Academic Journal of Management and Social Sciences
ISSN: 2958-4396 | Vol. 6, No. 2, 2024

Research on the Driving Effect of Digital Economy on the Modernization of Agriculture and Rural Development

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Abstract: To sort out the mechanism of the digital economy supporting the development of agricultural and rural modernization, the panel model is used to empirically analyze the impact and mechanism of the digital economy on the development of agricultural and rural modernization, using panel data of 30 Chinese provinces, autonomous regions, and municipalities from 2011 to 2020 as the research object. Research shows that the digital economy can positively promote the development of agricultural and rural modernization, that is, it has a significant driving effect; Heterogeneity analysis shows that there are regional differences in the driving effect of the digital economy on agriculture and rural areas, showing a development trend of "Northeast > East > Central > West"; Mechanism analysis shows that the level of economic development, the intensity of government support for agriculture, and the level of regional innovation are important paths for the digital economy to drive the development of agricultural and rural modernization. Further research found that the driving role of the digital economy in agricultural and rural modernization is affected by the level of economic development, the intensity of government support for agriculture, and the level of regional innovation, showing a threshold effect. The research findings can offer useful avenues for using the digital economy to propel the growth of agricultural and rural modernization in the future.

Keywords: Modernization of Agriculture and Rural Development; Digital Economy; Regional Economic Level; Government Support for Agriculture; Regional Innovation Level.

1. Introduction and Literature Review

In the report of the 20th National Congress of the Communist Party of China, General Secretary Xi Jinping clearly pointed out that "the most arduous and arduous tasks in building a socialist modern country in an all-round way still lie in rural areas" and "adhere to the priority development of agriculture and rural areas" [1]. In February 2021, the "Opinions of the Central Committee of the Communist Party of China and the State Council on Comprehensively Promoting Rural Revitalization and Accelerating Agricultural and Rural Modernization" pointed out that to solve the problem of unbalanced and inadequate development, the key and difficulty lies in "agriculture, rural areas and farmers". The realization of agricultural and rural modernization is an important part of promoting the Chinese-style modernization process [2]. Agricultural and rural modernization is not only a systemic change linking urban and rural areas, but also an overall reshaping involving agriculture, rural areas, and farmers [3]. With the acceleration of industrialization and urbanization, the problems of unbalanced urban and rural development and insufficient rural development require an urgent understanding and breakthrough. The weak backwardness of rural areas does not meet the needs of modern agricultural production development, the adaptability of the agricultural industry chain structure is poor, and farmers lack motivation to increase income [4] [5] [6]. The No. 1 Central Document of 2023, "Opinions of the Central Committee of the Communist Party of China and the State Council on Comprehensively Promoting Key Works of Rural Revitalization in 2023" clearly pointed out the in-depth implementation of digital rural development actions [7]. One crucial way for China's agricultural and rural modernization to accomplish worldwide "overtaking" is by finding a solution to the problem of "agriculture, rural areas, and farmers" through the growth of the digital economy.

Scholars have a wealth of evidence showing how the digital economy is driving "agriculture, rural areas and farmers" development. They also anticipate that the digital economy will play a role in advancing the modernization of rural regions and agriculture. Relevant research is mainly carried out from the following three aspects: First, research focusing on digital economy and high-quality development of agriculture. The digital economy makes full use of the diffusion and inclusive effects of agricultural information technology to promote agricultural industry integration, broaden the agricultural industry chain, and enhance industrial competitiveness and risk resistance [8] [9] [10]. Realize the optimization of the agricultural industry system, the reconstruction of the agricultural production system, and the efficiency of the agricultural management system [11] [12] [13]. Second, research focusing on digital economy and rural revitalization. The digital economy has the characteristics of "benefiting the poor", increasing farmers' income by increasing self-employment, using financial technology to reshape the rural industrial structure, and assisting the development of rural industry revitalization [14] [15] [16] [17] [18]. Third, focus on research on digital economy and urban-rural integrated development. The digital economy achieves integration with the rural economy by integrating industrial technology and digital technology, and alleviates the information asymmetry problem under the urban-rural dual

system through information technology [19]. The digital economy can accelerate the two-way flow of urban and rural factors and promote urbanization, narrowing the urban-rural "digital divide" and other aspects to promote urban-rural integrated development [20] [21].

But several academics have expressed skepticism. The development benefits brought about by the application of digital technology are unevenly distributed [22]. The digital economy will increase the "digital divide" and contribute to regional imbalances through the "Matthew Effect" [23]. (He Zongyue et al, 2020) constructed a multidimensional poverty index and showed through empirical analysis that the digital economy has increased the unemployment probability of poor residents facing digital disadvantages, especially deepening the multidimensional poverty problem of rural residents [24]. (Li Yi and Ke Jiesheng, 2021) confirmed that the "access gap" of digital infrastructure and the "use gap" of digital technology have triggered a digital divide with the digital "income gap" as the main feature [22]. (He Yaping, 2019) explored the impact of the digital economy on agricultural and rural modernization from the perspective of the Internet from the two dimensions of public policy and dual economic structure. Research shows that the digital economy has exacerbated the urban-rural income gap and cannot help the process of agricultural and rural modernization [25]. At the same time, some studies have shown that the scale of capital owned by farmers is different, and the level of conversion into "Internet capital" is different, resulting in differences in the digital dividends enjoyed by farmers [26].

In summary, there is no consensus about the relationship between agricultural and rural modernization and the digital economy, and the findings of different studies do not corroborate one another. Based on existing research, this article includes the digital economy into the scope of the investigation of factors influencing the development of agricultural and rural modernization, and attempts to answer: Can the vigorous development of China's digital economy drive the development of agricultural and rural modernization? If there is indeed a driving effect between the two, what is its underlying mechanism? At the same time, we will explore whether the driving effect of the digital economy on the development of agricultural and rural modernization is different due to the presence of other influencing factors? Among the studies that are now available, the academics mainly focuses on research on digital economy and high-quality development of agriculture, rural industry revitalization, and urban-rural integrated development [27] [28] [29] [30] [31]. However, research on the development of agricultural and rural modernization from the perspective of digital economy still needs to be expanded. Relevant literature has provided useful inspiration for this article. In view of this, the marginal contribution of this article mainly lies in: first, scientifically and reasonably establishing agricultural and rural modernization evaluation indicators, and using the entropy method to measure the inter-provincial comprehensive agricultural and rural modernization development index; Second, use the two-way fixed effect model and the intermediary effect model to empirically analyze the impact and mechanism of the digital economy on agricultural and rural modernization; Third, the 30 provinces are divided into four parts: the eastern region, the central region, the western region and the northeastern region, and the regional heterogeneity of the digital economy-driven agricultural and rural modernization development is analyzed respectively; Fourth, further analyze the threshold effect of digital economy driving the development of agricultural and rural modernization. The research in this article provides empirical evidence for the digital economy to promote the development of agricultural and rural modernization in China, and provides a new policy perspective for the formulation of relevant policies aimed at improving the level of agricultural and rural modernization.

