

Digital Trade and the Enhancement of National Export Competitiveness— Evidence from Cross-Country Panel Data

Longzhen Zheng

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

Abstract. The rise of digital trade has triggered profound changes in the pattern of international trade interest distribution and exerted multiple complex impacts on the enhancement of a country's competitiveness. Based on cross-country panel data of 37 countries from 2000 to 2020, this paper empirically studies the impact of digital trade on the improvement of national export competitiveness. The research conclusions show that digital trade significantly enhances a country's export competitiveness, and this finding not only enriches the research results in related fields but also provides useful reference for understanding the new changes in contemporary international trade.

Keywords: Digital trade, Export competitiveness, Cross-Country Panel Data, Two-Way Fixed Effects Model.

1. Introduction

The continuous advancement of digital technologies and the vigorous rise of the digital economy have thoroughly reshaped the operational models and core objects of traditional trade, and international trade is accelerating into a new "digitally driven" development stage. As an extension and concrete application of the digital economy in the trade field, digital trade is gradually becoming the new normal of global trade activities and even profoundly reconstructing the resource allocation logic and competitive pattern of the global market.

Relying on internet platforms as the core carrier and deeply leveraging emerging digital technologies such as artificial intelligence, big data, and cloud computing, digital trade not only largely breaks the temporal and spatial constraints of traditional trade, gives rise to new trade forms such as cross-border e-commerce and digital service trade, and significantly reduces transaction costs and market access thresholds but also optimizes the efficiency of global resource allocation by promoting the cross-border free flow of key production factors (e.g., capital, technology, and data), enhances a country's technological innovation capabilities and industrial upgrading momentum, thereby creating more high-value-added growth opportunities for economic development. According to the *Global Digital Trade Development Report 2024* jointly released by the Organizing Committee of the Global Digital Trade Expo and the International Trade Centre (ITC), the global total digital trade volume increased from \$6.02 trillion to \$7.13 trillion between 2021 and 2023, with an average annual growth rate of 8.8%; the proportion of digital trade in total international trade rose from 19.6% to 22.5%, with an average annual growth rate of 6.2%, indicating that digital trade has entered a stage of explosive growth.

In recent years, however, affected by multiple complex factors such as the spread of the "anti-globalization" wave, the continuous escalation of international economic and trade frictions, and the intensification of global economic fragmentation, traditional foreign trade activities have encountered severe shocks, and their growth momentum has weakened significantly. As one of the "three major drivers" of economic growth, exports are directly related to a country's economic stability and development quality, and have become a core issue of focus for governments around the world. The sustained expansion of a country's export scale is essentially a dynamic process in which export quality and quantity mutually promote and synergistically improve, and the strength of export competitiveness is the key to determining whether this process can be sustained. Against this backdrop, will the rapid development of digital trade have an impact on national export



competitiveness? If so, what are the direction and effect of this impact? Systematically answering these questions can not only provide new empirical evidence for the theoretical research on digital trade and export competitiveness but also offer practical implications for countries to enhance their export competitiveness through the development of digital trade and respond to changes in the global trade pattern, which is of great theoretical and practical significance.

2. Literature Review

Existing literature closely related to the research theme of this paper mainly focuses on the following two core areas:

2.1. Research on the Economic Effects of Digital Trade

In recent years, the digital transformation of traditional trade has become an important trend in global economic development. This transformation has not only given rise to new trade models such as cross-border e-commerce and digital service trade but also promoted the innovation of production methods and the upgrading of production technologies (Ianencko et al., 2019), making digital trade gradually become one of the core engines driving economic growth and technological innovation. Based on this, scholars at home and abroad have conducted extensive and in-depth discussions on the economic effects of digital trade. Dai et al. (2025) found that digital trade has a significant positive impact on urban green total factor productivity in China, confirming the green growth effect of digital trade. Wen et al. (2023) conducted an empirical analysis based on panel data from 131 countries, and the results showed that digital service trade can significantly promote the improvement of a country's technological innovation capabilities through multiple channels, such as increasing income incentives, accelerating knowledge spillovers, promoting trade liberalization, and deepening financial development.

2.2. Research on the Influencing Factors of National Export Competitiveness

As a core indicator to measure the quality of a country's foreign trade development, the influencing factors of export competitiveness have long been a focus of academic attention, and a wealth of research results has been formed (Ye et al., 2025). In recent years, with the rise of the digital economy, the impact of digital technologies and digital transformation on export competitiveness has gradually become a research hotspot (Yang et al., 2023; Tao & Cai, 2025). For example, Zhang et al. (2023) pointed out that imports of digital products can significantly promote the improvement of export product quality through multiple mechanisms, such as technology spillover effects, productivity improvement effects, and information search capability enhancement effects, thereby enhancing national export competitiveness.

