

Research on the Effect of E-Commerce Adoption on Improving the Economic Welfare of Chinese Farmers under the Background of Digital Economy

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Abstract

As an important economic mode in the era of digital economy, e-commerce can have a significant impact on the rural economy. E-commerce of agricultural products has become a new driving force to promote agricultural industrialization, digitalization and increasing farmers' income. By taking into account the sample selection bias and heterogeneity, a multiple regression model is used to measure the economic welfare of Chinese farmers who participate in e-commerce, and finds that investing in e-commerce of agricultural products helps increase the income of agricultural businesses, but it is not as significant as the effects of land area, labor, brand building and other factors on income at this stage. However, the positive impact of adopting e-commerce of agricultural products on farmers' income will increase with the deepening of its absorption. Especially in its advanced stage, the network scale effect will be gradually released. The diminishing marginal cost also enhances the effect of e-commerce of agricultural products on income.

Keywords

Digital Economy; E-Commerce Adoption; Farmer Benefits; Economic Welfare.

1. Introduction

The digital economy has developed rapidly in recent years. It refers to the economic activities and structures that rely on digital technology. Digital technology is essential for the digital economy. E-commerce uses network and computer technologies to create a networked business platform for enterprises and individuals. It is a typical form of the digital economy. E-commerce in China has developed rapidly, but there is still room for improvement. Especially the vast rural market. There is still great potential for development. The rural market will be a new direction for e-commerce competition in the future.

In the context of the digital economy, the development of e-commerce is already a key point that must be paid attention to for the rural economy. E-commerce sinking into the rural market has achieved some results. In many rural areas, e-commerce shopping has become a norm. Many areas have established logistics networks. Through the Internet and e-commerce platforms, smallholder farmers can obtain timely and effective information such as agricultural policies, market prices and consumer feedback. They can also arrange production and operation scientifically. Moreover, they can sell their products beyond geographical boundaries and access a wider market.

With the further development of digital information technology, the rise of the digital economy and the implementation of the rural revitalization strategy, e-commerce as an important mode of the digital economy can have a significant impact on rural economic development. The adoption of e-commerce by Chinese farmers has also become a research hotspot in academia. In the current economic context, the theory of this project is of great significance.

2. Literature Review

With the rapid development and adoption of digital technology in agriculture, the academic and practical circles have paid more and more attention to the innovation and evaluation of agricultural management models that use Internet technology, e-commerce technology, blockchain and other digital tools. Before rural e-commerce was implemented, the academic community did not discuss too much what kind of “digital dividend” the adoption of e-commerce technology would bring to farmers. They focused more on topics such as “Internet”, “informatization” and “Taobao village”. Nowadays, the state has comprehensively promoted rural revitalization. It has made the development of rural e-commerce one of its key priorities. It has also strengthened its support for capacity building. These measures have highlighted the impact of rural e-commerce on research.

Digital economy is an important and emerging economic mode in China and even the world. In the context of rural revitalization, rural areas need to adopt e-commerce as a way to transform and develop their economies. Despite this, the goal of equal sharing of digital dividends has not been achieved simultaneously (World Bank, 2016). However, there are still digital penetration gaps and digital capability gaps between different countries, urban and rural areas, regions and groups. With the rapid development and comprehensive penetration of the digital economy. The first-level digital divide is characterized by the “access gap” of digital infrastructure. The second-level digital divide is characterized by the “use gap” of digital technology. They are triggering a third-level digital divide that is characterized by the “income gap” caused by digitization (Li Yi, 2021).

There are many common problems for “smallholder farmers” in connecting to “big markets” (Markelova et al., 2009; Wiggins et al., 2010; Poulton et al., 2010). Two of the most prominent problems are information asymmetry and poor sales. Small farmers have difficulty keeping abreast of the market supply and demand and prices of agricultural products. They often base their production arrangements for the new year on the market conditions of the previous year and their own experience. This leads to slow sales. This causes the problem of “increasing production without increasing income”. Even if smallholder farmers learn about this information, poor distribution channels may still leave them with unmarketable or undersold agricultural products in local markets. Agricultural e-commerce relies on modern information technology and the Internet. It has greatly improved the problem of imperfect traditional agricultural information and poor marketing (Poole, 2001).