2. Theoretical Analysis and Research Hypotheses

2.1. Analysis of the Direct Driving Effect of Digital Economy on the Development of Agricultural and Rural Modernization

According to relevant research, agricultural and rural modernization involves three subjects: agriculture, rural areas, and farmers, and its connotation should include two dimensions: agricultural modernization and rural modernization. The digital economy uses digital technology as a means to widely penetrate into various fields of agriculture and rural areas, providing opportunities for the modernization process of agriculture and rural areas. First, when traditional agricultural factors are stable in the long term, regional agriculture can easily approach Pareto optimal efficiency [32]. The Chinese government uses digital governance to remove obstacles to the flow of factors for the development of agricultural and rural modernization. The socialist market economic system guides the comprehensive penetration of digital technology into the agricultural and rural areas through market mechanisms, alleviates the constraints of information asymmetry in the development of agricultural and rural modernization, and promotes traditional agricultural industries. The whole chain upgrade and digital transformation promote the integrated development of urban and rural areas, forming evidence of the macro-driving force of the digital economy on the modernization development of agriculture and rural areas. Second, the digital economy uses digital technology as a means to participate in the entire process of agricultural production, gradually disintegrating the strict boundaries between physical labor and mental labor in agricultural production. At the same time, the digital economy is gradually integrated into the entire agricultural production industry chain, helping to expand the division of labor and specialization, and enable small farmers and agricultural-related enterprises to form closer vertical cooperation relationships [33]. Third, the digital economy incorporates technology and holistic governance ideas into the rural governance structure, promotes the transformation of the rural governance model from one unit to multiple subjects, improves the quality and sustainability of the rural environment, and realizes the modernization of the rural governance system. The above forms evidence of the micro-level driving force of the digital economy on the development of agricultural and rural modernization. In view of this, this article proposes the following hypothesis:

Hypothesis H1: The digital economy can significantly drive the development of agricultural and rural modernization.

2.2. Analysis of the Driving Mechanism and Threshold Effect of Digital Economy on the Development of Agricultural and Rural Modernization

To deeply analyze the internal mechanism of digital economy driving the development of agricultural and rural modernization, this article starts from three aspects: First, the mechanism of economic development level. There is a linkage mechanism between the digital economy and the improvement of regional economic level [34].

The digital economy accelerates the flow of financial factors in the agricultural and rural fields, improves the allocation efficiency of agricultural production resources and agricultural total factor productivity, realizes the matching of supply and demand in the agricultural and rural fields, strengthens rural economic development, improves the balanced level of the regional economy and the quality of economic development, and ensures the development of agricultural and rural modernization with financial support, thus advancing the modernization process. Second, the government's mechanism to support agriculture. Digital technology can innovate government governance models and force the evolution of traditional agricultural industry policies. The government has increased its support for agriculture, rural areas, and farmers, increased financial support for rural digital infrastructure construction, promoted the extension of digital technology to rural areas, effectively promoted the sustainable development of agriculture and rural areas, and provided policy guarantees for the modernization of agriculture and rural areas. Third, regional innovation level mechanism. Based on the theory of technological empowerment, agricultural technology can reshape the rural development pattern from the three levels of individuals, families, and villages [35]. The radiation effect of the digital economy can drive the innovation level of marginal coverage areas and provide technical support for the modernization of agriculture and rural areas. The digital economy strengthens the in-depth integration of agriculture with the secondary and tertiary industries through regional economic development levels, government support for agriculture, and regional innovation levels, and promotes the multi-directional extension and diversified expansion of the agricultural industry chain. The driving effect of digital economic development on agricultural and rural modernization may be affected by the level of economic development, the intensity of government support for agriculture, and the level of regional innovation, and may have non-linear effects. In view of this, the following hypothesis is put forward:

Hypothesis H2a: The digital economy improves the development level of agricultural and rural modernization by promoting the level of economic development, government support for agriculture and regional innovation levels.

Hypothesis H2b: There is a threshold effect in the driving role of digital economy in the development of agricultural and rural modernization.

2.3. Analysis of Regional Heterogeneity in the Development of Agricultural and Rural Modernization Driven by Digital Economy

Due to the influence of multiple factors such as geographical environment, policy support and capital endowment, the regional economy of each province and city presents a spatial gradient pattern. In the early stages of the development of the digital economy, due to differences in factor endowments between regions, the level of digital economy in developed areas will develop first, forming a "trickle-down effect" [36]. The "digital dividends" that different locations experience is not uniform and vary in size. The characteristics of regional imbalance are demonstrated by the disparities in the development of the digital economy, which indicate a declining tendency in space from east to west [37]. In particular, the central and western regions are limited by spatial and geographical factors, and their digital economic development level is relatively lagging behind, and their sensitivity to market changes is relatively low. The macro-level agricultural factor allocation effects, opening-up effects, and micro-level economies of scale and long tail are stronger in areas with developed digital economies than they are in the central and western regions with less developed digital economies [38] [39]. The integration of digital economy and agricultural and rural modernization development still faces bottlenecks such as weak digital infrastructure, shortage of digital economy talents, and imperfect data sharing systems. In view of this, the following hypothesis is put forward:

Hypothesis H3: There is regional heterogeneity in the driving effect of the digital economy on the development of agricultural and rural modernization.

2.4. Theoretical Framework

Based on the above theoretical analysis, the theoretical framework of this article is constructed, as shown in Figure 1. This article measures the level of agricultural and rural modernization from the two dimensions of agricultural modernization and rural modernization, and summarizes the connotation of agricultural and rural modernization into "three modernizations and four levels", namely, the modernization of the agricultural industry system, the modernization of the agricultural production system, the modernization of the agricultural management system, and the modernization of rural infrastructure; construction level, rural ecological environment construction level, rural social and cultural development level and rural governance capacity modernization level. The digital economy can rely on the core driving force of digital technology to act in the agricultural and rural areas, or provide financial support to the agricultural and rural areas by pooling financial resources to directly drive the development of agricultural and rural modernization [40]. The three indirect driving mechanisms through which the digital economy drives the development of agricultural and rural modernization are as follows: First, the digital economy provides financial guarantee for the development of agricultural and rural modernization by improving the level of economic development; second, the digital economy increases government support for agriculture and provides policy guarantee for the development of agricultural and rural modernization; third, the digital economy improves regional innovation level, providing technical support for the development of agricultural and rural modernization. At the same time, there may be one or more thresholds for the indirect driving mechanism of the digital economy.