A comprehensive review of existing literature shows that digital trade, as a product of the in-depth integration of digital technologies and traditional industries, has significant complexity and uniqueness in its impact mechanism on national export competitiveness. It is not only different from the action paths of traditional trade or value chain trade but also distinct from the impact of digital technologies through directly triggering changes in the production process. However, existing studies have not systematically examined the relationship between digital trade and export competitiveness within a unified analytical framework, and the discussion on the impact mechanism and empirical evidence between them still needs to be deepened. Based on this, this paper takes cross-country panel data of 37 countries as the research sample to deeply explore the impact of digital trade on national export competitiveness, aiming to make up for the shortcomings of existing research and provide useful supplements and improvements for research in related fields.

3. Theoretical Analysis and Research Hypotheses

Existing literature generally holds that digital trade plays an important role in enhancing national export competitiveness, and its impact mechanism can be analyzed from both micro and macro levels

(Yang et al., 2024; Liu et al., 2023). At the micro level, relying on the support of digital platforms, digital trade can help enterprises obtain key information such as global knowledge, cutting-edge technologies, and market demands more quickly, efficiently, and at lower costs, significantly reducing the information search costs and transaction costs of enterprises. At the same time, digital trade also lowers the threshold for enterprises to enter the international market, especially providing opportunities for small and medium-sized enterprises and enterprises in developing countries to participate in global competition, helping enterprises expand their domestic and foreign market shares and deeply integrate into the global value chain system.

At the macro level, the development of digital trade can accelerate the wide application of digital technologies in various industrial fields and the cross-border circulation of digital products, thereby promoting the digital transformation and upgrading of domestic traditional industries (Wang et al., 2023). In addition, digital trade can also drive the transformation of traditional production factors into digital innovative factors, making the value creation process of traditional production sectors more knowledge-intensive and technology-intensive, and improving the production efficiency and product added value of the entire industry. At the same time, by integrating consumer-side big data with production-side links such as design, R&D, manufacturing, and management, digital trade can help the manufacturing industry achieve intelligent transformation, promote a country's division of labor status in the global value chain to continuously rise, and thereby significantly enhance its international competitiveness.

Based on the above theoretical analysis, this paper proposes the following core research hypothesis:

H1: The development of digital trade can significantly enhance national export competitiveness.

4. Research Design

4.1. Econometric Model Design

To empirically test the impact of digital trade on national export competitiveness, this paper uses a two-way fixed effects model for analysis to control the interference of national individual differences and time trends on the regression results. To avoid the impact of heteroscedasticity on the estimation results, all variables are processed with logarithmic transformation. The specific model is set as follows:

$$\ln Mpiva_{it} = \alpha_0 + \alpha_1 \ln Dt_{it} + \alpha_2 Controls_{it} + \theta_i + \theta_t + \varepsilon_{it} \quad (1)$$

In Equation (1), i represents the country, t represents time, $Mpiva_{it}$ denotes the export competitiveness of various countries, Dt_{it} stands for the development level of digital trade in various countries, $Controls_{it}$ is the set of control variables, θ_i is the country fixed effect, θ_t is the year fixed effect, and ε_{it} is the random disturbance term.

4.2. Indicator Construction and Explanation

4.2.1. Explained Variable: National Export Competitiveness($Mpiva_{it}$)

Currently, indicators commonly used to evaluate export competitiveness include the Revealed Comparative Advantage Index, Revealed Competitive Advantage Index, market penetration rate, and Trade Competitive Index, among others. Through analysis, it is found that the market penetration rate can more effectively distinguish a country's export competitiveness in different regions and is simple to calculate. Therefore, this paper selects the market penetration rate as the indicator to measure national export competitiveness, and measure the market penetration rate of various countries in the international market using trade in value-added data.

$$Mpiva_{it} = \frac{VA_{it}}{IM_t} \quad (2)$$

In Equation (2), IM_t represents the total world imports at time t , and VA_{it} represents the domestic value-added of country i in foreign final demand at time t .

4.2.2. Core Explanatory Variable: Digital Trade Development Level (DT_{it})

This paper selects the global export value of Information and Communication Technology (ICT) products from 2000 to 2020 to construct a digital trade development index, which is used to evaluate the development level of a country's digital product trade. ICT product categories include computers and their peripheral equipment, communication equipment, consumer electronic products, electronic components, and miscellaneous electronic components.

$$DT_{it} = ICT_{cd} + ICT_{cpp} + ICT_{ce} + ICT_{cee} + ICT_{other} \quad (3)$$

In Equation (3), ICT_{cd} is the export value of communication equipment, ICT_{cpp} is the export value of computers and peripheral equipment, ICT_{ce} is the export value of consumer electronic products, ICT_{cee} is the export value of electronic components, and ICT_{other} is the export value of miscellaneous electronic components.

