WEP Warwick Evans Publishing

International Journal of Global Economics and Management

ISSN: 3005-9690 (Print), ISSN: 3005-8090 (Online) | Volume 4, Number 1, Year 2024
DOI: https://doi.org/10.62051/ijgem.v4n1.41
Journal homepage: https://wepub.org/index.php/IJGEM/index

Study on the Influence of Rural Economic Development on the Export Competitiveness of Agricultural Products

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ABSTRACT

How to influence the export competitiveness of agricultural products from the perspective of rural economic development is a topic worthy of attention. When the rural economy develops, does it have an important impact on the export competitiveness of agricultural products? What is the underlying mechanism? Based on the theoretical analysis of the internal mechanism of rural economic development affecting the export competitiveness of agricultural products, this paper constructs a two-way fixed effect model and systematically examines the impact of rural economic development on the export competitiveness of agricultural products. It is found that the rural economic development significantly promotes the export competitiveness of agricultural products, and this effect is more obvious in developed regions. The mechanism test shows that rural economic development has a positive impact on the export competitiveness of agricultural products through the accumulation of rural human capital.

KEYWORDS

Rural economy; Agricultural products; Export competitiveness

1. INTRODUCTION

The 19th National Congress of the Communist Party of China highlighted that issues concerning agriculture, rural areas, and farmers are fundamental to national economy and people's livelihood. It emphasized the need to prioritize resolving the "three rural" issues and implement the rural revitalization strategy. The level of rural economic development underpins this strategy and directly relates to farmers' living standards. Thus, enhancing the quality of rural economic development, fostering farmers' rural revitalization capabilities, diversifying income sources, and promoting the integrated development of rural primary, secondary, and tertiary industries are crucial.

In recent years, the proportion of agricultural trade in China's international trade has been increasing. The improvement of agricultural products' export competitiveness is crucial for enhancing the quality of export trade. As the cornerstone of the national economy, rural economic development plays a pivotal role in shaping the export competitiveness of agricultural products.

Over the past decades, many developing countries have made remarkable progress in rural economies. However, the extent to which these advancements influence the international competitiveness of agricultural products remains a topic deserving in-depth study. The question of whether rural economic development can enhance agricultural production efficiency, quality, and sustainability, thereby elevating a country's position in the global agricultural market, is of paramount concern to both academia and policymakers. This paper aims to delve into the mechanisms underpinning the

influence of rural economic development on agricultural products' export competitiveness, offering new perspectives and insights for the sustainable development of agriculture and rural economies, as well as contributing to the construction of a more prosperous and sustainable agricultural export system.

2. LITERATURE REVIEW

The relevant literature in this article mainly focuses on the following aspects. First, the coupling and connection of high-quality development of rural economy. Li Haiyang and others used exploratory spatial-temporal data analysis methods and coupling coordination degree models to reveal the spatial-temporal evolution law of high-quality development of rural finance and rural economy. The study found that the high-quality development level of rural finance and rural economy presents a gradient differentiation pattern that decreases from east to west, and there is a north-south differentiation in the co-variation trend of the two in the local spatial structure. The collaborative evolution process between them is stable and there is no antagonistic relationship. The spatial agglomeration pattern of coupling coordination has gradually formed. Based on this, it is suggested to adopt a regional linkage mutual development model and synchronous coordinated development. [1] Lv Yixian 2023 believes that under the background of the rural revitalization strategy, the development of rural vocational education has ushered in an opportunity. Starting from the current situation of the coordinated development of rural vocational education and rural economy, based on the perspective of synergy, this paper clarifies effective countermeasures to promote the coordinated development of the two. [2] Xu Wei 2023 studied the coordinated development of Xinjiang's road transport industry, rural economy and ecological environment based on the coupling theory. The research conclusion found that the coupling degree, coordination degree and coupling coordination degree of the three subsystems of Xinjiang's road transport industry, rural economy and ecological environment showed a fluctuating growth trend from 2011 to 2020. The coordination level experienced a transition from moderate imbalance, imminent imbalance, primary coordination, barely coordination, and imminent imbalance, and then fluctuated between barely coordination and primary coordination. However, in 2020, the coupling coordination faced imminent imbalance mainly due to the impact of COVID-19, which led to slow economic development. From the perspective of coupling development types, it has undergone a transformation from ecological environment-led to highway transportation-led, and then to rural economy-led. From the perspective of the grey correlation of influencing factors, among many influencing factors, the relatively high correlation is between passenger traffic volume and fixed assets investment new production capacity (new roads), urban and rural residents' income ratio and the proportion of the first industry's employees, and forest coverage rate and solid waste generation. [3] Xu Li 2023 et al. constructed an evaluation index system for rural logistics and rural economy in Guangxi from a multi-dimensional perspective of rural revitalization, and used the entropy method to calculate weights for evaluation. At the same time, based on the comprehensive evaluation data, the relationship between rural logistics and rural economy is further demonstrated through the establishment of a coupling coordination model. The research results found that from 2000 to 2019, Guangxi's rural logistics and rural economy have been greatly improved and showed a continuous upward trend, and the interactive relationship between the two has shifted to a good coordinated development level. [4] Liang Huxia 2023 explored the coupling relationship between rural economy and environment under the background of rural human settlement environment improvement based on the perspective of China's provincial regions, analyzed the coordinated relationship between the level of rural human settlement environment and economic development, which is conducive to promoting the development of rural human settlement environment in various provinces, cities and districts towards high quality and harmonious and beautiful direction, and put forward practical policy suggestions. [5] Wang Yuyi 2023, based on the perspective of coupling coordination, defined the concepts of rural informatization, regional rural economy, and collaborative development on the basis of reviewing the research status at home and abroad. Based on the theories