3. Research Design

3.1. Model Setting

Based on the above theoretical analysis, the basic test model set in this article is as follows:

$$Modern_{i,t} = \alpha_0 + \alpha_1 Digit_{i,t} + \alpha_i Control_{i,t} + \mu_i + y_i + \varepsilon_{i,t} \quad (1)$$

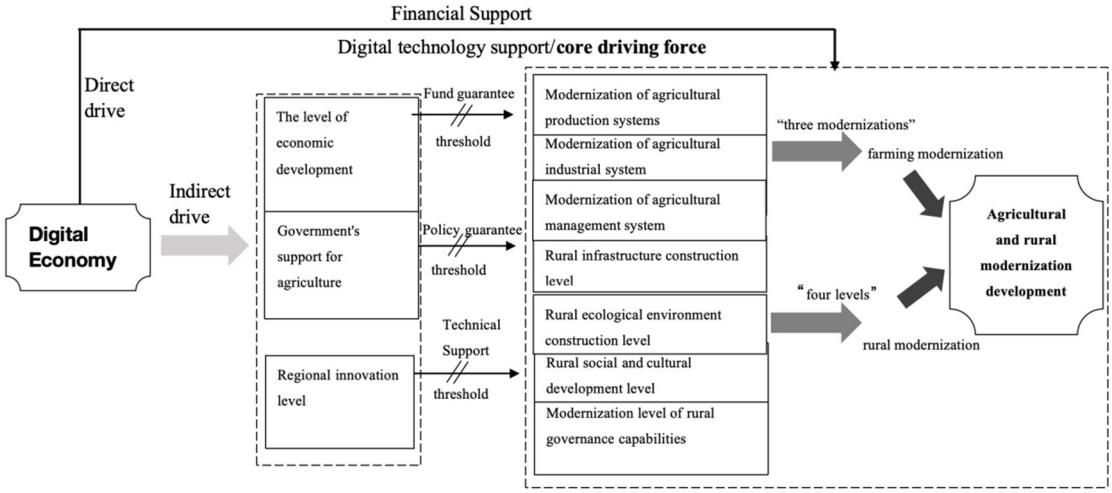

Figure 1. Theoretical framework of digital economy driving agricultural and rural modernization development

Among them, i and t represent province and time respectively. $Modern_{i,t}$ represents the level of agricultural and rural modernization and is the core explained variable of this article. $Digit_{i,t}$represents the level of digital economy and is the core explanatory variable of this article. $Control_{i,t}$ represents control variables, including urbanization level, human resources level and production efficiency level. $\mu_i$is the individual fixed effect.$y_i$is the time fixed effect.$\varepsilon_{i,t}$is the random disturbance term.

In order to test the intermediary effect of digital economy driving the development of agricultural and rural modernization, this article conducts a mechanism test based on model (1) and draws on Wen Zhonglin's research [41]. The mechanism of action model is set as follows:

$$Media_{i,t} = \beta_0 + \beta_1 Digit_{i,t} + \beta_i Control_{i,t} + \mu_i + y_i + \varepsilon_{i,t} \quad (2)$$

$$Modern_{i,t} = \varphi_0 + \varphi_1 Digit_{i,t} + \varphi_2 Media_{i,t} + \varphi_i Control_{i,t} + \mu_i + y_i + \varepsilon_{i,t} \quad (3)$$

Among them,$Media_{i,t}$are intermediary variable, including the level of economic development, government support for agriculture and regional innovation level.

3.2. Variable Selection

3.2.1. Explained Variable ($Modern_{i,t}$)

The level of agricultural and rural modernization, which is the core explained variable of this article. There is currently no one construction standard developed by the agricultural and rural modernization indicator system. Nonetheless, there is a general agreement among academics regarding the development level of both agricultural and rural modernization when examining the two aspects of modernization: agricultural and rural. Relevant indicators were constructed on the basis of existing research, and the entropy method was used to determine the comprehensive index of agricultural and rural modernization [42] [43] [44]. The specific indicators are shown in Table 1.

3.2.2. Core explanatory Variables ($Digit_{i,t}$)

The core explanatory variable is the level of digital economy. Drawing on relevant research, from the five dimensions of Internet penetration rate, number of Internet-related employees, Internet-related output, number of mobile Internet users and digital inclusive financial development, the entropy method is used to calculate the digital economy development index [45].

3.2.3. Mediating Variable ($Media_{i,t}$)

(1) Economic development level, measured by GDP per capita ($LnGDP_{i,t}$). (2) The intensity of government support for agriculture ($Gov_{i,t}$) is measured by the proportion of expenditures on agriculture, forestry, animal husbandry and fishery to the added value of agriculture, forestry, animal husbandry and fishery. (3) Regional innovation level ($LnInno_{i,t}$) is measured by the natural logarithm of the number of invention patent applications accepted.

3.2.4. Control Variables ($Control_{i,t}$)

(1) The level of urbanization is measured by the proportion of the permanent urban population in each province to the total population ($Urban_{i,t}$). (2) Human resources level, measured by per capita years of education ($Hum_{i,t}$). (3) The level of production efficiency is measured by the gross production value of agriculture, forestry, animal husbandry and fishery ($Pro_{i,t}$).

3.3. Data Source

This article selects panel data from 30 provinces in China from 2011 to 2020 as a research sample. The original data of this article mainly come from the rural statistical yearbooks of each province, "China Statistical Yearbook", "China Agricultural Machinery Industry Yearbook", "China Rural Statistical Yearbook", etc. The digital financial inclusion index adopts the financial inclusion index jointly developed by the Digital Finance Research Center of Peking University and Ant Financial Group. For missing data, the average annual growth rate or interpolation method is used to fill in the missing data.

3.4. Empirical Testing

3.4.1. Baseline Regression Analysis

First, the benchmark model for this study is selected. Mixed regression model, fixed effect model and random effect model were used for regression respectively. By comparing F test, LM test and Hausman test, the fixed effect model was finally selected as the benchmark regression for subsequent analysis. Secondly, univariate regression analysis was performed. The regression results in columns (1) and (2)

of Table 2 show that regardless of whether two-way fixed effects are added, the results are significant. It can be seen that the digital economy can greatly improve the level of agricultural and rural modernization development. Finally, control variables are added to the model for analysis. Columns (3), (4) and (5) of Table 2 add control variables in sequence: urbanization level, human resources level and production efficiency level, while adding two-way fixed effects. It can be found that the regression coefficient of the digital economy is 0.317, which is significant at the 1% level. This result preliminarily verified hypothesis H1.