For rural households that use e-commerce in the context of the digital economy. Studies have identified eight factors, such as farmers’ health status, education level, income structure, family work status and other factors, that have a significant impact on their adoption of e-commerce (Song Ying, 2021). Moreover, e-commerce sales organically connect traditional smallholder farmers with modern large markets. This breaks the traditional trade model of agricultural products. Adopting e-commerce sales has a significant income effect for smallholder farmers (Wu Xiaoting, 2021). For large-scale agricultural professionals. Their expectation confirmation is an important mediator in the process of forming intentions and adopting e-commerce (Cai Bo, 2021). Therefore, the research on the effect of e-commerce adoption on improving farmers’ income and welfare is still a blind spot in academic research.

3. Theoretical Analysis and Research Hypotheses

According to the theory of farmers’ decision-making behavior, the motivation for pursuing benefits is the baton of farmers’ behavior. Only when the expected utility of participating in e-commerce operations is better than that of the marketing channels currently adopted by farmers, and the comparative benefits are weighed, will farmers turn to adopting e-commerce

technology. E-commerce can build virtual markets to increase farmers' incomes by reducing costs, raising prices and expanding markets.

First of all, it benefits from the reduction of production and operating costs. China's rural market tentacles only extend to the township level, and farmers who are not in the agricultural industrialization management organization system often need to take transportation or walk to nearby township or county-level agricultural product markets to sell their products. However, due to the relative inconvenience of public transportation in rural areas and the fixed opening hours of markets, farmers must bear the high transportation costs for them in order to reach the market in time. In addition, farmers in some areas also need to pay marketing expenses such as market booth fees or market management fees to sell in local markets. With the adoption of e-commerce technology, farmers seamlessly transform into independent market operating units. This can achieve two-way docking with consumers, save market search costs and help increase farmers' income.

Second, it benefits from the price elasticity of agricultural products. With convenient technical features, e-commerce can build the use of e-commerce platform into an information center, trading center, direct sales center, price center and experience center. In traditional agricultural trade, farmers determine the selling price based on past experience or passively accept the buyer's price. This simple pricing method will mostly cause two embarrassing situations: either the price of agricultural products does not reach the optimal price and farmers lose potential benefits; or the product is overpriced, the sales volume is not satisfactory and the direct benefit of farmers is damaged. With the openness and information transparency of e-commerce platforms, farmers can understand the market prices of similar agricultural products without threshold, build a dynamic pricing mechanism according to the overall pricing situation of the market, adjust prices synchronously and flexibly according to peer price changes, achieve a premium for agricultural products and increase farmers' operating income.

Finally, it benefited from increased sales of agricultural products. In reality, due to the similarity of natural resource endowments and economic and social environments, coupled with farmers' limited ability to develop the market, farmers in the same region are basically engaged in the production of the same type of agricultural products, resulting in the market scope of direct sales of agricultural products being limited to the local area. In this case, the supply of agricultural products is relatively saturated and the marginal income of farmers selling agricultural products is relatively low. The e-commerce platform has built a virtual agricultural product trading market, which makes up for the uneven distribution of sales channels in the offline market of farmers. The parallel unbounded sales of online and offline integration maximize the boundaries of farmers' trade behavior and can transmit agricultural product information to areas outside the local market circle, filling the vacuum area of product marketing and greatly improving the cross-regional competition of farmers.

Based on this, this paper puts forward a research hypothesis: e-commerce participation can increase the income and welfare of rural households.

4. Study Design

At present, it is generally believed that non-agricultural income and agricultural production operation income are the main sources of income for farmers. Some scholars propose the term "income change", and the academic research on the form of income change of Chinese farmers includes four mainstream change theories: growth slowdown theory, growth lag theory, difference theory, distance expansion theory, and income fluctuation theory. The theory of diminishing growth emphasizes that farmers' income is affected by price and cost factors and their growth will decline from year to year; According to the theory of lagging growth, the growth of farmers' income lags behind economic growth and further intensifies the lagging

development of agriculture; According to the difference theory, the income gap between urban and rural residents is gradually widening and it is expected that the regional income gap will also widen; According to the income fluctuation theory, farmers' income is usually uncertain and fluctuating and e-commerce's contribution to income growth may exceed these four arguments, forming different income growth trends.

