Study on the Boosting Effect of Digital Development on Agricultural Economic Development - the Moderating Effect of Industrial Structure Upgrading

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Abstract: The research focus of this paper is agricultural economic development, and panel data from 31 provinces and cities in China during 2011-2020 are chosen as a sample to explore the boosting effect of digital development on agricultural economic development. We constructs a regression model using the provincial digital digitization development composite index measured by the entropy method as the core explanatory variable, and explores the impact of the moderating effect of industrial structure upgrading on it. The following conclusions were drawn: The improvement of digitalization at the provincial level has a facilitative effect on agricultural economic development. And industrial structure upgrading has a significant negative regulating effect.

Keywords: digitalization, agricultural economic development, industrial upgrade

1 Introduction

The nation's development is greatly impacted by digitalization. According to the Digital China Development Report (2022), the digital economy will contribute 40.6% of China's GDP, which is a significant factor in the country's economic growth. A national consensus for China's development is to speed up the real economy's integration of digital technology as conventional industries continue to undergo digital transformation. Farmers can combine all aspects of agricultural production, distribution, and operation with digital technology, so that rural economic development can change from a crude business model to an intensive business model, enhance the endogenous power of agricultural development, continuously enrich the types of industrial structures for economic development in rural areas, including new agriculture and rural tourism, and realize modernizing and transforming industrial structures. The introduction of digital technology provides more vitality for the development of rural areas, and at the same time is important for expanding demand in the domestic market at a time when the consumer market in China's cities and towns is gradually entering relative saturation. Therefore, studying how digital progress affects rural modernization is important for practical reasons.

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2 Literature Review

In the field of manufacturing, digital information becomes the "standardized" circulation medium in the industry chain, and the manufacturing industry chain will be deconstructed, and smart manufacturing will become mainstream[1,2]. The Chinese manufacturing sector's data mining capabilities are still weak when compared to those of other nations. As a result, it should begin to develop an industrial digital platform to accommodate changing consumer demands in the digital economy[3]..

Digitization in agriculture refers to the application of information technology in agriculture to improve the efficiency and effectiveness of agricultural production, management, and decision-making[4,5]. The development of digitization in a region also contributes to the development of the local agricultural economy[6,7]. Scholars have also conducted some research in this area. Martin Kenney explored the use of digital devices in agriculture, exploring the benefits of five types of platform business models for various players in the Agricultural food system [8]. Olga Vasilieva describes the characteristics of the market and its changes due to digitization, analyzing the dynamics and structure of production of different categories of agricultural enterprises, as well as changes in the number of enterprises from 2016 to 2018, based on the data of the Russian agricultural tabulation for 2006 and 2016[9]. The opposite conclusion has also been proposed by scholars, Mudda, using India as a sample, suggested that digitization may the livelihoods of farmers in some rural India, farmers operate in a complex, diverse, and risk-prone environment and have difficulty accessing information [10].

In summary, there are abundant research results related to the development of traditional industries enabled by new digital dynamics, and most of the existing studies focus directly on the promotion effect of digital development on traditional industries, without including the upgrading effect of industrial structure into the measurement model. We measure the digitization degree in each province of China and to test its contribution to the agricultural economy. This paper will also examine the moderating role of industrial structure upgrading in the path of digitalization's impact on agricultural economic development.

3 Model setting and data selection

3.1 Model Setting

Based on the entropy power approach, this study calculates the overall measure of the development of the province's digital economy, and the specific indicators are selected with reference to the previous study. And the indicator system is constructed using the data shown in Table 1

Table 1 Provincial digital economy development comprehensive index evaluation system construction

Provincial Digital Economy Development Composite Index	Secondary indicators	Indicator content
	Internet penetration rate	Internet users per 100 population
	Number of employees in the Internet industry	Percentage of employees in computer services and software

	Internet-related output	Total telecommunication services per capita
	Number of mobile Internet users	Number of cell phone subscribers per 100 people
	Digital Financial Inclusion	Development China Digital Inclusion Index

In the baseline regression section, this paper uses a Two-Factor Fixed Effects Model, as shown in (1).

$$AE_{i,t} = \beta_0 + \beta_1 DIG_{x,t} + \varphi_c Z_{x,t} + \varepsilon_{x,t} \quad (1)$$

AE is the level of agricultural economic development. DIG is the provincial digital economy development composite index measured by the entropy method above. $Z_{x,t}$denotes a set of control variables.$\varepsilon_{x,t}$denotes the random perturbation term.