of informatization, economic growth, and synergy, this paper elucidates the mechanism of action between rural informatization and the rural economy. Using the theoretical methods of factor analysis, entropy weight method, comprehensive index method, coupling coordination degree model, gray correlation degree model, and ARCGIS, this paper explores the level of rural informatization and rural economic coordination in 16 prefecture-level cities in Shandong Province and its three economic circles from the perspectives of space-time and correlation from 2011 to 2020. The results show that in terms of time distribution, both rural informatization and rural economic level in Shandong Province have shown an upward trend, and the coupling coordination degree between the two has also entered a mature stage in 2018. In terms of spatial distribution, by 2020, the Jiaodong Economic Circle, the Provincial Capital Economic Circle, and the Lunan Economic Circle have all entered the intermediate coordination stage. Within this context, the Jiaodong Economic Zone is notably influenced by Qingdao City, and the development of each city within the zone is relatively balanced; The radiation effect of Jinan City in the provincial capital economic circle is not significant, and even causes the difference in the level of coordination between cities to increase; The development of the Lunan Economic Circle is relatively balanced. [6] Wang Miao 2023 et al. believe that there is a certain coupling relationship between rural human settlement environment and economic development. Using a coupling coordination model, they analyzed and evaluated the coupling relationship between human settlement environment and economic development. The results showed that the coordination level between rural human settlement environment and economic development in Hebei Province increased year by year from 2011 to 2020, and the relationship between the two became more equal and reasonable [7].

Second, the research on the promotion strategy of agricultural product export competitiveness. Wan Qing 2022 et al. analyzed the export scale and export structure of Chinese aquatic products to Japan, and used the Revealed Comparative Advantage Index and Trade Competitive Advantage Index to study the changing trend of Chinese aquatic products' export competitiveness to Japan in the past decade. They found problems in Chinese aquatic products' exports to Japan and proposed strategies such as addressing non-tariff barriers at night. [8] Li Aini 2022, based on the aquatic product trade data of Dalian from 2011 to 2019, calculated the export competitiveness of Dalian's aquatic products through trade indexes such as resource endowment coefficient, revealed comparative advantage index, and trade competitive advantage index, analyzed the current situation and existing problems of Dalian's aquatic product export competitiveness, and put forward suggestions for the further development of Dalian's aquatic product exports. [9] Song Jingyi analyzed the competitiveness of Sichuan's agricultural product export trade through the TC and PI indices in 2022, and proposed relevant strategies from the aspects of accelerating the transformation and upgrading of agricultural modernization structure, strengthening the training of talents from government, schools and enterprises, and developing diversified markets. This is of great significance for enhancing the competitiveness of China's agricultural products and increasing its international market share [10].

