



Coupling Effect of Digital Economy and Agricultural Modernization

Yuhang Sun

Harbin University of Commerce, Harbin, China

Corresponding author: 15244777316@163.com

Abstract. A mutually reinforcing link may be seen in the rapid expansion of the digital economy and agricultural modernisation in recent years. This essay uses China's time-related data series from 2011 to 2019 as its analysis object. The coupling degree model is used to gauge the degree of coupling between China's digital economy and the growth of agricultural modernization after the weights have been determined using the entropy approach. The study's findings indicate that China's digital economy is expanding quickly, agricultural modernization is progressing steadily, and the relationship between the two is now adversarial. According to the findings, we should step up efforts to encourage the development of digital economy infrastructure, speed up the use of digital technology in agricultural modernization, and speed up the integration of the digital economy and agriculture in order to support rural revitalization and develop a development model that supports the mutual promotion of agriculture and the digital economy.

Keywords: Rural Revitalization, Digital Economy, Agricultural Modernization

1 Introduction

The phrase "digital economy" primarily refers to a set of economic activities that utilize digital knowledge and information as critical production factors, contemporary information networks as significant carriers, and the effective application of information and communication technology as a key driving force for efficiency improvement and economic structure optimization. "We must steadfastly address the issue of 'agriculture, rural areas, and farmers' as the top priority of the work of the whole party, and use the strength of the whole party and society to comprehensively promote rural revitalization and accelerate the modernization of agriculture and rural areas," the CPC Central Committee's No. 1 central document for 2023 stated. The digital economy is expanding at a record-breaking rate in the big data age. The digital economy is driving China's agriculture from traditional agriculture to modern agriculture through integration with agriculture. For the advancement of agricultural modernization and the digital economy in China, research on the development link between these two trends is crucial.

There are few studies on the coupling impact of the digital economy and agricultural modernization, which is the major topic of current study, which primarily focuses on how the digital economy promotes the growth of agricultural modernization. Researchers seldom examine the possibility of reciprocal promotion between agricultural modernisation and the digital economy. The coupling effect model will be used in this study to assess the link between the digital economy and agricultural modernization based on the findings of previous research.

2 Literature Review

In recent years, the digital economy has grown quickly in emerging nations. It can be characterized in three ways: the industry that creates fundamental digital goods, which serves as the foundation of the digital economy, A small segment of the digital economy, or "digitalized economy," is made up of the digital sector plus new digital and platform services. The term "digital economy" refers to the use of information and communication technologies across all sectors of the economy (Bukht 2017)¹. The idea of the "digital economy" This essay will also make use of the notion of a broader digital economy. Asian digital economy refers to business and social transformation and information-driven regional growth changes. Digital business processes are changed through technological innovation, government growth policies and digital entrepreneurship. After the advent of COVID, Asian digital economy has also ushered in new problems (Kai 2020)². Despite the fact that the digital economy has brought about a number of fresh and forward-thinking improvements to company models and economic growth, it has also brought many problems, such as privacy issues. Therefore, it is crucial for government agencies to control how the digital economy develops in order to prevent it from taking a turn that would be detrimental to consumers (Michael, 2021)³. The digital economy can support inclusive and sustainable growth because it improves the quality of life for people and consumers, boosts worker and company productivity, and assists governments in providing essential services to those who need them most (Wermelinger 2016)⁴. Digital networks and communication infrastructures provide a global platform for enterprises and organizations to develop strategies. They also make it possible for cooperation, economical communication, information sharing, and efficiency. The digital economy is leading the way in increasing effectiveness: the more customers an enterprise has, the more efficiently it will attract new users and be able to offer better services at the same price (Baxriddin Jurayevich, M. 2021)⁵.

Modernization usually refers to the change of society or system, which is generally reflected in the meaning of 'progress'. The technological progress of agricultural modernization mainly lies in improving technical accuracy and production efficiency, thereby reducing costs, and the core lies in improving labor productivity, which leads to agricultural modernization. Agricultural activities are directed to more fertile areas of land (Nicholas Parrot 2017)⁶. In terms of agricultural modernization research, (Deichmann 2016) proposed that small farmers in developing countries lack financially sustainable business models in addition to a slight lack of access to

information channels and communication skills. Market differentiation is also one of the factors limiting agricultural modernization. According to (Hossen 2019) ⁷, the degree of agricultural modernization is reflected in the degree of agricultural mechanization, which is measured by the number of tractors per hectare (Carugati 2010) ⁸. Others contend that the emergence of agricultural modernization is a result of the internal organization of agriculture for organizational survival and development, which explains the key endogenous factors that drive agricultural modernisation (Karel 2010) ⁹ believed that the modernization process of the Dutch agricultural system has three development characteristics: rationalization, specialization and expansion of production.