4.1. Data Sources

The microdata of this study came from a sampling survey in several counties and cities in Anhui Province, China. Anhui Province has many advantages such as high-quality agricultural products, talent intelligence, high-tech, transportation location, and fully has the basic conditions for carrying out agricultural product e-commerce. Anhui Province has also achieved remarkable results in the process of developing e-commerce of agricultural products, but some areas still face infrastructure constraints due to the uneven economic and social development in various parts of Anhui Province. Compared with the traditional e-commerce provinces in the eastern coastal region, Anhui Province is still relatively lagging behind in developing agricultural e-commerce.

4.2. Variable Selection

It is not difficult to find that when studying the factors affecting income changes, scholars select different main variables according to different research objectives. Through inductive combing, the mainstream of academia determined that the factors related to the change of farmers' income are mainly capital (land, labor, households, etc.), regional environment, national policy support, etc. According to the research needs, this study controlled the relevant variables affecting farmers' income, including the adoption of agricultural products e-commerce, business characteristics, household, and regional environmental advantages.

Table 1. Variable descriptions

Variable groups	The variable name	Measurement basis
Farmer e-commerce adoption	E-commerce spending ratio	The proportion of input to the development of e-commerce of agricultural products as a proportion of total productive expenditure
	Number of e-commerce employees	The number of people in the e-commerce business
Organizational characteristics	Total working population	Annual fixed labor force / average number of cooperative members
	Land per capita	The actual land operation area is divided by the number of acres of annual fixed labor force / the average land of cooperative members
Business characteristics	Type of business	Types of agricultural products produced and operated: 1 = food crops 2 = cash crops 3 = grain crops Both material and cash crops 4 = others
	Funding base	I (the organization) have sufficient funds to sell produce online: 1 = strongly disagree 2 = disagree 3 = general 4 = comparative agreement 5 = strongly agree
	Human capital base	I (a member of the organization) have good skills to sell produce online: 1 = strongly disagree 2 = disagree 3 = general 4 = comparative agreement 5 = strongly agree
Decision maker characteristics	age	Average age level (farmers, cooperatives): 1 = under 25 years old, 2 = 25-35 years old, 3 = 36-45 years old, 4 = 46-55 years old, 5 = 55 years old and above

	educate	Average level of education (farmers, cooperatives): 1 = primary school education 2 = junior high school education 3 = high school / secondary school / secondary vocational education 4 = college and higher vocational education 5 = bachelor degree or above
	gender	Gender of farmer and cooperative president: 0 = female 1 = male
	Political identity	Whether the farmer or the chairman of the cooperative is a member of the Communist Party: 0 = no party or other party, 1 = member of the CCP
	Years of farming	Years of agricultural production (farmers, cooperatives): 1 = within 5 years 2=5-10 years 3=11-15 years 4=16-20 years 5=more than 20 years
Environmental characteristics	Infrastructure environment	Whether there are logistics conditions to support the e-commerce of agricultural products, according to the question "Where I am It is convenient to send goods in the area" to measure: 1 = strongly disagree 2 = disagree 3 = general 4 = comparative agreement 5 = strongly agree
	Policy environment	Whether the government is willing to support organizations selling agricultural products online depends on the question "The government is willing to support me in selling agricultural products online" measured: 1 = strongly disagree 2 = disagree 3 = general 4 = comparative agreement 5 = strongly agree
Brand effect	Agricultural product brands	Whether the agricultural products produced and operated belong to the "three products and one standard" products: 0 = no 1 = yes
Revenue-increasing effect	Average annual household income	It is calculated based on the annual sales revenue of agricultural products (or divided by the number of members).