In summary, existing research focuses on the coupling relationship between high-quality development of the rural economy and discusses the path to high-quality development of the rural economy, but there are few studies on the impact of rural economic development on the competitiveness of agricultural exports. In view of this, the possible marginal contributions of this article are as follows: 1. In terms of research perspective, this article builds a time-province panel data based on the current situation of rural economic development to explore the impact of rural economic development on the competitiveness of agricultural exports. 2. In terms of research content, the study examines the impact of rural economic development on the competitiveness of agricultural exports. Using panel data, a benchmark regression model is constructed for empirical testing. The impact of rural economic development on the competitiveness of agricultural exports is studied through the mechanism of rural human capital.

3. THEORETICAL MECHANISMS AND RESEARCH HYPOTHESES

Before analyzing the internal mechanism of rural economic development affecting the competitiveness of agricultural exports, it is necessary to first define the connotations of rural economy and agricultural export competitiveness.

Rural economy refers to an economic structure based on rural land and characterized by agricultural production. Rural economy includes the economic relations, economic activity laws and their application in the process of rural material production, as well as the various economic and social relations generated by farmers as the main body of the rural market in production, distribution, exchange and consumption activities. One of the development directions of the rural economy is to improve the international competitiveness of agriculture, including the competitiveness of agricultural product exports. The export competitiveness of agricultural products refers to the ability of agricultural products to win price advantages, product quality control, technical level, and service level over other countries' agricultural products in international trade. The export competitiveness of agricultural products not only includes the price of agricultural products themselves, but also includes agricultural production, quality control, and logistics distribution. The competitiveness of agricultural product exports is mainly affected by factors including production technology, product quality, production efficiency, and cost control.

Due to constraints in natural conditions, there are significant differences in the management models, development, and business models of crops in rural areas. Most farmers rely on existing land and other natural resources for production, with an aging workforce and limited research on high-quality agricultural production. They tend to rely on experience-based production methods, and the proportion of new technology farmers in the rural workforce is low, resulting in relatively weak competitiveness in agricultural exports. At the same time, agricultural enterprises are more likely to be located in areas with developed transportation and advantages in agricultural production, which can also lead to lower production efficiency and lower recovery rates. The development of rural economy will further improve the rural living environment, optimize the efficiency of agricultural capital allocation, bring more technology and capital, improve the production efficiency of agricultural products, reduce the production cost per unit of agricultural products, and enhance the competitiveness of agricultural product exports. Based on the above analysis, this article proposes hypothesis 1 to be tested.

H1: The development of rural economy will improve the competitiveness of agricultural product exports.

China's agriculture is in an important period of supply-side structural reform, and the support of emerging technologies such as drone-based pesticide spraying, farmland water sensors, and water-saving irrigation plays an important role in increasing agricultural production. Farmers are the main users of agricultural equipment, and the level of technical skills of researchers and developers determines the efficiency of the use of advanced equipment and high-tech technologies. The improvement of rural human capital level can have a positive effect on the production process and efficiency of agricultural products, resulting in a decrease in the production cost per unit of agricultural products. In international trade, the higher the efficiency of agricultural production factors, the lower the cost, the more advantageous the price, and the stronger the international competitiveness in the market. Therefore, the improvement of the quality of rural human capital can enhance the competitiveness of agricultural exports. Based on the above analysis, this article proposes hypothesis 2 to be tested.

H2: Rural human capital plays a moderating role in the impact of rural economic development on agricultural product export competitiveness, that is, the positive impact of rural economic development on agricultural product export competitiveness will continue to increase with the improvement of rural human capital, and vice versa.

4. NDICATOR DESCRIPTION AND MEASUREMENT MODEL

4.1. Indicator Description and Data Source

In terms of sample selection, national data were selected as much as possible. Due to the serious lack of relevant data in Tibet and Shanghai, they were excluded from the sample. For the parts with less missing data, linear interpolation was used to compensate, and finally balanced panel data from 2010 to 2021 were obtained. The specific variables are shown in Table 1.