This paper introduces advanced industrial structure (IND)as a moderating variable, the specific model is designed, as shown in (2).

$$AE_{i,t} = \beta_0 + \beta_1 \ DIG \ _{i,t} + \beta_2 IND_{x,t} + \beta_3 IND_{x,t} * DIG_{x,t} + \varphi_c Z_{x,t} + \varepsilon_{x,t} \quad (2)$$

3.2 Variable selection and data description

AE is the level of economic development of agriculture. The data of gross agricultural output value released by the Chinese National Bureau of Statistics were used as the explanatory variables. In the robustness test section, the gross agricultural output value index was used as a proxy variable for the explanatory variables for robustness testing.

The explanatory variables, namely the provincial digital economy development integrated index (DIG) measured by the entropy method in the previous section, are standardized and then downscaled for the five secondary indicators to finally arrive at the provincial digital economy development integrated index for each province in China.

The moderating variable is advanced industrial structure (IND), which is calculated as the ratio of the added value of the tertiary industry to that of the secondary industry. For example, Beijing's value added of the secondary industry in 2011 was 375.248 billion yuan, and the value added of the tertiary industry was 1,236.318 billion yuan, so its IND score is 3.29 (= 1,236.318/375.48). The IND (industrial structure) will have an impact on the local agricultural economy and the level of digitalization, which will be discussed in this paper below.

This work also introduces several control variables to lessen the endogeneity of the model, drawing on the current literature: Mechanization of agriculture (MAC), mechanization, and automation in agricultural production can reduce the cost of agricultural production, which is measured in this paper using the total power of agricultural machinery (million kilowatts). Fertilizer inputs (FER) and pesticide use (PES), which is measured using the amount of fertilizer application for agriculture in discounted form (million tons) and the amount of pesticide use (million tons). Plastic film (MUL), which can be used as ground cover to effectively reduce water evaporation and soil erosion, is used in this paper to measure the amount of agricultural plastic film use (t). (ACR), rural arable land is the basis of agricultural production, which is measured in this paper using the total sown area of crops (thousand hectares).

The time period selected for this study is 2011-2020, and the study object is China's 31 provincial administrative units (Hong Kong, Macau, Taiwan, etc. are missing due to data availability). All data in this paper are obtained from the National Bureau of Statistics and the Statistical Yearbook of China and China Rural Statistical Yearbook for the corresponding years from 2011-2020.

4 Analysis of empirical results

4.1 Baseline regression results

A two-way fixed effects model is used for the benchmark regression analysis, as shown in Table 2. Absent consideration of the control variable, the regression analysis of merely the degree of digital development in the model (1) reveals that the level of digitalization increases rural output by 18.41 units for every 0.01 unit. With the introduction of control variables in the model (2), a significant improvement in the goodness of fit of the model can be found, with the R-squared improving from 0.493 to 0.605, proving that the selected control variables are reasonable. The coefficient of DIG in the model (2) is 1258.804, which is significantly positive, indicating that digitalization can contribute to the development of the rural economy. Model (3) and model (4) replace the explanatory variables with the index of agricultural gross output value for regression analysis. The coefficient of DIG remains significantly positive and passes the significance test. The total agricultural output value index is utilized as the replacement variable in model (4), and the coefficient of DIG is 3,316.432, meaning that if a region's digitalization index rises by 0.01 points, its total agricultural output value index will rise by 33.16 points. The conclusion that digitization is beneficial for agricultural productivity has thus been verified twice.