4.3. Descriptive Statistics of Variables

Table 2. Descriptive statistical results

Variable groups	The variable name	mean	standard
Farmer e-commerce adoption	E-commerce spending ratio	1.706	3.492
	Number of e-commerce	2.951	1.228
Organizational characteristics	Total working population	1.386	1.625
	Land per capita	1.649	1.347
Business characteristics	Type of business	2.271	1.379
	Funding base	3.640	1.732
	Human capital base	3.301	1.656
Decision maker characteristics	age	2.639	0.703
	educate	3.010	0.811
	gender	0.822	0.476
	Political identity	0.140	0.483
	Years of farming	2.018	2.022
Environmental characteristics	Infrastructure environment	3.291	1.842
	Policy environment	2.215	2.102
Brand effect	Agricultural product brands	0.192	0.394
Revenue-increasing effect	Average annual household	5.328	3.566

To collect the relevant data for the above variables, questionnaires were distributed and completed by the participants. The data were then checked for reliability and validity. The descriptive statistics for the final sample are presented in table 2.

4.4. Empirical Testing of Income Impact Models

For e-commerce, we assume that the income determination equation that affects farmers' income has a semi-logarithmic form. Its expression is as follows:

$$\ln INC_{it} = \alpha_0 + \alpha_1 EC_{it} + \alpha_2 OS_{it} + \alpha_3 MS_{it} + \alpha_4 DS_{it} + \alpha_5 ES_{it} + \alpha_6 TE_{it} + \varepsilon_{it}$$

In the above formula, “*i*” represents an individual farmer, “*t*” represents the organization, “*lnINC*” represents the natural logarithm of annual household income, “*EC*” represents the adoption of e-commerce for agricultural products, “*OS*” represents organizational characteristics, “*MS*” represents business characteristics, “*DS*” represents decision-maker characteristics, “*ES*” represents environmental characteristics, and “*TE*” represents brand effect.

The following table shows the regression analysis performed with the data obtained from practice. The regression result of regression 1 is the reference for the benchmark equation, and the regression result of regression 2 is obtained after introducing EC as a variable for farmers' adoption of e-commerce.

Table 3. Results of regression analysis

Variable groups	The variable name	Regression 1		Regression 2	
		Estimate parameters	standard deviation	Estimate parameters	standard deviation
Farmer e-commerce adoption	E-commerce spending ratio	-	-	0.168**	0.021
	Number of e-commerce employees	-	-	0.232***	0.026
Organizational characteristics	Total working population	0.424***	0.107	0.400***	0.109
	Land per capita	0.486***	0.038	0.481***	0.035
Business characteristics	Type of business	0.184**	0.012	0.163*	0.014
	Funding base	0.251***	0.056	0.239***	0.066
	Human capital base	0.241***	0.083	0.240***	0.085
Decision maker characteristics	age	-0.007	0.004	-0.003	0.004
	educate	0.106*	0.030	0.127*	0.041
	gender	0.009	0.035	0.070	0.036
	Political identity	0.197**	0.059	0.202**	0.066
	Years of farming	0.170**	0.040	0.172**	0.044
Environmental characteristics	Infrastructure environment	0.145*	0.051	0.160*	0.063
	Policy environment	0.399***	0.103	0.394***	0.101
Brand effect	Agricultural product brands	0.272***	0.079	0.301***	0.082
F		19.897***		24.365***	
R ²		0.331		0.410	

Note: ***, **, * indicate significant at the 1%, 5% and 10% levels, respectively.

5. Empirical Results and Analysis

From the regression results, after adding the hypothetical variable of agricultural e-commerce in model 2, there was no significant difference between the direction of the estimated coefficient and the significance level of other variables. The R² increased by 0.08, indicating

that agricultural e-commerce had a significant positive impact on income change in the overall sample. All variables were statistically significant except for age and sex of decision-makers, which did not have a statistically significant effect on income. Among them, total labor force and agricultural product brands had large estimated coefficient values, while e-commerce expenditure ratio had the smallest value. Both variables of agricultural e-commerce were statistically significant and in line with the study expectations. However, the number of e-commerce employees was significantly larger than the estimated coefficient of e-commerce expenditure, which showed the importance of e-commerce talents. Political identity and non-farm work experience were statistically significant in both models. The Party membership and rich non-agricultural work experience of agricultural business entity decision-makers had a positive impact on income changes. The variable agricultural brands also showed positive importance in both models, indicating that branded or GI agricultural products were always the main competitive factor in increasing sales and revenue, whether offline or online.