Table 1. Agricultural and rural modernization development indicator system

Dimensions	First level indicator	Secondary indicators	Measurement method	Characteristic
Farming Modernization	Modernization of agricultural production systems	Comprehensive level of agricultural mechanization	Total mechanical power per capita (kWh/person)	Positive
		Agricultural facilities level	Total area of facility agriculture/arable land area (%)	Positive
		Agricultural production efficiency level	Labor productivity-gross agricultural output value/rural population (yuan/person)	Positive
			Land productivity-total crop output/crop sown area (yuan/per acre)	Positive
		Agricultural product supply level	Per capita possession of major agricultural products (hectare/person)	Positive
	Modernization of agricultural industrial system	Industrial integration development level	Agricultural product processing industry operating income/gross agricultural output value (%)	Positive
			Total output value of agriculture, forestry, animal husbandry and fishery service industry/total output value of primary industry (%)	Positive
			Annual marketing income of leisure agriculture/total output value of primary industry (%)	Positive
		Agricultural product market construction level	Online retail sales of agricultural products (100 million yuan)	Positive
		Agricultural opening level	Import and export volume of agricultural products/total agricultural output value (%)	Positive
	Modernization of agricultural management system	Crop diversification development level	Grain sown area/total crop sown area (%)	Positive
		Management standardization level	Standardized agricultural fertilizer usage + standardized pesticide usage (kg/ha)	Negative
			Effective irrigation area (thousand hectares)	Positive
		Standardized construction level of farmers' professional cooperative organizations	Number of farmers' professional cooperatives per 10,000 people in rural areas (number)	Positive
Rural modernization	Rural infrastructure construction level	Investment in public facilities	Investment in village public building construction (10 thousand yuan)	Positive
		Water supply security level	Comprehensive water supply production capacity (10,000 cubic meters/day)	Positive
		Degree of electrification	Per capita electricity consumption of rural residents (kWh/person·year)	Positive
	Rural ecological environment construction level	Rural greening degree	Forest cover rate (%)	Positive
		Rural domestic waste disposal situation	Harmless treatment rate of domestic waste (%)	Positive
		Renewable energy utilization	Rural solar water heater ownership/rural population (square meters/person)	Positive
	Rural social and cultural development level	Construction level of cultural and entertainment facilities	Number of township cultural stations/number of townships (%)	Positive
		Fiscal education expenditure level	Local financial education expenditure (100 million yuan)	Positive
	Modernization level of rural governance capabilities	Urban-rural income gap	Rural residents' income/urban residents' income (%)	Positive
		Social security level	Rural minimum living security expenditure (10 thousand yuan)	Positive
		Public service level	Number of village committees (number)	Positive

3.4.2. Robust Test

The robustness check of this article includes the following four steps:

First, the instrumental variable method. Drawing on Huang Qunhui's research, the interaction term between the number of fixed phones per 100 people in 1984 and the amount of national Internet investment in the previous year was selected as the instrumental variable for the development of the digital economy for analysis [46]. The results are shown in column (1) of Table 3. The significance has not changed significantly, indicating that the above research results are robust.

Second, eliminate samples. Due to the imbalance and insufficiency of current economic development, the digital economy may have inconsistent driving effects on agricultural and rural modernization. Therefore, this article excludes the data from the four municipalities of Beijing, Tianjin, Shanghai and Chongqing. The estimation results are shown in column (2) of Table 3. The significance has not changed significantly, indicating that the above research

results are robust.

Table 2. Baseline regression results

Variable	(1)	(2)	(3)	(4)	(5)
$Digit$	0.291***	0.426***	0.321***	0.307***	0.317***
	(6.48)	(2.84)	(3.51)	(3.55)	(3.56)
$Urban$	—	—	-0.006**	-0.006**	-0.007***
			(-2.35)	(-2.33)	(-3.09)
Hum	—	—	—	0.004	0.006
				(0.58)	(0.92)
Pro	—	—	—	—	0.000***
					(2.83)
Constant	0.099***	0.074	0.606***	0.558**	0.649***
	(11.82)	(1.08)	(2.90)	(2.28)	(2.98)
Observations	300	300	300	300	300
Province	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively, the same be**low.**

Third, shrink the tail. Digital economic indicators are winsorized by 1% to eliminate the impact of extreme values on the research results. The results are shown in column (3) of Table 3. The regression coefficient of the digital economy is significantly positive, that is, there is still a positive promotion effect between the digital economy and the development of agricultural and rural modernization, indicating that the above research results are robust.

Fourth, replace the explained variable. The natural logarithm of the level of agricultural and rural modernization is selected, that is, measured by $LnModern$.

The results are shown in column (4) of Table 3. The regression coefficient is 1.070, which is significant at the 1% level, indicating that the above research results are robust.

Table 3. Robustness test results

Variable	(1)	(2)	(3)	(4)
	Instrumental Variable Method	Remove Municipalities	Winsorization	Replace the Explained Variable
$Digit$	0.838***	0.200***	0.245***	1.070***
	(0.261)	(3.51)	(3.57)	(4.44)
$Urban$	-0.005***	-0.005***	-0.008***	-0.003
	(0.001)	(-4.43)	(-7.03)	(-0.62)
Hum	-0.011	0.012**	0.011*	0.041
	(0.009)	(2.55)	(1.79)	(1.51)
Pro	0.000***	0.000***	0.000***	0.000**
	(0.000)	(6.41)	(4.95)	(2.31)
Constant	0.467***	0.203***	0.708***	-2.220***
	(0.111)	(3.20)	(6.07)	(-3.72)
Observations	300	260	300	300
Province Fixed	YES	YES	YES	YES
Year Fixed	YES	YES	YES	YES

3.4.3. Mechanism of Action Analysis

According to the previous theoretical analysis, it can be seen that the digital economy may drive the development of agricultural and rural modernization through three paths: first, the digital economy can drive the development of agricultural and rural modernization by improving the level of regional

economic development; Second, the digital economy can improve the level of agricultural and rural modernization through the government's agricultural support mechanism; third, the digital economy can improve the level of agricultural and rural modernization by improving the level of regional innovation. In this regard, this article uses the level of economic development, government support for agriculture and regional innovation level as intermediary variables to test the transmission mechanism of digital economic development to the development of agricultural and rural modernization. The test results are shown in Table 4. In column (1), the digital economy coefficient is 0.317, which is significant at the 1% level. Columns (2), (4) and (6) in Table 4 respectively show the regression results of the digital economy on the three intermediary variables of economic development level, government support for agriculture and regional innovation level. The regression coefficients are 1.106, 1.798 and 1.052, which are significant at the 1% or 5% level, which shows that the digital economy can promote the level of economic development, government support for agriculture, and regional innovation levels. Column (3), column (5) and column (7) in Table 4 show the results of the joint effect of digital economy and economic development level, government support for agriculture and regional innovation level on the development of agricultural and rural modernization respectively. They are all within 1%. Level is significant.

