enthusiasm for employment(Chen Tingting, 2023)[2].

Secondly, most agricultural products are planted with cyclical seasonality, and the emergence and development of e-commerce allows farmers to learn Internet skills and e-commerce operation knowledge on the Internet (Cao Zengdong, 2024) [3]. To enable farmers to achieve a balance between agriculture, cottage industry and family transportation, to provide farmers with new employment directions and opportunities, to create more part-time jobs, and to promote the transfer and employment of surplus rural labor (Tian Yu, 2024)[4].

2.2. Promoting the construction of rural logistics systems and the flow of information to reduce transaction costs.

Transaction cost is the price that people have to pay in order to carry out economic transaction activities in the market. Firstly, the direct use of network sales pinpoints consumer groups, reduces unnecessary intermediate communication links, lowers transaction costs, and drives farmers to increase their income (Zhang Siyu et al, 2024)[5]; Secondly, the development of the logistics system makes it possible to sell agricultural products, fresh food, fruits and vegetables all over the country, expanding the market for agricultural products and increasing the income of farmers (Lv Yingjie, 2022)[6].

3. Analysis of the current situation of e-commerce and farmers' income in Shanxi Province

3.1. Status of E-commerce Development in Shanxi Province.

As a typical inland rural province, Shanxi Province has a vast rural area and a large population, and the local agricultural products have regional characteristics and are rich in variety, which are loved by consumers in various regions. In recent years, along with the nationwide e-commerce boom, Shanxi Province, in line with this trend, accelerated the development of e-commerce, and achieved remarkable results, but there are still some problems.

As can be seen from Figure 1, e-commerce in Shanxi Province is developing fast, with e-commerce turnover growing from 500 billion yuan in 2018 to 2.1 trillion yuan in 2022, an increase of more than two times; Secondly, in recent years, under the guidance of the cultivation of talents in Shanxi Province, a number of new leading e-commerce enterprises and e-commerce professionals have grown up, playing a significant role in promoting the development of e-commerce to drive and expand the effect of e-commerce, and gradually forming a new situation of flourishing e-commerce with a point to bring a line and a line to bring a surface (Hao Jieying et al, 2023)[7].

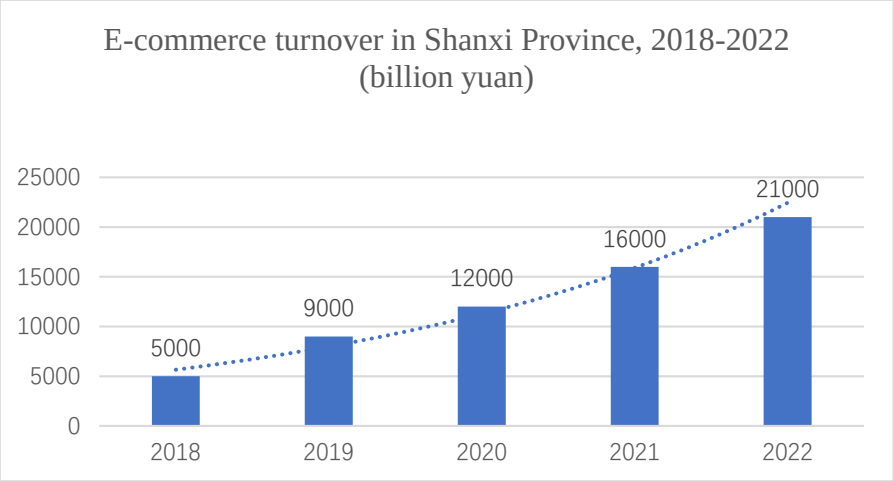

Figure 1: E-commerce turnover in Shanxi Province, 2018-2022 (billion yuan)

But Shanxi Province, there are still some problems with e-commerce, first of all, the sale of agricultural products is still a one-family individual sales model, has not formed industrialization, large-scale, unable to play the agglomeration effect and the scale of the incremental effect (Liu Heng, 2023)[8];Secondly, there is a lack of e-commerce professionals as a support, the complete introduction of talent training model has not yet been formed; finally, the infrastructure is not perfect, especially the logistics and transportation system needs to be further improved (Zhao Qiu Hong, 2024)[9].