In the investigation of how the internet economy affects the progress of agricultural modernisation, (Rijswijk 2019) ¹⁰ mentioned that if digital technology is used in combination with agriculture, it is necessary to clarify the issue of data property rights to avoid unnecessary transaction costs for agricultural producers. At the same time, the organization needs to think strategically about the digital process, and with the participation of customers and partners, it needs to change on the supply side to provide tailored services. (Small B 2017) ¹¹ mentions that consumer demands are changing in the direction of food safety and sustainable agriculture. The efficiency, efficacy, and transparency of agricultural production are quickly changing because to digital technologies, the nature of agricultural work and labor demand, the structure of agricultural value chains, the scope of agricultural business models, and farmers' lifestyles. The growth of the rural population is greatly aided by mobile applications. Growers can obtain agricultural knowledge through various applications. (aNawab Khan et al 2019) ¹²

3 Research Design

3.1 Theoretical Analysis

Digital technology is the foundation and beating heart of the digital economy. The expansion of the digital economy is aided by the advancement of digital technologies. Modern digital technology has made data a new component of production., which was created through technical innovation. Data, a novel class of production factors, differs from traditional production factors in that it does not obey the rule of declining marginal returns. Data's marginal returns are rising, which raises the value index of the data. The effective distribution of agricultural resources can be enhanced by digital technologies. Agricultural businesses may cut expenses by using modern digital technologies. Agricultural data may also be utilized to create fresh production models.

The connection of the digital economy with agriculture fosters the growth of agricultural modernisation. Integrating with other sectors, using digital technology to increase the production efficiency of conventional industries, the three primary ways that the digital economy fosters the expansion of other sectors are through cutting the production costs of such enterprises. The growth of agricultural modernization may be supported by the integration of the contemporary digital economy with agriculture,

which can boost worker productivity while simultaneously raising production of agricultural goods and decreasing the cost of agricultural products per unit. Through innovative sales strategies like online e-commerce in the process of agricultural product sales, the contemporary digital economy pushes the production of agricultural commodities and agricultural processing products to more clients with more desire to buy. Therefore, by integrating with the whole agricultural industry chain, the digital economy may enhance the production efficiency of agricultural goods and the sales efficiency of products, fostering the growth of China's high-quality agriculture modernisation.

3.2 Data Sources

China's annual time series from 2011 to 2019 are used in this study as sample data. The data are derived from the "China Statistical Yearbook" and the "China Rural Statistical Yearbook."

3.3 Construction of Index System

This work provides an assessment system for both the degree of agricultural modernization and the level of the digital economy based on current research, and then integrates each evaluation index system to create a development system for the coupling of the two.

In this study, the information entropy is employed to express the degree of each index's difference from the others while the entropy technique is used to process the data weight. In order to prevent data units and orders of magnitude from impacting the study findings, the obtained data are first normalized. The information entropy is then determined. The more information the change in the index conveys, the higher the information entropy is. Then determine each index's weight; the higher the weight, the more of an influence the index will have on the total index. The score for each year is then determined. The degree of development for the year is determined by the score.

3.4 Research Methods

The information entropy is used to represent the difference degree of each index in this paper, and the weight is then determined by the difference degree of each index, allowing us to determine each index's relative importance in an objective manner.

The coupling degree model developed in this study is appropriate for China's growth of its digital economy and agricultural modernization: Define the degree of linkage between U_1 and U_2 , the whole stages of agricultural modernization and the digital economy, respectively:

$$C = \left[\frac{U_1 \times U_2}{(U_1 + U_2)^2} \right]^{\frac{1}{2}}$$

The range of values for C , which denotes the degree of coupling between the digital economy and the system's level of agricultural modernization, is $[0,1]$. According to earlier research, when $C = 0$, there is no association between the level of agricultural modernization and the digital economy; when $C = 1$, it shows a favorable coupling between the two. According to relevant research, this range can be divided into four intervals: when $C = 0$ there is a low-level coupling relationship between the digital economy and agricultural modernization; when $C \leq 0.3$ there is an antagonistic stage (i.e., the two compete and are not comparable) between the digital economy and agricultural modernization. When $0.5 < C \leq 0.8$, the relationship between the two is in a running-in phase; when $0.8 < C \leq 1$, there is a strong coupling between the digital economy and agricultural modernisation.