The above results show that the three intermediary variables can all play a mediating effect, and the level of economic development, government support for agriculture, and regional innovation level play a mediating role in the driving effect of the digital economy on the development of agricultural and rural modernization. The results verified hypothesis H2a.

Table 4. Mediation effect test results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable	*Modern*	*LnGDP*	*Digit*	*Gov*	*Digit*	*LnInno*	*Digit*
Digit	0.317***	1.106***	0.290***	1.798***	0.234***	1.052**	0.331***
	(5.60)	(2.69)	(4.85)	(5.48)	(4.22)	(2.06)	(5.58)
LnGDP	—	—	0.025***	—	—	—	—
			(2.80)				
Gov	—	—	—	—	0.046***	—	—
					(3.17)		
LnInno	—	—	—	—	—	—	-0.013**
							(-2.19)
Urban	-0.007***	0.019***	-0.008***	-0.049***	-0.005***	0.062***	-0.007***
	(-6.64)	(3.06)	(-7.16)	(-6.71)	(-5.00)	(6.63)	(-5.92)
Hum	0.006	0.010	0.006	0.008	0.006	-0.045	0.006
	(1.13)	(0.25)	(1.07)	(0.23)	(1.23)	(-0.85)	(1.00)
Pro	0.000***	0.000**	0.000***	-0.000**	0.000***	-0.000***	0.000***
	(5.63)	(2.31)	(5.04)	(-2.50)	(6.25)	(-4.30)	(4.43)
Constant	0.649***	9.322***	0.420**	4.235***	0.454***	5.579***	0.723***
	(5.79)	(13.18)	(2.56)	(6.09)	(4.56)	(5.41)	(5.92)
Observations	300	300	300	300	300	300	300
Province Fixed	YES	YES	YES	YES	YES	YES	YES
Year Fixed	YES	YES	YES	YES	YES	YES	YES

3.4.4. Heterogeneity Analysis

Because there are differences in the development level of the digital economy and the development level of agricultural and rural modernization in eastern, central, western and northeastern China, the development of agricultural and rural modernization driven by the digital economy may be different in each region. Based on the regional division method of the National Bureau of Statistics, this article divides the country's 30 provinces into four regions: eastern, central, western and northeastern regions, and analyzes the heterogeneity of the development of agricultural and rural modernization driven by the digital economy.

The results of the heterogeneity test are shown in Table 5. The regression coefficients of the digital economy in the four regions are all positive, indicating that the digital economy can drive the development of agricultural and rural modernization. At the same time, there are significant regional differences in the driving level of the digital economy for the development of agricultural and rural modernization, which is manifested as "Northeast > East > Central > West", verifying hypothesis H3. The main reason may be that the Northeast region is located in a plain, has high

levels of agricultural mechanization and agricultural production efficiency, and has a relatively good agricultural production and management system. The eastern region has advantages such as a higher degree of openness to the outside world, marketization level, and complete infrastructure. The driving effect of the digital economy on the modernization of agriculture and rural areas has been released early. Due to the relatively lagging level of digital economy in the central and western regions, the driving effect on agricultural and rural modernization is at a low level.

The impact of the digital economy on the development of agricultural and rural modernization in the western region is not significant. The possible reason is that rural areas in the western region are relatively backward in terms of market construction, opening up and infrastructure. The cost of digital transformation of agricultural production is still high for small farmers. Farmers still have obstacles to the application of digital technology. The degree of digital development in the western region is still relatively low.

Table 5. Regional difference regression results

Variable	(1)	(2)	(3)	(4)
	East area	Central Region	Western Region	North-east area
$Digit$	0.526***	0.431*	0.040	0.563***
	(4.68)	(2.01)	(0.54)	(3.50)
$Urban$	-0.007***	-0.001	-0.001	0.018***
	(-3.63)	(-0.54)	(-0.92)	(3.83)
Hum	-0.036***	-0.011**	0.011**	-0.000
	(-3.78)	(-2.13)	(2.40)	(-0.12)
Pro	0.000***	0.000*	0.000**	0.000***
	(3.91)	(1.90)	(2.40)	(4.46)
Constant	1.023***	0.205**	0.044	-1.122***
	(5.08)	(2.34)	(0.57)	(-3.93)
Observations	100	60	110	30
Province Fixed	YES	YES	YES	YES
Year Fixed	YES	YES	YES	YES

3.4.5. Further Analysis

The digital economy may have a nonlinear effect on the driving force of agricultural and rural modernization development. This article draws on Hansen's research results and sets a single threshold panel regression model as follows [47]:

$$Modern_{i,t} = \emptyset_0 + \emptyset_1 Digit_{i,t} \times I(Q_{i,t} \le \gamma) + \emptyset_2 Digit_{i,t} \times I(Q_{i,t} > \gamma) + \emptyset Control_{i,t} + \varepsilon_{i,t} \quad (4)$$

The multi-threshold panel regression model is set as follows:

$$Modern_{i,t} = \emptyset_0 + \emptyset_1 Digit_{i,t} \times I(Q_{i,t} \le \gamma_1) + \emptyset_2 Digit_{i,t} \times I(\gamma_1 < Q_{i,t} \le \gamma_2) + \cdots + \emptyset_n Digit_{i,t} \times I(\gamma_{n-1} < Q_{i,t} \le \gamma_n) + \emptyset_{n+1} Digit_{i,t} \times I(Q_{i,t} > \gamma_n) + \emptyset Control_{i,t} + \varepsilon_{i,t} \quad (5)$$

Among them, $Digit_{i,t}$is the core explanatory variable; $Q_{i,t}$ represents the threshold variable, including the level of economic development ($LnGDP_{i,t}$), government support for agriculture ($Gov_{i,t}$) and regional innovation level ($LnInno_{i,t}$); γrepresents the threshold value to be estimated. I(·) is an indicator function. If the conditions in the brackets are met, I(·) takes the value 1; otherwise, I(·) takes the value 0.

First, check whether the threshold effect exists. With the help of Bootstrap method, sampling was repeated 400 times. The results are shown in Table 6. Secondly, determine the number of threshold values of the threshold variables selected in this article. The results are shown in Table 7. Finally, the regression effect of the threshold effect is tested, and the results are shown in Table 8.