Table 1. Indicator Description

	Variable name	variable symbol	data source
Dependent variable	Competitiveness of agricultural product exports	eci	Ministry of Commerce, Statistical Yearbook
Explanatory variables	The level of rural economic development	lneco	Statistical Yearbook
control variable	Development level of digital economy	ict	Statistical Yearbook
	Economic scale of agriculture, forestry, animal husbandry and fishery	gzb	Statistical Yearbook
	Trade openness	open	Statistical Yearbook
	Financial expenditure level	lnfin	Statistical Yearbook
	Utilization level of foreign investment	lnfdi	Statistical Yearbook
Intermediary variable	Rural human capital	aedu	Statistical Yearbook

(1) Explanatory variable

Competitiveness of agricultural product exports(eci): This article draws on the approach of Li Chaolin in 2023, using the eci index to represent the export competitiveness of agricultural products [11]. The data mainly comes from the China Statistical Yearbook and provincial and municipal statistical yearbooks. Through data collection, processing and analysis, an indicator system was constructed, and the agricultural product export competitiveness index was published as follows:

$$eci_{it}=(export_{it}/\sum_{i=1}^{n} export_{it})/(gdp_{it}/\sum_{i=1}^{n} gdp_{it}) \quad (1)$$

exportit represents the export volume of region i in year t, and gdpit represents the gross domestic product of region i in year t.

(2) Core explanatory variables

The level of rural economic development(lneco) is represented by the per capita disposable income of rural residents, drawing on the approach of Li Hongwen et al. in 2022 [12].

(3) Control variables

Considering that the export competitiveness of agricultural products will also be affected by other factors, we select the level of digital economy development (ict), trade openness (open), fiscal expenditure level (lnfin), utilization of foreign investment level (lnfdi), and scale of agriculture, forestry, animal husbandry, and fishery economy (gzb) as control variables to control for other factors that may affect the changes in the export competitiveness of agricultural products in various provinces.

Development level of digital economy (ict). The digital economy can not only provide more choices and channels for the sales of agricultural products, but also solve the problem of financing difficulties in agricultural production, and reduce the cost of agricultural product export trade. Through e-commerce platforms, agricultural product exporters can easily understand the market demand at home and abroad, and consumers can also easily understand product information [11].

Trade openness (open). The level of opening up to foreign trade is related to the level of participation in international trade, directly affecting the convenience of export and indirectly affecting the competitiveness of agricultural exports. This article refers to the practice of Guo Feng et al. in 2013, using the ratio between the foreign trade volume of each province and the gross domestic product of the province as an important indicator to measure trade openness [13].

The level of regional fiscal expenditure (lnfin). The level of regional fiscal expenditure reflects the performance of local government fiscal functions, and government intervention indirectly affects the competitiveness of agricultural product export trade. This article uses the proportion of general government budget expenditure to regional GDP to measure the level of regional fiscal expenditure.

The level of foreign investment utilization (lnfdi). Foreign enterprises' investment in agricultural production not only promotes local agricultural production and improves production efficiency, but also stimulates enterprises engaged in agriculture to increase capital investment and improve the competitiveness of agricultural product exports.

Economic scale of agriculture, forestry, animal husbandry and fishery (gzb). Referring to Zhou Huixuan's approach in 2023, using the proportion of GDP in agriculture, forestry, animal husbandry and fishery to GDP to measure, the size of the indicator indicates that the agricultural economy is relatively strong, which can reduce market dependence and improve the competitiveness of agricultural exports [14].

(4) Intermediary variables

Rural Human Capital (lnaedu). Rural human capital is related to whether agricultural products can be produced with high quality, and agricultural professionals have a significant impact on improving the competitiveness of agricultural exports. This article refers to the 2020 approach of Zhan Xinyu et al., using the proportion of college students in the total rural population as rural human capital, and selecting the number of college students in the undergraduate and graduate programs as the final proportion of rural human capital, which is used as an intermediary variable [15].

4.2. Measurement Model

To verify the impact of rural economic development on the competitiveness of agricultural exports, the econometric model is set as follows:

$$eci_{it}=a_0+a_1lneco_{it}+a_2Control_{it}+\mu_i+\mu_t+\varepsilon_{it} \quad (2)$$

Where, i and t represent the year and region respectively, eciit represents the export competitiveness of agricultural products, Ecoit represents the level of rural economic development, Cit is a control variable, μi is the individual fixed effect, μt is the time fixed effect, and εit is the random error term.

