ISSN: 2692-7608 DOI: 10.6981/FEM.202501_6(1).0010

The Impact of Digital Economy Development on the Technical Sophistication of Manufacturing Exports

Chenyu Wu*, Lingzhi Li

School of Economics and Management, Nanjing University of Science and Technology, Nanjing, China

*Corresponding author: 331842452@qq.com

Abstract

The development of the digital economy is conducive to the digital transformation of the manufacturing industry, thereby enhancing the technological complexity of manufacturing exports. To clarify the relationship between the two, this paper constructs a fixed effects model using data at the provincial level in China from 2013 to 2022. The research results show that the development of the digital economy can promote the enhancement of technological complexity in manufacturing exports, and this effect is stronger in non-eastern regions. Finally, based on the research conclusions, relevant suggestions are proposed.

Keywords

Digital Economy; Manufacturing Exports; Technical Sophistication.

1. Introduction

In recent years, China's manufacturing industry has faced significant challenges. On one hand, China's manufacturing exports are primarily based on processing trade, with low added value and a position at the lower end of the global value chain. On the other hand, with the disappearance of the demographic dividend, the advantage of labor cost is continuously weakening, and China's traditional reliance on mid-to-low-end manufacturing is being increasingly diverted to other developing countries in Asia. To change the extensive growth situation of China's manufacturing exports and break the "low-end lock-in" dilemma, it is necessary to find new drivers for the development of the manufacturing industry, thereby enhancing the technological content of China's manufacturing export products, increasing the added value of manufacturing export products.

At the same time, digital information technologies led by artificial intelligence, the Internet, big data, and blockchain have been widely applied in various fields of society, and the digital economy has ushered in a period of rapid development. According to data from the China Academy of Information and Communications Technology, by 2023, China's digital economy scale had reached 53.93 trillion yuan, accounting for 43% of GDP, indicating the rapid development of China's digital economy and its profound impact on high-quality economic development.

Against this research backdrop, whether the development of the digital economy can empower the transformation and upgrading of China's manufacturing industry, enhance the technological content of manufacturing exports, help the manufacturing industry improve its market competitiveness to better go global, and achieve the industrial transformation and upgrading of China's manufacturing industry is a question that urgently needs to be answered and explored in depth.

ISSN: 2692-7608 DOI: 10.6981/FEM.202501_6(1).0010

2. Literature References

2.1. Research on the Digital Economy

The concept of the digital economy was first proposed by Tapscott (1996), who believed that the digital economy is an emerging economic form that would appear in the future, characterized by representing economic information through digital media. Moulton (1999) considered the digital economy as a product of the future when the economy and computer technology reach a certain stage of development. The development of the digital economy depends on the advancement of information technology and will promote the growth of e-commerce platforms. Mesenbourg et al. (2001) argued that according to the application of digital technology, it can be divided into three parts: digital transaction carriers, digital transaction forms, and digital transaction processes.

2.2. Research on the Export Sophistication

At the beginning of the 20th century, Hausmann and Rodrik (2003) introduced the concept of export complexity in their article and provided a method for calculating it. Building on this, Hausmann et al. (2005) expanded the original method for measuring export technology complexity by incorporating the productivity of export products into the formula. As one of the proposers of export technology complexity, Rodrik (2006) also supplemented the concept of export technology complexity from the perspective of productivity, and through empirical research, found that a region's export technology complexity is highly positively correlated with the region's total factor productivity, indicating that regions with high export technology complexity can be in an advantageous position in international division of labor. Hausmann et al. (2007) later proposed a formula for calculating export technology complexity based on revealed comparative advantage, which greatly improved the measurement of export technology complexity. However, this method did not consider the differences in sub-products and simply used proportions as weights, and ignored the part of export statistics that is processing trade, leading to an overestimation of the results. Some scholars have made improvements to this. For example, Xu (2007) found in his research that using per capita income to calculate export complexity has two measurement biases: on the one hand, using China's overall income level would greatly underestimate the income level of some coastal export areas, and on the other hand, the current export complexity index in research does not consider the differences in product quality, which would lead to an overestimation of China's export technology complexity. Therefore, he recalculated using export region weighted income levels and product unit value differences as proxies for quality differences, and the results showed that the measurement biases had been corrected in the revised calculation method.

3. Theoretical Basis

Transaction cost theory was proposed by the British Nobel laureate in Economics, Coase, in 1937. In this theory, he pointed out that the concept of transaction costs is relative to the general meaning of production costs, referring to the various costs required to reach a transaction. Williamson, in 1975, expanded on this theory, arguing that transaction costs arise due to market failures caused by factors such as human nature and the environment. Based on this, he divided transaction costs into six categories: search costs, information costs, bargaining costs, decision-making costs, monitoring costs, and breach costs. The digital economy, driven by data elements and technologically empowered, can reduce the transaction costs of manufacturing enterprises.