3.2. Status of farmers' income in Shanxi Province.

For Shanxi Province, with its large rural population, farmers' income has always been a key issue. In recent years, rural areas in Shanxi Province have seen continuous technological innovation and policy support to achieve sustained growth in farmers' incomes.

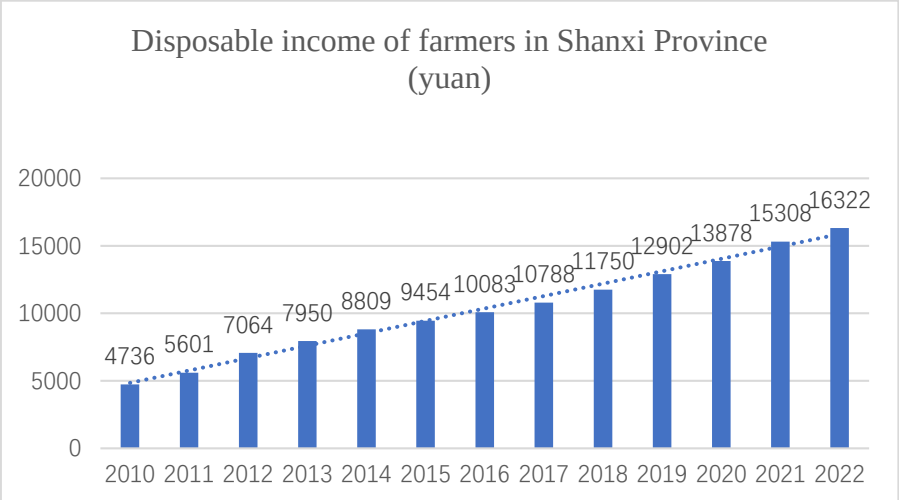

Figure 2: Disposable income of farmers in Shanxi Province (yuan)

Analyzing Figure 2, it can be seen that the disposable income of rural residents has increased from RMB 4,763 in 2010 to RMB 16,322 in 2022, with an overall upward trend year by year. The growth rate has further accelerated after 2019, which may be attributed to the fact that under the leadership of the Shanxi Provincial Government, it has vigorously carried out e-commerce for poverty alleviation, cultivated a large number of backbone e-commerce enterprises for poverty alleviation and

talents, and continuously injected new vitality into the rural economy and the increase of farmers' incomes. It can be seen that the disposable income of rural residents in Shanxi Province is on a year-on-year positive trend (Yuan Chaoyang, 2023)[10].

4. Empirical test of the impact of e-commerce development on farmers' income in Shanxi Province

4.1. Selection and sources of data indicators.

This section provides data measures for the relationship between the two. It begins by describing the data and sources used for the empirical analysis, interprets the key variables, selects and tests the econometric model, and finally analyzes the results of the study.

4.1.1. Variable selection.

Explained variable: per capita income of farmers in Shanxi Province (Y). The per capita disposable income of farmers was taken as the explanatory variable according to the research theme of the article.

Explanatory variable: the level of e-commerce development in Shanxi Province (X1). Most of the existing studies use the number of regional express delivery, e-commerce turnover, or the number of regional Taobao towns and Taobao villages published by the Ali Research Institute as the indicators of e-commerce development. Based on the availability and accuracy of data, the article uses the number of express delivery in Shanxi Province as an indicator of the level of e-commerce development.

Control variables: per capita sown area (X2), number of general and vocational undergraduate graduates (X3), railroad mileage (X4), general public budget expenditures (X5), and regional gross production value (X6) (Jia Chao, 2023) [11].

4.1.2. Data sources.

Table 1: Selected variables and their definitions.

Variable category	variable name	Variable definitions (units)
explanatory variable	Per capita income of farmers	Disposable income of rural residents (yuan)
Core explanatory variables	Level of e-commerce development	Number of express delivery operations for the year (in thousands)
control variable	Sown area per capita	Total area sown in agriculture/number of persons employed in the primary sector (thousands of hectares/ten thousand persons)
	educational level	Number of graduates from general and vocational undergraduate programs (10,000)
	Railroad mileage	Railroad mileage (kilometers)
	Level of financial support for agriculture	Portion of fiscal expenditures in support of agriculture (billions of dollars)
	Level of regional economic development	Gross regional product (million yuan)

Based on the availability of data, the article adopts the data of Shanxi Province from 2010 to 2022 for empirical analysis. The data are mainly obtained through the China Statistical Yearbook, Shanxi Provincial Statistical Yearbook, and the Postal Administration of Shanxi Province Table 1.