Table 2. Descriptive statistics of variables

Variable	N	Mean	SD	Min	Max
eci	348	0.78	0.90	0.01	7.25
lneco	348	9.27	0.61	8.11	10.99
lnagdp	348	7.12	1.26	4.02	8.98
ict	348	0.29	0.10	0.11	0.58
gzb	348	0.15	0.21	0.01	1.04
open	348	0.05	0.08	0	0.90
lnfin	348	8.13	0.85	5.18	9.81
lnfdi	348	3.55	1.73	-3.51	5.88
aedu	348	0.06	0.06	0.01	0.28

(Note: Competitiveness of Agricultural Product exports= eci, The level of rural economic development= lneco, ln (Rural Human Capital) = lnagdp, Rural Human Capital= aedu, Digital Economy Development= ict, Trade Openness = open, Fiscal Expenditure Level = lnfin, Utilization of Foreign Investment level = lnfdi, and scale of agriculture, forestry, animal husbandry, and fishery economy = gzb)

5. EMPIRICAL RESULTS AND ANALYSIS

5.1. Benchmark Regression

Table 3 reports the regression results of the impact of rural economic development on agricultural exports. Among them, column 1 is the result without considering control variables and fixed effects, column 2 is the result with control for city and time fixed effects, and columns 3 and 4 are the results with control variables added to column 1 and 2. The results show that the regression coefficient of lneco is significantly positive in all cases, which indicates to a certain extent that the development of rural economy has significantly improved the export competitiveness of agricultural products, and hypothesis 1 is verified.

Table 3. Benchmark regression results

	(1)	(2)	(3)	(4)
VARIABLES	eci	eci	eci	eci
lneco	0.5277***	0.2263**	0.2802***	0.1043***
	(7.1785)	(2.5649)	(3.7063)	(2.9960)
Control_Var	N	N	Y	Y
Fixed effect	N	Y	N	Y
Observations	348	348	348	348
R-squared	0.1296	0.1927	0.3453	0.6432

(Note: Competitiveness of Agricultural Product exports= eci, The level of rural economic development= lneco, t statistics in parentheses* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$)

5.2. Robustness Test

To ensure the accuracy of the research results, this article further replaces the explanatory variable with the agricultural product TC index Tc and replaces the explanatory variable with the primary industry GDP lnagdp to verify the robustness of the previous conclusions. Table 3 reports the regression results of the impact of rural economic development on agricultural exports. The results show that the regression coefficient of lneco is significantly positive in all cases, indicating that the

development of the rural economy has significantly improved the competitiveness of agricultural exports, and hypothesis 1 is verified.

Table 4. Robustness Test

VARIABLES	(1)	(2)
	Tc	eci
lneco	0.0679**	
	(2.3138)	
lnagdp		0.0409*
		(1.9861)
Control_Var	Y	Y
Fixed effect	Y	Y
Observations	348	348
R-squared	0.1677	0.4042

(Note: Competitiveness of Agricultural Product exports= eci, The level of rural economic development= lneco, ln (Rural Human Capital) = lnagdp, t statistics in parentheses* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$)

5.3. Heterogeneity Analyses

The heterogeneity test in this article mainly answers the following questions: Does the role of rural economy in enhancing the competitiveness of agricultural exports vary significantly across regions? Based on the research of Shen Xiaobo et al. in 2021, the regions are divided into eastern, central, and western regions for heterogeneity analysis. Due to the lack of data in Shanghai, it is excluded.

From the regression results in column 1, 2and 3, the impact of rural economic development on agricultural product export competitiveness in the central and western regions is relatively small, while the promotion effect of rural economic development on agricultural product export competitiveness in the eastern and central regions is more obvious. In contrast, the eastern and central regions are more developed than the western regions, and regions with more developed rural economies have a more significant role in promoting the competitiveness of agricultural exports.