The following stages are where digitization specifically contributes to the agriculture economy. At the production level, the digital disclosure and transmission of information on agricultural cultivation and breeding, prices of agricultural products, market demand for agricultural products, financial subsidies, and fiscal policies for the benefit of farmers and the people can make agricultural production more and more accurate and efficient and promote agricultural economic growth. From the financing level, agricultural production requires financial input. Digital inclusive finance using digital technology provides convenient financial support for agriculture, which helps alleviate the credit constraints of agriculture and provides lower-cost financial services for agricultural production.From the sales level, agricultural products are perishable and the traditional complex agricultural products distribution links take a long time. The development of e-commerce within the framework of the digital economy model has created a platform for the sale of agricultural goods while also streamlining the supply chain, both of which encourage the sale of such goods and the expansion of the agricultural economy.

Table 2 Baseline regression results

	model1	model2	model3	model4
DIG	1,841.171***	1,258.804***	3,316.432***	2,818.615***
	(16.45)	(8.01)	(14.64)	(11.34)

control variable		√		√
Constant	1,388.390***	-544.379	688.680***	-400.174
	(47.98)	(-1.57)	(24.66)	(-1.65)
Observations	310	279	186	186
R-squared	0.493	0.605	0.582	0.655

4.2 Moderating effect of industrial structure upgrading

This paper examines the regulatory role of industrial structure upgrading in digital development on agricultural economic development. Digital technology can be applied to the processing and value chain extension of agricultural products to promote the transformation of agricultural products from primary processing to deep processing and high-value-added products, and the upgrading of industrial structure plays an important role in this process. It can be seen that industrial structure upgrading has a significant negative moderating effect during the influence mechanism of digitalization for the agricultural economy in Table 3. Possible reasons for this include: 1.Regions with a high share of tertiary industries tend to focus more on the development of services and modern industries, while the agricultural economy accounts for a relatively small share of their overall industrial structure. Under such circumstances, governments and enterprises may be more inclined to apply digital technologies to services and modern industries, and invest less in digital development in agriculture, resulting in a weaker promotion of agricultural digitalization. 2. Areas with a high proportion of tertiary industries tend to be more urbanized, while infrastructure development in rural areas may be relatively lagging behind. The application of digital technology in agriculture requires good network coverage and communication facilities, and in some rural areas, these infrastructures may not be well developed yet, which affects the advancement of digital development in agriculture.

Table 3 Tests of the moderating effect of industrial structure upgrading

VARIABLES	y
DIG	1,963.855***
	(7.81)
IND	299.677***
	(3.27)
DIG#IND	-578.566***
	(-5.25)
Constant	-503.767
	(-1.53)
Observations	279
control variable	√
R-squared	0.646

5 Conclusions

The panel data of 31 provincial administrative units in China for the period 2011-2020 were used as a sample for empirical analysis and discussion. The empirical results of this paper show that: The improvement of digitalization at the provincial level has a catalytic effect on agricultural economic development.

Improve network coverage, communication capabilities, and digital infrastructure conditions in rural areas through strengthening digital infrastructure construction. To enable farmers to more effectively utilize technology and enhance management and efficiency of agricultural production, provide training in digital technology.

Using the characteristic agricultural industries and unique geographical resource conditions in the western region, we will promote the digital transformation of agriculture with local characteristics, promote the fine management and economical use of agricultural water in the western region, increase support for the R&D and application of agricultural digital technology, promote advanced agricultural digital technology, and improve the efficiency and quality of agricultural production.

Combine digital development in rural areas with industrial transformation and upgrading to promote e-commerce development in rural areas. Establish a rural digital platform to integrate information on agricultural production, processing and sales, and provide a full chain of agricultural services, as shown in Fig. 1

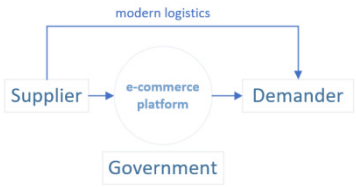

Fig. 1. An example of digitization for transformation in agricultural trading

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