4.1.3. Descriptive statistics.

The results of the descriptive statistical analysis are presented in the table 2 below:

Table 2: Descriptive statistics

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
number	13	22,892	23,290	1,479	78,131
income	13	10,357	3,597	4,736	16,322
space	13	3,657	109.4	3,524	3,797
edu	13	19.52	2.833	15.20	24.80
road	13	5,071	1,002	3,752	6,341
revenue	13	3,773	1,238	1,931	5,876
gdp	13	42983	13821	26397	73675

4.2. Empirical analysis.

4.2.1. Smoothness check.

In order to ensure the accuracy of the analyzed results, the original data were first logarithmically processed and then tested for smoothness before the regression was carried out. By analyzing the p-value in the results, it shows that the variables are non-stationary series. So the data was continued to be second order differenced using the ADF test. The results of the test are as follows Table 3:

Table 3: ADF test results

	t-Statistic	**Prob**
D(LNY,2)ADF	-7.288	0.0000.
D(LNX1,2)ADF	-4.849	0.0004
D(LNX2,2)ADF	-4.292	0.0032
D(LNX3,2)ADF	-3.827	0.0152
D(LNX4,2)ADF	-4.703	0.0007
D(LNX5,2)ADF	-3.972	0.0143
D(LNX6,2)ADF	-3.558	0.0336

Analyzing the above ADF test results, it can be seen that: after the second-order differencing, for each variable in this time series, the P-value of the ADF test results of LNY, LNX1, LNX2, LNX3, LNX4, LNX5, LNX6 is less than 0.05 at the confidence interval of 5%, and the original hypothesis is rejected at the confidence level of 5%, which means that the series is smooth and can be next regression analysis.

4.2.2. Multivariate regression analysis.

Multiple regression analysis was carried out on the basis of ensuring that the data of each variable was a smooth series after differential treatment of the data (Zhao, Fang, 2024) [12].

First the regression model equation is established as follows:

$$LNY_t=\beta_0+\beta_1 LNX1_t+\beta_2 LNX2_t+\beta_3 LNX3_t+\beta_4 LNX4_t+\beta_5 LNX5_t+\beta_6 LNX6_t+\varepsilon t$$

Where the explanatory variable is the logarithm of farmers' income LNY, the core explanatory variable is the logarithm of the level of e-commerce development in Shanxi LNX1, the control variables are still LNX2, LNX3, LNX4, LNX5, and εt is a random disturbance term with the subscript t representing the year Table 4.

Table 4: Regression results

Variable	Coefficient	Std.Error	t-Statistic	Prob
LNX1	0.1269016	0.125403	10.12	0.001
LNX2	0.6264226	0.1631604	3.84	0.018
LNX3	0.016281	0.0025635	6.35	0.003
LNX4	0.0000708	0.0000125	10.04	0.001
LNX5	0.0001358	0.0000395	3.44	0.018
LNX6	0.3770738	0.1182296	3.19	0.033
R-squared	0.9883			

The regression equation can be derived from the above:

$$LNY_t=0.126515LX1_t+0.7715262LNX2_t+0.0179563LNX3_t+0.0000717LNX4_t+0.0001358LNX5_t+\varepsilon t$$

By analyzing the above table, in this regression model, the regression coefficient of the level of e-commerce development, i.e., the core explanatory variable LNX1, is 0.126515, and the P-value obtained is 0.005 less than 0.05 and greater than 0 at 5% confidence level, which indicates that the role of e-commerce development in Shanxi Province on the income of the farmers is positive and has significant impact. Meanwhile, the remaining five control variables, at the 5% confidence level, have positive regression coefficients on the explanatory variables, and the P-value is still less than 0.05, which indicates that it also has a positive effect on farmers' income.