Both the single threshold test and the double threshold test of the economic development level passed the test ($LnGDP_{i,t}$). The threshold values are 4.5971 and 11.2666 respectively. From the regression results of the threshold effect in column (1) of Table 8, when the economic development level is less than or equal to 4.5971, the digital economy has a negative impact on agriculture and rural areas. The driving effect of modernization development is the strongest. The possible reason is that the digital economy develops faster in areas with relatively backward economic development, especially for low-income rural groups. A large number of academic research results have confirmed this view [48] [49]. When the level of economic development is in the range of [4.5971, 11.2666), the driving effect of the digital economy on the development of agricultural and rural modernization is significantly weakened. The possible reason is that there may be a bottleneck period for the digital economy to promote the

development of agricultural and rural modernization. After passing the bottleneck period, when the economic development level breaks through the threshold of 11.2666, the digital economy can more significantly drive the development of agricultural and rural modernization. There is a non-linear relationship between the digital economy and the development of agricultural and rural modernization.

The single threshold test of the government's support for agriculture ($Gov_{i,t}$) passed the test. The single threshold for government support for agriculture is 0.8889. The threshold effect regression results are shown in column (2) of Table 8. When the government's support for agriculture is less than or equal to 0.8889, the regression coefficient of the digital economy is 0.132, which is significant at the 5% level. When the government's support for agriculture is greater than 0.8889, the regression coefficient of the digital economy increases. When the government's support for agriculture exceeds the threshold, the driving role of the digital economy in agricultural and rural modernization can be greatly enhanced. There is a non-linear relationship between the digital economy and the development of agricultural and rural modernization.

A single threshold test of regional innovation level ($LnInno_{i,t}$) passes the test. The single threshold for regional innovation level is 11.0124. The threshold effect regression results are shown in column (3) of Table 8. The regression coefficient of the digital economy increases significantly when the regional innovation level exceeds 11.0124. The regression results show that when the regional innovation level crosses the threshold, the digital economy can more significantly drive the development of agricultural and rural modernization. There is a non-linear relationship between the digital economy and the development of agricultural and rural modernization.

In summary, the driving effect of digital economic development on agricultural and rural modernization is affected by the level of economic development, the intensity of government support for agriculture, and the level of regional innovation. There is a threshold effect between the two, which verifies hypothesis H2b.

Table 6. Threshold effect test

Threshold Variable	Model	F value	P value	10% critical value	5% critical value	1% critical value	BS times
$LnGDP$	Single threshold model	110.17	0.0050	60.5785	69.5383	98.9802	400
	Double threshold model	205.44	0.0025	31.2195	38.1775	58.7614	400
	Triple threshold model	30.74	0.5525	94.3091	110.9955	152.9970	400
Gov	Single threshold model	125.53	0.0050	50.7468	65.4149	97.4708	400
	Double threshold model	20.51	0.4225	45.9365	64.9507	97.1593	400
$LnInno$	Single threshold model	139.92	0.0000	32.0256	41.1900	62.0483	400
	Double threshold model	39.97	0.0550	29.4789	40.7347	53.4884	400

Table 7. Threshold results

Threshold variable	Threshold	Estimated value	95% confidence interval lower limit	95% confidence interval upper limit
$LnGDP$	γ_1	4.5971	4.5757	4.5981
	γ_2	11.2666	11.2599	11.3014
Gov	γ_1	0.8889	0.7618	1.0885
$LnInno$	γ_1	11.0124	11.0080	11.0184

Table 8. Threshold effect regression results

Variable	(1) lnGDP (Double Threshold)	(2) Gov (Single Threshold)	(3) LnInno (Single Threshold)
$LnGDP \leq 4.5971$	0.406*** (0.0241)	—	—
$4.5971 < LnGDP \leq 11.2666$	0.101** (0.0416)	—	—
$LnGDP > 11.2666$	0.232*** (0.0420)	—	—
$Gov \leq 0.8889$	—	0.132** (0.0479)	—
$Gov > 0.8889$	—	0.293*** (0.0653)	—
$LnInno \leq 11.0124$	—	—	0.147*** (0.0509)
$LnInno > 11.0124$	—	—	0.276*** (0.0638)

4. Research Conclusion and Policy Recommendations

4.1. Analysis Conclusion

This article uses 30 provinces (cities, autonomous regions) in China from 2011 to 2020 as research samples to construct an agricultural and rural modernization index system, and uses a panel model to test the driving effect and mechanism of the digital economy on the development of my country's agricultural and rural modernization. The research conclusions are as follows:

First, the digital economy can have a significant driving effect on the development of agricultural and rural modernization. After a series of robustness tests, this conclusion still holds.

Second, the level of economic development, the intensity of government support for agriculture, and the level of regional innovation play an intermediary role in the driving effect of the digital economy on the development of agricultural and rural modernization. The digital economy can promote the modernization of agriculture and rural areas through three paths: economic development level, government support for agriculture, and regional innovation levels.

Third, there is regional heterogeneity in the driving effect of the digital economy on agricultural and rural modernization. It has a greater promoting effect on the northeastern and eastern regions, followed by the central region, while its effect on the western region is not significant.

Fourth, the threshold test shows that the driving effect of the digital economy on the development of agricultural and rural modernization is a threshold effect, and the digital economy has the most significant driving effect on areas with low levels of economic development. When the government's support for agriculture and regional innovation levels cross the threshold, the digital economy's driving role in the development of agricultural and rural modernization can be greatly enhanced.

4.2. Policy Suggestion

First, promote the deep integration of digital economy and agricultural and rural modernization to achieve sustainable development of agriculture and rural areas. Apply digital technology to all aspects of agricultural production such as farming, sowing, fertilizing, harvesting, transportation and sales, and realize intelligent management and control of agricultural production through digital technology. At the same time, the digital economy should be integrated into the construction process of modern rural areas, such as applying digital technology to monitor and manage the rural environment to improve the quality and sustainability of the rural environment. By achieving deep integration of the digital economy and the growth of agricultural and rural modernization, it can encourage the transition of agricultural production methods into ecological and green directions, as well as the modernization of agricultural production and rural society.

Second, improve the investment support system and technological innovation system for digital transformation, and consolidate the element guarantee and endogenous power guarantee for the modernization of agriculture and rural areas. The rapid development of the digital economy requires government support and promotion. The government should create a good policy environment for the development of the digital economy by formulating relevant policies, increasing investment, and improving scientific and technological support. At the same time, an agricultural and rural information platform should be established to empower the modern development of agriculture and rural areas with digital technologies such as the Internet of Things, cloud technology, and blockchain. Scientific and technological innovation achievements should be integrated into the entire process of the agricultural industry chain and rural governance to achieve rapid transformation of relevant scientific and technological achievements, promote the construction of digital villages, and enable farmers to share digital dividends.