The digital economy reduces the information and search costs for manufacturing enterprises. Information and search costs are not isolated and should not be separated because information generally does not present itself directly; there is usually a search process involved before the

ISSN: 2692-7608 DOI: 10.6981/FEM.202501_6(1).0010

exchange of information. The development of digital economy-related technologies such as the internet and big data has lowered the barriers to market competition for businesses, enabling them to acquire and process information at a lower cost. For manufacturing enterprises, this means they can quickly and accurately understand the development of international advanced technologies and changes in overseas market demands, collect and analyze overseas consumer data more rapidly, and thus effectively adjust product strategies. They can improve technology based on demand changes, design new products, and enhance the technical level of export products to meet consumer expectations.

The digital economy reduces bargaining and decision-making costs. The existence of blockchain and digital currencies has reduced the costs and time of cross-border payments and simplified the procedures. In the past, due to a lack of standards and poor communication, the manufacturing industry has always suffered from the "data silo" phenomenon, leading to inefficient supply chain segments that cannot be effectively integrated and shared. The development of the digital economy has improved the transparency and efficiency of the manufacturing supply chain. Relying on big data technology, manufacturing can build advanced supply chain systems, optimize resource allocation, increase production efficiency, and reduce related costs, thereby breaking the "data silo" and enhancing market price transparency. Consequently, the development of the digital economy can reduce the costs incurred by enterprises in negotiating and bargaining over contract terms such as price. Additionally, the development of the digital economy allows market information to be fully utilized, significantly reducing the degree of market information asymmetry. Information is one of the foundations of decision-making, and more detailed and accurate information enables manufacturing enterprises to make more scientific decisions. The development of digital technologies, especially artificial intelligence and big data analysis, can act as corporate decision consultants, helping manufacturing enterprises quickly formulate, adjust, and optimize corresponding development strategies, reducing interference caused by subjective factors such as human emotions. Their analysis of massive market data helps achieve rapid response to market demands.

4. Empirical Analysis

4.1. Model Construction

The empirical model constructed in this paper is as follows:

$$Expy_{it} = \beta_0 + \beta_1 Ded_{it} + \beta X_{it} + \gamma_i + \lambda_t + \varepsilon_{it} \tag{1}$$

In the model, i represents provinces or regions, t represents years, the dependent variable expy is the technological complexity of manufacturing exports in various regions, which is logged to eliminate the heteroscedasticity caused by different magnitudes. β represents the coefficients of various terms, the core explanatory variable ded represents the level of digital economy development in the region, X represents the selected control variables, γ_i is the province fixed effect, λ_t is the year fixed effect.

4.2. Variable Selection and Explanation

This paper selects foreign direct investment inflow, trade openness, government intervention, the proportion of the secondary industry, and the level of infrastructure construction as control variables for the model.

In the construction of the digital economy indicator system, this paper selects indicators such as optical cable density, internet port access density, per capita telecommunications traffic, per

ISSN: 2692-7608 DOI: 10.6981/FEM.202501_6(1).0010

capita e-commerce sales, and the proportion of corporate e-commerce, and employs principal component analysis for weighting.

4.3. Regression Results

Table 1. Regression Results

	(1)
	expy
ded	0.310***
	(3.580)
fdi	0.015**
	(2.112)
open	0.096*
	(1.912)
inter	-0.312
	(-1.405)
prod	0.284**
	(2.149)
ins	0.169*
	(1.712)
_cons	10.504***
	(72.188)
N	300
r2	0.969
Region	YES
Time	YES

In column (1) of the table, the regression coefficient for the core explanatory variable is 0.310, which is significant at the 1% level. This means that for every one-unit increase in the level of digital economy development, the technological complexity of manufacturing exports can increase by 33%. This indicates that the level of digital economy development in various regions can significantly and positively promote the enhancement of the technological complexity of manufacturing exports, suggesting that the core hypothesis of this paper is valid.

4.4. Heterogeneity Test

Based on the data analysis of regional digital economy and manufacturing export technology complexity as discussed earlier, the eastern region leads other regions in both manufacturing export technology complexity and digital economy development. Therefore, there may be regional heterogeneity between the eastern and non-eastern regions. This paper divides the sample into two groups, the eastern region and the non-eastern region, for regression analysis.

The results in column (1) are the regression results for the eastern region. It can be observed that the significance of the regression coefficient for the digital economy development level in the eastern region has decreased, changing from being significant at the 1% level in the benchmark regression to being significant at the 10% level, while the significance of the regression coefficient for the digital economy development level in the non-eastern region remains consistent with the benchmark regression. Moreover, when comparing the differences in their coefficients, the promotional effect of the digital economy in the non-eastern region is higher than that in the eastern region. This indicates that the role of the digital economy on the technological complexity of manufacturing exports exhibits regional heterogeneity. Based on the data analysis of regional digital economy and manufacturing export technology complexity as mentioned earlier, the eastern region is higher than other regions in both aspects. However,

ISSN: 2692-7608 DOI: 10.6981/FEM.202501_6(1).0010

according to the subgroup regression results, the higher level of digital economy development in the eastern region does not have a stronger promotional effect on manufacturing than the non-eastern region. There are two possible reasons for this situation: First, the development of the digital economy can indeed promote the development of the manufacturing industry in that region, but as the level of digital economy development increases, this promotional effect may exhibit a diminishing return, with the eastern region being in this state, while the digital economy development level in the non-eastern region is in a rapid development phase, providing a stronger impetus for the development of manufacturing. Second, the development of the digital economy to a certain stage will drive the transformation of the industrial structure, leading to an increase in the proportion of the tertiary sector in the gross product, and a decline in the status of manufacturing in that region, which also results in the promotional effect of the digital economy in the eastern region being weaker than in the non-eastern region.