4.2.3. Control Variables

Combined with existing research results and theoretical analysis, this paper selects the following four types of variables as control variables to exclude the interference of other factors on the regression results:

1. Foreign Direct Investment (FDI_{it}), measured by the stock of foreign direct investment;
2. Urbanization Level ($Urban_{it}$), measured by the proportion of urban population to total population;
3. Human Capital ($Human_{it}$), measured by the proportion of education expenditure in GDP;
4. Openness Level ($Open_{it}$), measured by the proportion of total import and export volume in GDP.

4.3. Data Processing and Statistical Description

Based on the principle of data availability, this paper selects panel data of 37 countries from 2000 to 2020 as the research sample. The original data sources of each variable are as follows: Data on digital trade indicators and foreign direct investment are from the United Nations Conference on Trade and Development (UNCTAD) database; National export competitiveness indicators are calculated using trade-in-value-added data provided by the OECD-TiVA (Organisation for Economic Co-operation and Development - Trade in Value-Added) database; Data on control variables (including Urbanization Level, Human Capital, Openness Level, and Digital Infrastructure Level) are all from the World Bank World Development Indicators (WDI) database. For missing data in individual years, linear interpolation is used for supplementation to ensure the integrity of the sample data. The statistical characteristics of key variables are shown in Table 1.

Table 1. descriptive statistics

| Variable | Def. | VIF | Obs. | Mean | SD | Min | Median | Max |
|--------------|---------------------------------|------|------|--------|---------|--------|--------|----------|
| $Mpiva_{it}$ | National Export Competitiveness | - | 1176 | 1.047 | 1.530 | 0.021 | 0.583 | 10.209 |
| DT_{it} | Digital Trade Development Level | 5.23 | 1176 | 24.384 | 67.122 | 0.001 | 3.449 | 701.638 |
| FDI_{it} | Foreign Direct Investment | 1.32 | 1167 | 32.527 | 73.204 | 0.050 | 12.519 | 1014.119 |
| $Urban_{it}$ | Urbanization Level | 1.30 | 1176 | 72.541 | 15.907 | 24.374 | 75.205 | 100.000 |
| $Human_{it}$ | Human Capital | 1.27 | 1066 | 4.876 | 1.228 | 2.057 | 4.834 | 8.614 |
| $Open_{it}$ | Openness Level | 1.23 | 1176 | 96.887 | 67.462 | 19.560 | 77.035 | 437.327 |
| $Infra_{it}$ | Digital Infrastructure Level | 5.81 | 1134 | 94.220 | 332.013 | 0.003 | 19.518 | 4835.495 |

5. Econometric Results and Analysis

This paper adopts a regression strategy of gradually incorporating control variables to test the impact of digital trade on national export competitiveness. The baseline regression results are shown in Table 2.

As can be seen from the regression results in Table 2, in the process of gradually incorporating control variables (including foreign direct investment, urbanization level, digital infrastructure level, human capital, and openness level), the coefficient of the core explanatory variable ($\ln Dt_{it}$) remains positive at the 1% significance level, and the t-value is stable between 3.36 and 5.21, indicating that the positive promoting effect of digital trade on national export competitiveness is highly robust. In terms of the magnitude of the coefficient, the coefficient of the core explanatory variable gradually converges from 0.0904 in Column (1) to 0.0496 in Column (6). Although the value decreases, there is no directional change, which indicates that after excluding the interference of other factors, the promoting effect of digital trade on export competitiveness still exists significantly, effectively avoiding the impact of omitted variable bias on the regression results.

From the regression results of control variables: The coefficient of foreign direct investment ($\ln Fdi_{it}$) is significantly positive at the 1% significance level, indicating that foreign direct investment can promote the improvement of national export competitiveness through channels such as technology spillovers and capital supplementation; The coefficient of urbanization level ($\ln Urban_{it}$) is significantly negative, which may be due to problems such as resource misallocation and unreasonable industrial structure in the urbanization process of some countries, which inhibit the improvement of export competitiveness to a certain extent; The coefficient of human capital ($\ln Human_{it}$) is significantly negative at the 5% significance level. This result is inconsistent with some existing studies, which may be related to the human capital structure and allocation efficiency of sample countries and requires further in-depth analysis; The coefficient of openness level ($\ln Open_{it}$) is significantly positive at the 5% significance level, indicating that the improvement of trade openness can create a favorable external environment for the enhancement of national export competitiveness; The coefficient of digital infrastructure level ($\ln Infra_{it}$) fails to pass the significance test, which may be due to significant differences in the development level of digital infrastructure among sample countries, leading to heterogeneous impacts on export competitiveness.