Third, follow the differences in regional geographical environments and promote differentiated development of agriculture according to local conditions. The driving effect of the digital economy in the northeastern and central regions on the development of agricultural and rural modernization has shown considerable potential. The eastern region has certain location advantages and factor conditions, and the digital economy can be quickly integrated into the agricultural and rural areas. All provinces and cities must adhere to the principle of adapting measures to local conditions, develop characteristic modern agriculture based on their own agricultural development levels and regional characteristics, and form a new model of modern agriculture and rural areas that is compatible with their own development.

5. Conclusion

This article begins with the digital economy and explains the theoretical logic of the digital economy's impact on the development of agricultural and rural modernization from seven perspectives: the modernization of the agricultural production system, the modernization of the agricultural industry system, the modernization of agricultural operations, the level of rural infrastructure construction, the level of rural ecological environment construction, the level of rural social and cultural development, and the modernization level of rural governance capabilities. First, this article uses a two-way fixed effect model and a mediating effect model to empirically analyze the impact and mechanism of the digital economy on agricultural and rural modernization. Research shows that the digital economy can drive the development of agricultural and rural modernization and has a significant driving effect. It can be seen that the digital economy has huge potential and market space in promoting the modernization of agriculture and rural areas. At the same time, the digital economy can have a driving effect on the modernization of agriculture and rural areas by leveraging the level of economic development, government support for agriculture, and regional innovation levels. Second, combined with location characteristics, explore the heterogeneous characteristics of the digital economy's impact on the development of agricultural and rural modernization. Research shows that there are regional differences in the driving effect of the digital economy on agriculture and rural areas, showing a development trend of "Northeast > East > Central > West". This conclusion enhances the logic and persuasiveness of the full text. Third, using the level of economic development, government support for agriculture, and regional innovation level as threshold variables, a panel

threshold model is used to test the nonlinear relationship between the digital economy and the development level of agricultural and rural modernization. This research conclusion has important reference value for maximizing the benefits of digitalization. The research in this article also provides empirical evidence that the digital economy promotes the modernization of China's agriculture and rural areas. The study recommends proactively seizing new opportunities for the development of the digital economy, strengthening the penetration of digital technology into the agricultural and rural areas, focusing on using digital technology to support agricultural and rural production and operation activities, and promoting the digital economy to become the core driving force for high-quality agricultural and rural development.

Acknowledgments

Phased results of the National Natural Science Foundation project "Research on the Evolution Mechanism and Path of Cross-border Supply Chain Finance Promoting GMS Industrial Chain Upgrading under Fintech" (72163018).

References

[1] Xi Jinping. Hold high the great banner of socialism with Chinese characteristics and work together to build a modern socialist country in an all-round way - Report at the 20th National Congress of the Communist Party of China [J]. Gazette of the State Council of the People's Republic of China, 2022, No. 1785 (30): 4-27.

[2] Central Committee of the Communist Party of China. Opinions of the State Council on Comprehensively Promoting Rural Revitalization and Accelerating Agricultural and Rural Modernization [J]. Bulletin of the Ministry of Agriculture and Rural Affairs of the People's Republic of China, 2021, No. 209 (02): 6-13.

[3] Gao Qiang, Zhou Li. Strategic connotation, source of motivation and policy choices in building an agricultural power [J]. Zhongzhou Academic Journal, 2023, No. 315 (03): 43-51.

[4] Liu Zhongmin, Cui Yi. "Three Weaknesses" are the root causes of the "agriculture, rural areas and farmers" problems in Jilin Province [J]. Research World, 2008, No. 178 (07): 46+48.

[5] Lu Shan, Li Dan. Research on the green development of agricultural industry chain based on interest game [J]. Journal of Central South University (Social Science Edition), 2018, 24 (06): 124-131+154.

[6] Zhang Cheng, Hong Zheng, Wang Lin. Research on the impact of rural inclusive finance on agricultural industrialization [J]. Journal of Guizhou University of Finance and Economics, 2021 (03): 35-44.

[7] Central Committee of the Communist Party of China. Opinions of the State Council on Comprehensively Promoting Key Works of Rural Revitalization in 2023 [J]. Gazette of the State Council of the People's Republic of China, 2023, No. 1797 (06): 4-10.

[8] Xia Xianli, Chen Zhe, Zhang Huili, Zhao Minjuan. High-quality agricultural development: digital empowerment and implementation paths [J]. China Rural Economy, 2019 (12): 2-15.

[9] Luo Qianfeng, Zhao Qifeng, Zhang Lixiang. The theoretical framework, efficiency-enhancing mechanism and implementation path of digital technology empowering high-quality agricultural development [J]. Contemporary Economic Management, 2022, 44 (07): 49-56.

[10] Guo Yongtian. Make full use of information technology to promote the development of modern agriculture—Australian agricultural informatization and its enlightenment to my country [J]. Journal of Huazhong Agricultural University (Social Science Edition), 2016 (02): 1-8+134.

[11] Wang Lejun, Kou Guangzeng. Some thoughts on promoting the integrated development of primary, secondary and tertiary industries in rural areas [J]. Agricultural Economic Issues, 2017, 38 (06): 82-88+3.

[12] Zhang Xiaowen, Sui Haixia. Innovation practice and reflection on modern agricultural science and technology service system - taking Chengdu as an example [J]. Rural Economy, 2015 (12): 89-93.

[13] Han Xudong, Yang Huilian, Zheng Fengtian. Informatization development of new agricultural management entities in the context of rural revitalization [J]. Reform, 2018 (10): 120-130.

[14] Zhang Biqiong, Wu Wanting. Digital inclusive finance, entrepreneurship and income distribution - an empirical study based on the perspective of urban and rural differences in China [J]. Financial Review, 2021, 13 (02): 31-44+124.

[15] Zhang Xun, Wan Guanghua, Zhang Jiajia, He Zongyue. Digital economy, inclusive finance and inclusive growth [J]. Economic Research, 2019, 54 (08): 71-86.

[16] N. N. Skiter & N. V. Ketko & A. F. Rogachev, et al,. Institutional Poverty as One of the Main Threats to the Digital Economy. International Journal of Sociology and Social Policy. 2021, pp.15-23.

[17] Thorsten Beck, Asli Demirguc-Kunt and Ross Levine. Finance, inequality and the poor[J]. Journal of Economic Growth, 2007, vol. 12, issue 1, 27-49.