4 Research Results

4.1 China's Digital Economy and Agricultural Modernization Level Measurement and Analysis

Agricultural industrialization has a weight of 0.4815 in Table 1's assessment method for agricultural modernization, followed by agricultural informatization with a weight of 0.2769, and agricultural informatization with the lowest weight of 0.2416. The weight score for industrial digitization in the digital economic evaluation method is 0.4395, and the share of digital industrialization is relatively high at 0.5605.

Table 1. Third grade indexes and weight

Third grade indexes	Weight
Agricultural machinery total power	0.1164
Number of large and medium-sized tractors	0.1252
Electricity consumption of rural whole society	0.1340
Number of rural broadband access users	0.1429
The share of primary industry's added value in GDP	0.1517
The share of primary industry workers in the overall number of workers	0.1605
Total value of output Agriculture, forestry, animal husbandry, and fishing are all examples of industries.	0.1693
Industry added value Scientific research and technology service industry	0.1737
Total post and telecommunication business (comparable price)	0.1868
Software business income	0.2000
Number of Internet users	0.2132
Mobile phones	0.2263

China's digital economy has grown swiftly and steadily since 2011, going from a level of development of 0.064 to 0.832 in 2019. This indicates that China's digital economy has advanced significantly since 2011. China's digital economy composite

index rose quickly, particularly in 2017–2018. The key reason is because the phrase "digital economy" was first used in the 2017 government work report, which significantly assisted China's digital economy's expansion. However, from a trend standpoint, China's digital economy still has a lot of opportunity to develop.

The assessment index of China's agricultural modernization progress level changed somewhat between 2016 and 2018 as a result of the limitations imposed by the natural environment. The degree of agricultural modernisation in China is continually rising and has advanced significantly in the nine years between 2011 and 2019.

Although though China's digital economy is still developing and is initially moving at a somewhat slow pace, this tendency is always being maintained. Even while the degree of agricultural modernization is higher than the digital economy at this point, the pace of development is slower than it is for the Chinese digital industry. After both achieved the same level in 2017, the digital economy outpaced agricultural modernisation and took the lead in its overall development.

4.2 An Examination of the Degree of Coupling Between the Chinese Digital Economy and Agricultural Modernization

In recent years, China's agriculture modernization development level and digital economy's coupling degree have been around 0.49 (see Table 4). A coupling degree between 0.3 and 0.5 defines the antagonistic stage, which means that the rate of agricultural modernization and the expansion of the digital economy are in direct conflict to one another. It demonstrates that there is no overt trend of agricultural modernisation and China's digital economy promoting one another. The data also shows a growing trend in the degree of coupling between China's digital economy and the development of its agricultural sector, indicating a growing dependency between these two economic sectors.

5 Conclusions and Suggestions

5.1 Encourage the development of digital economic infrastructure in rural regions

According to the assessment index system's score findings, China's digital economy has recently experienced a sharp increase in its rate of development and has also produced some impressive outcomes. The index technique used to quantify the degree of the digital economy gives greater weight to the number of Internet users and mobile phone users. In addition, Table 1's data on rural broadband connection carries a particular weight in the approach used to assess the degree of agricultural modernisation. As a result, we should encourage the development of rural digital economic infrastructure, such as the installation of mobile signal base stations, the installation of optical cables, and the inclusion of rural user support centers. We should also boost the number of rural Internet users in China, as well as the number of rural broadband access and users in China. Farmers in China may adapt to the digital economy age and get greater knowledge of digital economy information by bolstering

the building of China's digital economy infrastructure. By taking this action, China may advance its degree of agricultural modernization while also accelerating the growth of its digital economy.