4.2.3. Granger causality test.

To further investigate the causal relationship between the two, Granger causality test was conducted (Gao, Wenjing et al, 2023)[13].

Below are the test results Table 5:

Table 5: Regression results

suppose	F-Statistic	Prob
LNX1 does not Granger Cause Y	3.69	0.0869
LNY does not Granger Cause X1	0.62268	0.5251

As can be seen from the above table, the original hypothesis cannot be rejected at the level of confidence interval of 5%, but the P value is 0.0869 which is greater than 0.05 and less than 0.1, indicating that the original hypothesis can be rejected at the confidence level of 10%, i.e., the original hypothesis is considered that there is a causal relationship between farmers' income and e-commerce development. As for the second Granger hypothesis, at the 5% confidence level, the P value is 0.5251, which is much larger than 0.1, and it is not possible to reject the original hypothesis, that is, it is considered that the farmers' income is not the cause of e-commerce development. In this regard, the article concludes that: the impact of the development of e-commerce in Shanxi Province on farmers is a long-term effect, and the short-term is not significant; and the development of e-commerce in Shanxi Province is relatively lagging behind, and in the early stage of development, the causal

relationship between the two is not obvious. However, it is certain that there is a causal link between the development of e-commerce and farmers' income.

5. Conclusions and recommendations for response

5.1. Findings.

From the above regression results, it can be seen that the relationship between e-commerce development and farmers' income is significant and positive at the 5% confidence level. In order to verify the causal relationship between e-commerce development and farmers' income, Granger causality test is used, and there is a certain causal relationship between the two at the 10% confidence level.

5.2. Recommendations for countermeasures.

According to the analysis of the above research, the development of e-commerce in Shanxi Province has a significant positive impact on farmers' income, and the goal of increasing farmers' income and enrichment is realized by promoting the sustainable and healthy development of e-commerce. Focusing on the specific situation of Shanxi Province, suggestions are made in terms of policy, technology and talents.

5.2.1. Increased policy support.

Strengthening guidelines for financial institutions in rural areas and promoting concessions by financial institutions. Increase support for rural policy banks, and utilize the Internet to carry out business processing in the form of combining online applications and offline audits. At the same time, banks are encouraged to reduce lending costs by lowering the lending rate for e-commerce, innovating financial service products and improving the quality of financial products (Zhou Rong, 2024)[14].

With regard to fiscal policy, the role of active fiscal policy has been brought into play, and specific policy recommendations are set out below. First, in terms of fiscal revenue, the government should continue to implement structural tax and fee reduction policies and reduce the tax burden of small and medium-sized e-commerce enterprises in the province and region, or for innovative enterprises with development potential, they can use innovative technological achievements to offset taxes. Second, in terms of fiscal expenditure, the government should strengthen spending on education in all regions and expand the scope of education and provide learning opportunities for farmers who are eager to learn about e-commerce and are interested in working in e-commerce (Zhu Yeliang, 2023)[15].

5.2.2. Improving e-commerce infrastructure.

First of all, for rural areas, it is necessary to smooth the construction of internal roads in rural areas internally, and to improve the transportation channels between urban and rural areas externally. Internally, it is necessary to build a comprehensive and convenient infrastructure to solve the problem of the “last kilometer” of rural transportation, and to provide more convenient transportation facilities for farmers to transport their products (Xie Lijuan et al. 2023) [16].

Secondly, for e-commerce, Shanxi Province need to accelerate the realization of the province's regions and economically developed regions to effectively connect and expand the product sales market. Focus on promoting the construction of highways, the bridges should be built , linking Shanxi Province and Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta, the Belt and Road along the important areas, for the development of e-commerce in Shanxi to provide a broad market space.

5.2.3. Strengthening the introduction and training of professionals.

Shanxi Provice should strengthen the introduction of e-commerce professionals. Regions in Shanxi Province should integrate and utilize resources under the leadership of demonstration zones and demonstration counties, communicate and contact with universities and research institutes in nearby areas, and reach a joint training mechanism, or call for talents to enter the countryside by means of on-line recruitment and special recruitment, so as to form a full chain of talent introduction.

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