Based on the empirical analysis of whether the introduction of agricultural e-commerce by farmers brings about income growth, the following conclusions are drawn:

Conclusion 1: There is a positive relationship between e-commerce input and the income of agricultural products. Statistical significance results show that the development of agricultural e-commerce has a positive impact on revenue growth for both the total sample and classified samples.

Whether it is regression analysis of the total sample or categorical samples, statistically significant results show the positive impact of agricultural e-commerce on income growth. In the course of our survey in sample areas, we found that many farmers' incomes were much greater after engaging in agricultural e-commerce than when selling agricultural products entirely through traditional channels. Moreover, for some poor villages that have lifted their entire villages out of poverty through e-commerce, the income-increasing effect of e-commerce for agricultural products is obvious. However, although the development of agricultural e-commerce can help increase income, compared with total labor force, per capita land, and agricultural product brands and other factor inputs, the income-increasing effect of e-commerce for agricultural products is not as high as expected.

Conclusion 2: Investment in human capital for agricultural e-commerce has a greater impact on income growth than capital investment.

Empirical results show that increasing investment in talent for agricultural e-commerce has the greatest positive impact on income, exceeding the income-increasing effect of increasing investment in e-commerce by more than two times. This proves the importance of talent in agricultural e-commerce for increasing revenue. In the network economy, data, information, knowledge and other factors have become new labor objects and demand for information workers who can use information networks as labor tools is growing rapidly year by year. A lack of this information can seriously restrict productivity development in an internet environment.

6. Conclusion and Recommendations

6.1. Main Conclusion

The development of e-commerce for agricultural products is conducive to income growth for agricultural business entities, especially investment in human capital for e-commerce, which has a greater effect on increasing income than capital investment in e-commerce. In sample data, each additional unit of human capital investment in e-commerce can bring 16.9% income growth to family farms and large professional households and farmers' professional cooperatives can increase farmers' income by about 8.5%. However, the income-increasing effect of e-commerce investment is currently less than the income obtained from investing in

factors such as land area, labor and brand cultivation. Due to the delay between input and output in e-commerce and high input costs in the early stages of e-commerce, the advantage of reducing transaction costs through e-commerce is largely offset, leading to a phenomenon of 'high input, low return' when adopting e-commerce for agricultural products.

However, as a typical model of the network economy, e-commerce has characteristics such as increasing marginal benefits and gradually increasing network scale effects. With the in-depth development of e-commerce for agricultural products, its income returns will show a multiplier effect. From changes in household income seen in sample data, family farms and large professional households have experienced the greatest increase in income from adopting e-commerce for agricultural products. Although demonstration cooperatives led by enterprises and cooperatives with characteristic agricultural products have higher enthusiasm and better results when adopting e-commerce for agricultural products due to their characteristic approach overall the role of farmers' professional cooperatives in carrying out e-commerce for agricultural products to drive farmers' income growth needs improvement.

6.2. Policy Recommendations

Based on the above research conclusions, in order to maximize the efficiency of e-commerce to benefit farmers, this research puts forward the following policy suggestions.

(1) Use finance as a lever to create a policy environment that supports the development of the rural e-commerce economy. Fiscal policy support should focus on providing subsidies for cultivating characteristic industries, developing e-commerce training, adopting e-commerce technology, and providing financial loans. This will create a sustainable and favorable macro environment for farmers to integrate into the e-commerce supply chain. Financial policy support is crucial and it is recommended to connect all entities in the e-commerce supply chain through agricultural supply chain finance. This will establish a close community of shared interests and promote mutual development.

(2) Mobilize social forces to vigorously carry out the improvement of farmers' e-commerce skills. On the basis of adhering to county e-commerce public service centers or government training services as the main purchasers, encourage multiple entities such as e-commerce companies, e-commerce associations, vocational schools, e-commerce cooperatives, and new agricultural businesses to participate. Jointly build the main resource library of e-commerce technical training, and dynamically optimize the content and time settings of e-commerce training. Fine e-commerce training matching supply and demand to improve training efficiency.

Acknowledgments

This paper is supported by Anhui University of Finance and Economics Undergraduate Scientific Research Innovation Fund (XSKY22021ZD) and National College Student Innovation and Entrepreneurship Training Program(202210378079). The ownership of the research results belongs to Anhui University of Finance and Economics.

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