5.4. Mechanism Test

Based on the theoretical analysis above, in order to test the mechanism of rural economic development affecting the competitiveness of agricultural exports, and referring to the approach of Wen Zhonglin et al. in 2004, we use the mediating effect model to test hypothesis 2 on the basis of verifying hypothesis 1:

$$aedu_{it}=b_0+b_1lneco_{it}+b_2Control_{it}+\varepsilon_{it} \quad (3)$$

$$eci_{it}=c_0+c_1aedu_{it}+c_2lneco_{it}+c_3Control_{it}+\varepsilon_{it} \quad (4)$$

Among them, M represents the mediating variable of rural human capital. If rural human capital is an effective way for rural economic development to affect the competitiveness of agricultural exports, the signs of b1 and c1 should be significantly positive, leading to the conclusion that the proportion of mediating effects in the total effect is b1c1/a1.

The improvement of agricultural product export competitiveness cannot be separated from the accumulation of rural human capital. From the regression results in the second column of Table 5, the coefficient of lneco is significantly positive at the 5% level, indicating that the development of the rural economy has played a role in attracting talent. The results in the fourth column of Table 5

show that the coefficients of lneco and aedu are both significantly positive, indicating that the accumulation of rural human capital has promoted the improvement of agricultural product export competitiveness to a certain extent. And after calculation, the contribution of this mediating effect to the total effect is about b1c1/a1=21.03%. Therefore, hypothesis 2 is verified.

Table 5. Heterogeneity Analysis

VARIABLES	(1)	(2)	(3)
	Eastern region	Central region	Western region
lneco	0.0443**	0.1126*	0.2810*
	(2.2763)	(1.9412)	(1.8185)
Control_Var	Y	Y	Y
Fixed effect	Y	Y	Y
Observations	10	8	11
R-squared	0.8754	0.5567	0.3438

(Note: The level of rural economic development= lneco, t statistics in parentheses* p < 0.1, ** p < 0.05, ***p < 0.01)

Table 6. Mechanism Inspection Results

VARIABLES	(1)	(2)	(3)
	eci	aedu	eci
lneco	0.1043***	0.0121*	0.0823***
	(2.9960)	(1.8387)	(3.6532)
aedu			1.8135*
			(2.0030)
Control_Var	Y	Y	Y
Fixed effect	Y	Y	Y
Observations	348	348	348
R-squared	0.6432	0.2162	0.6630

(Note: Competitiveness of Agricultural Product exports= eci, The level of rural economic development= lneco, Rural Human Capital= aedu, t statistics in parentheses* p < 0.1, ** p < 0.05, *** p < 0.01)

6. CONCLUSIONS AND RECOMMENDATIONS

In the context of moving towards common prosperity and domestic and international dual circulation, in-depth analysis is conducive to stimulating the enthusiasm of agricultural production personnel and is of great significance for improving the export competitiveness of agricultural products. This article constructs a benchmark regression model based on 29 provincial panel data from 2010 to 2021 to analyze the impact of rural economic development on the export competitiveness of agricultural products. The study found that the development of rural economy significantly improved the export competitiveness of agricultural products, and this conclusion was supported by a series of robustness tests. The heterogeneity analysis found that the role of rural economic development in enhancing the export competitiveness of agricultural products is related to the level of regional economic development, that is, compared to the central and western regions, the role of rural economic development in enhancing the export competitiveness of agricultural product in the eastern region is more obvious. The mechanism test shows that the development of rural economy mainly has a positive impact on the export competitiveness of agricultural products through the impact mechanism of rural human capital. Based on the above conclusions, the policy implications of this article are:

Increase support for the economy in rural areas and effectively improve the level of rural economic development. The state should increase the construction of rural infrastructure, constantly improve the construction of rural road networks, improve the living environment in rural areas, increase the per capita disposable income of farmers, and effectively safeguard the vital interests of farmers.

Increase investment in rural education. The cultivation of professional talents in agricultural production is related to agricultural production and indirectly to the improvement of the competitiveness of agricultural product exports. The government should encourage higher education institutions to develop professional teaching subjects based on the needs of rural development, offer relevant majors in agricultural production, and cultivate technical talents in agricultural production.

Improve farmers' professional knowledge in agricultural production. Provide training on agricultural production knowledge to farmers, understand the production habits of agricultural products, and conduct targeted training based on actual conditions to improve farmers' professional literacy and help them become agricultural production experts, indirectly improving the competitiveness of agricultural product exports.

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