5.2 Promoting digital technology to enable agricultural modernization

At the moment, the majority of digital technology in agriculture in China is still in the production phase. The digitization degree of other links in the industrial chain is low, and the potential of other links in the industrial chain has not been activated. The use of digital information technologies to agriculture, such as remote sensing, geographic information systems, and computer technology, can increase the efficiency of the entire industrial chain, from production to sales. So that China's agricultural output is highly specialized, large-scale, and enterprise, China's agricultural production and sales system must be improved. To realize the "trinity" of agricultural personnel training, agricultural scientific research and agricultural achievement promotion in China, as well as to encourage the establishment of an agricultural e-commerce business in China, improve market promotion operation and logistics efficiency.

5.3 Accelerate the convergence of agriculture and the digital economy

The digital economy fosters the expansion of other sectors by integrating various industries. In order to create a new structure for agriculture, the production and planting industry, the industry that processes agricultural products, and the tertiary industry may all be merged. The expansion of the integration boundary between the digital economy and other agricultural industries, the promotion of new formats, and the full exploitation of the coupling effect between the digital economy and agricultural modernization are all things that need to be done in order to achieve the high level of integration of the digital economy and agriculture. Encourage the growth of rural agricultural products e-commerce marketing, establish a secure environment for such marketing, and nurture professional abilities. Vigorously develop tourism agriculture, create a number of high-quality tourism agricultural service brands, and use digital technology to promote service-oriented agricultural industries such as 'agritainment' and 'picking gardens'.

References

1. Bukht, Rumana and Heeks, Richard, Defining, Conceptualising and Measuring the Digital Economy (August 3, 2017). Development Informatics Working Paper no. 68
2. Il, Kai ; Kim, Dan J. ; Lang, Karl R. et al. / How Should We Understand the Digital Economy in Asia? Critical Assessment and Research Agenda. In: Electronic Commerce Research and Applications. 2020; Vol. 44, No. November–December
3. Spence, Michael, 2021. "Government and economics in the digital economy," Journal of Government and Economics, Elsevier, vol. 3(C).

4. Dahlman, C., S. Mealy and M. Wermelinger (2016), "Harnessing the digital economy for developing countries", OECD Development Centre Working Papers, No. 334, OECD Publishing, Paris,
5. Baxtiyarjon Bulturbayevich, M., & Baxriddin Jurayevich, M. (2021). The Impact of The Digital Economy On Economic Growth. *International Journal of Business, Law, and Education*, 1(1), 4 - 7. <https://doi.org/10.56442/ijble.v1i1.2> (Original work published October 1, 2020)
6. Karlheinz Knickel, Amit Ashkenazy, Tzruya Calvão Chebach & Nicholas Parrot (2017) Agricultural modernization and sustainable agriculture: contradictions and complementarities, *International Journal of Agricultural Sustainability*, 15:5, 575-592, DOI: 10.1080/14735903.2017.1373464
7. Hossen M A. Mechanization in Bangladesh: Way of modernization in agriculture. *International Journal of Engineering Trends and Technology*, 2019, 67(9): 69-77.
8. Carugati, Andrea; Fernandez, Walter; Mola, Lapo; and Cecilia, Rossignoli, " IT Driven Modernization in Agriculture" (2010). All Sprouts Content. 394. https://aisel.aisnet.org/sprouts_all/394
9. Citation for published version (APA): Karel, E. (2010). Modernization of the Dutch agriculture system 1950-2010. In Paper for the International Rural History Conference 2010, University of Sussex, Brighton (UK) 13-16 September 2010
10. Rijswijk K, Klerkx L, Turner J A. Digitalisation in the New Zealand Agricultural Knowledge and Innovation System: Initial understandings and emerging organisational responses to digital agriculture[J]. *NJAS-Wageningen Journal of Life Sciences*, 2019, 90: 100313.
11. Small B. Digital technology and agriculture: Foresight for rural enterprises and rural lives in New Zealand *Journal of Agriculture and Environmental Sciences* December 2017, Vol. 6, No. 2, pp. 54-77 ISSN: 2334-2404 (Print), 2334-2412 (Online)
12. Khan, N., Siddiqui, B., Khan, N., Khan, F., Ullah, N., Ihtisham, M., Ullah, R., Ismail, S., & Muhammad, S. (2020). Analyzing mobile phone usage in agricultural modernization and rural development. *International Journal of Agricultural Extension*, 8(2), 139-147. [doi:https://doi.org/10.33687/ijae.008.02.3255](https://doi.org/10.33687/ijae.008.02.3255)

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