[18] Chen Yiming. Mechanism innovation for the integrated development of digital economy and rural industries [J]. Agricultural Economic Issues, 2021, No.504 (12): 81-91.

[19] Hong Yinxing, Ren Baoping. The connotation and approach of deep integration of digital economy and real economy [J]. China Industrial Economy, 2023, No.419 (02): 5-16.

[20] Yao Yuchun, Zhang Jiashi. Political economic analysis of digital economy empowering urban and rural integrated development [J]. Inner Mongolia Social Sciences, 2023, 44 (02): 117-125+213.

[21] Huang Qinghua, Pan Ting, Shi Peihao. The impact of digital economy on the income gap between urban and rural residents and its mechanism [J]. Reform, 2023, No. 350 (04): 53-69.

[22] Li Yi, Ke Jiesheng. Three-level digital divide: income growth and income distribution effects of rural digital economy [J]. Agricultural Technology and Economics, 2021 (08): 119-132.

[23] Liu Huan. How industrial intelligence affects the urban-rural income gap—explanation from the perspective of employment of agricultural migrant labor [J]. China Rural Economy, 2020 (05): 55-75.

[24] He Zongyue, Zhang Xun, Wan Guanghua. Digital finance, digital divide and multidimensional poverty [J]. Statistical Research, 2020, 37 (10): 79-89.

[25] He Yaping, Xu Kangning. The impact of the Internet on the urban-rural income gap: a test based on Chinese facts [J]. Economic Economics, 2019, 36 (02): 25-32.

[26] Qiu Zeqi, Zhang Shuqin, Liu Shiding, et al. From digital divide to dividend difference - the perspective of Internet capital [J]. Chinese Social Sciences, 2016, No. 250 (10): 93-115+203-204.

[27] Cheng Dawei, Fan Qian, Zhou Xuhai. Pattern conception and realistic path of deep integration of digital economy and agriculture [J]. Lanzhou Academic Journal, 2022, No. 351 (12): 131-143.

[28] Fu Huanan, Li Xiaochun. The mechanism and effect of digital economy driving China's agricultural modernization [J]. Journal of South China Agricultural University (Social Science Edition), 2023, 22 (03): 18-31.

[29] Shi Ziteng. The internal mechanism of digital economy driving the revitalization of rural industries - Comment on "Digital Countryside: A New Paradigm for Agricultural and Rural Development in the Digital Economy Era" [J]. International Trade, 2022, No. 491 (11): 98.

[30] Meng Weifu, Zhang Gaoming, Zhao Fengyang. Digital economy empowers rural revitalization: impact mechanism and spatial effect [J]. Research on Financial and Economic Issues, 2023, No. 472 (03): 32-44.

[31] Ji Fujun. The impact of digital economy on the urban-rural income gap - Analysis of the regulatory effect based on the advanced industrial structure [J]. Economic Issues, 2023, No. 522 (02): 35-41.

[32] Chen Guojun, Wang Guoen. Perspective of "flow space" of "Hema Village": Reconstruction of agricultural and rural modernization development driven by digital agricultural economy [J]. Agricultural Economic Issues, 2023, No. 517 (01): 88-107.

[33] Li Wenrui, Zhou Shujun. Changes in my country's agricultural production methods under the background of digital economy: mechanisms, contradictions and solutions [J]. Journal of Xi'an Jiaotong University (Social Science Edition), 2023, 43 (01): 65-73.

[34] Yao Zhiyi, Zhang Yang. Dynamic analysis of the linkage between digital economy and regional economy [J]. Economic Jingwei, 2021, 38 (01): 27-36.

[35] Xu Zhizhong, Zhang Cheng, Liu Zuyun. How can agricultural technology reshape the countryside? —A three-dimensional investigation based on individuals, families, and villages [J]. Rural Economy, 2023, No. 485 (03): 108-117.

[36] Nie Xiuhua, Wu Qing. Research on the spatial spillover effect of digital finance driving the improvement of regional technological innovation level [J]. Contemporary Economic Management, 2021, 43 (12): 85-96.

[37] Lu Yanqin, Fan Tianzheng. Research on spatiotemporal differentiation and influencing factors of China's digital economy development [J/OL]. Journal of Chongqing University (Social Science Edition): 1-14 [2023-04-21].

[38] Wang Kaike, Wu Guobing, Zhang Guijun. Does the development of digital economy improve production efficiency [J]. The Economist, 2020 (10): 24-34.

[39] Zhu Heliang, Wang Chunjuan. Digital economy leads high-quality development of industries: theory, mechanism and path [J]. Financial Theory and Practice, 2020, 41 (05): 2-10.

[40] Dupas P, Robinson J. Savings Constraints and Microenterprise Development: Evidence from a Field Experiment in Kenya[J]. Social Ence Electronic Publishing. 2013, 5 (1): 163-192.

[41] Wen Zhonglin, Zhang Lei, Hou Jietai, et al. Mediation effect test procedure and its application [J]. Acta Psychologica Sinica, 2004 (05): 614-620.

[42] Research group of the Rural Economic Research Department of the Development Research Center of the State Council, Ye Xingqing, Cheng Yu. The connotative characteristics and evaluation system of agricultural and rural modernization in the new development stage [J]. Reform, 2021, No. 331 (09): 1-15.

[43] Jia Jin, Li Xuefeng, Shen Yun. Construction and empirical analysis of indicator system for rural revitalization strategy [J]. Financial Science, 2018 (11): 70-82.

[44] Wang Lina, Li Yushan. Analysis of the impact of the integrated development of rural primary, secondary and tertiary industries on farmers' income and its regional heterogeneity [J]. Reform, 2019, No. 310 (12): 104-114.

[45] Zhao Tao, Zhang Zhi, Liang Shangkun. Digital economy, entrepreneurial activity and high-quality development - Empirical evidence from Chinese cities [J]. Management World, 2020, 36 (10): 65-76.

[46] Huang Qunhui, Yu Yongze, Zhang Songlin. Internet development and manufacturing productivity improvement: intrinsic mechanism and Chinese experience [J]. China Industrial Economy, 2019 (08): 5-23.

[47] HANSEN BE. Threshold effects in non-dynamic panels Estimation, testing, and inference[J].Journal of Econometrics, 1999, 93 (2): 345-368.

[48] Yi Xingjian, Zhou Li. Does the development of digital inclusive finance significantly affect household consumption - microscopic evidence from Chinese households [J]. Financial Research, 2018 (11): 47-67.

[49] Song Min, Liu Xinyu. Research on the mechanism of digital economy empowering agricultural resilience—analysis of intermediary effects based on human capital [J]. Jiangsu Social Sciences, 2023, No. 326 (01): 103-112.