Table 2. Regional Regression Results

	(1)	(2)
	eastern	Non-eastern
ded	0.290*	0.341***
	(1.862)	(3.504)
N	100	200
r2	0.986	0.967
Controls	YES	YES
Region	YES	YES
Time	YES	YES

5. Advice

5.1. Strengthening the Development of Digital Talents

Firstly, universities should take on the responsibility of cultivating digital talents for society. Universities should actively reform their curricula to align with the trends of the digital economy, and reasonably establish interdisciplinary majors to meet the demands for digital technology talents while also equipping students with a background in finance. This requires universities to understand the definition and connotations of the digital economy, establish reasonable procedures for setting up programs, including assessment, review, and piloting. They should also recruit professors who specialize in digital economy research and develop comprehensive training plans to ensure effective student cultivation, so that students can meet the demands of positions related to the digital economy in the job market.

Secondly, universities can also strengthen cooperation with enterprises, including internet and financial companies. Enterprises can provide training objectives, and universities can develop corresponding training plans based on these needs. Together, they can design courses, strengthen theoretical knowledge in schools, and provide practical bases in enterprises to increase students' practical experience, exploring a talent cultivation model that integrates industry, academia, research, and application in the digital economy.

Lastly, the government should also actively introduce and cultivate digital talents. Based on the literature review, the accumulation of human capital can also enhance the technological complexity of regional manufacturing exports. The government can formulate regional digital talent development strategies and goals, provide financial subsidies to universities, enterprises, research institutions, and other digital talent incubators, and increase efforts to cultivate digital talents.

ISSN: 2692-7608 DOI: 10.6981/FEM.202501_6(1).0010

5.2. Optimize the Layout of the Digital Industry

Firstly, regions should improve the construction of digital infrastructure. Local governments should actively promote the construction and upgrading of network infrastructure such as 5G base stations, and start with indicators like internet penetration rate and broadband internet household penetration rate to promote the popularization of digital applications, especially in central, western, and northeastern regions. There should be increased financial investment in the construction of digital infrastructure, with systematic layout of facilities related to "data" and "computing power," to build interconnected digital infrastructure and lay a stable foundation for the development of the digital economy in the region. At the same time, attention should be paid to the construction of digital infrastructure in manufacturing industry parks, so that the development of the digital economy can better drive the transformation and upgrading of manufacturing.

Secondly, regions where the digital economy is lagging should place high importance on the development of the digital economy at the government level. The digital economy should be regarded as an important means to promote high-quality development and cultivate new quality productive forces. Strengthen top-level design and overall planning and formulate comprehensive development strategies for the digital industry according to the specific goals of the country and region. In addition, the government also needs to support local digital economy support industries and strengthen digital industry collaboration with regions where the digital economy is developed, to accelerate the two-way extension of the real economy and the digital economy.

Lastly, regions also need to vigorously promote the integrated development of the digital economy and the manufacturing industry. Data elements are playing an increasingly important role in economic activities; therefore, fully releasing the value of data elements and using data as a factor of production in the production process of the manufacturing industry can promote intelligent manufacturing with the progress of digital technology, achieving the transformation from "Made in China" to "Smart Made in China."

References

[1] Tapscott D. The Digtal Economy: Promise and Peril in the Age of Networked Intelligence[M]. New York: McGraw-Hill, 1996.

[2] Moulton B R .GDP and the digital economy: Keeping up with the changes[J].understanding the digital economy data, 1999.

[3] MESENBOURG TL. Measuring the Digital Economy[J].US Bureau of the Census,2001,1:1-19.

[4] Hausmann R, Rodirk D. Economic development as self-discovery. Journal of Development Economics. 2003, 72(2):603-633.

[5] Hausmann R, Pritchett L, Rodrik D. Growth accelerations[J]. Journal of Economic Growth, 2005, 10(4):303-329.

[6] Rodrik, D. 2006. "What's So Special about China's Exports?" China & World Economy: English Edition, 14(5): 19.

[7] Hausmann R, Hwang J, Rodrik D. What You Export Matters[J]. Journal of Economic Growth, 2007, 12(1): 1-25.

[8] BIN, XU. Measuring China’s Export Sophistication[J]. Working Paper, China Europe International Business School, 2007.