In addition, the R-squared of the model gradually increases from 0.9923 in Column (1) to 0.9935 in Column (6), indicating that the explanatory power of the model is continuously enhanced with the inclusion of control variables, and the regression results have high reliability.

Table 2. baseline regression results

| | (1) | (2) | (3) | (4) | (5) | (6) |
|------------------|------------------------|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | $\ln Mpiva_{it}$ | $\ln Mpiva_{it}$ | $\ln Mpiva_{it}$ | $\ln Mpiva_{it}$ | $\ln Mpiva_{it}$ | $\ln Mpiva_{it}$ |
| $\ln Dt_{it}$ | 0.0904*** (5.21) | 0.0615*** (3.95) | 0.0570*** (3.66) | 0.0560*** (3.63) | 0.0510*** (3.45) | 0.0496*** (3.36) |
| $\ln Fdi_{it}$ | | 0.1192*** (4.96) | 0.1117*** (4.63) | 0.1107*** (4.63) | 0.1091*** (4.72) | 0.1078*** (4.80) |
| $\ln Urban_{it}$ | | | -1.0550*** (-3.66) | -1.0851*** (-3.82) | -1.1157*** (-3.99) | -1.4205*** (-4.62) |
| $\ln Infra_{it}$ | | | | 0.0065 (0.58) | 0.0030 (0.27) | 0.0052 (0.46) |
| $\ln Human_{it}$ | | | | | -0.1338* (-1.78) | -0.1535** (-2.21) |
| $\ln Open_{it}$ | | | | | | 0.1822** (2.32) |
| _cons | -5.9543*** (-41.20) | -7.1396*** (-21.44) | -2.4151* (-1.95) | -2.3572* (-1.94) | -1.8959 (-1.60) | -1.3583 (-1.07) |
| N | 695 | 695 | 695 | 695 | 695 | 695 |
| R ² | 0.9923 | 0.9932 | 0.9933 | 0.9933 | 0.9934 | 0.9935 |

Notes: t-values are in parentheses; ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

6. Summary

Based on cross-country panel data of 37 countries from 2000 to 2020, this paper uses a two-way fixed effects model to empirically explore the impact of digital trade on national export competitiveness. The results show that the development of digital trade can significantly enhance national export competitiveness, and this conclusion remains robust after gradually incorporating various control variables, without spurious correlation caused by omitted variables.

In terms of research significance, the innovations and value of this paper are mainly reflected in the following two aspects: At the theoretical level, this paper incorporates digital trade and national export competitiveness into a unified analytical framework, empirically tests the causal relationship between them, enriches the research results on the economic effects of digital trade and the influencing factors of export competitiveness, and provides theoretical support for understanding the new laws of international trade in the digital economy era; At the practical level, the research conclusions of this paper provide clear empirical implications for countries to enhance their export competitiveness through the development of digital trade. Countries can give full play to the promoting effect of digital trade on export competitiveness by increasing investment in digital infrastructure construction, promoting the digital transformation of traditional industries, and improving the openness of digital trade, so as to respond to the challenges brought by changes in the global trade pattern.

References

- [1] Ianenko M, Ianenko M, Huhlaev D, et al. Digital transformation of trade: problems and prospects of marketing activities [C]//IOP Conference Series: Materials Science and Engineering. IOP Publishing, 2019, 497 (1): 012118.
- [2] Wen H. W., Chen W. J., Zhou F. X. Does digital service trade boost technological innovation?: International evidence [J]. *Socio-Economic Planning Sciences*, 2023, 88: 101647.
- [3] Dai S, Tang D, Li Y, et al. Digital trade, trade openness, FDI, and green total factor productivity [J]. *International Review of Financial Analysis*, 2025, 97: 103777.
- [4] Ye D, Tu Y, Xia S. Environmental regulation and corporate exports: Quasi-experimental evidence from China's environmental protection tax law [J]. *Journal of Environmental Management*, 2025, 373: 123818.
- [5] Tao X., Cai W. L. The impact of digital finance on export competitiveness: Evidence from Chinese manufacturing enterprises [J]. *Finance Research Letters*, 2025, 73: 106629.
- [6] Yang, F., Wang, Y., Whang, U. Trade restrictions on digital services and the impact on manufacturing exports [J]. *Journal of International Trade & Economic Development*, 2023, 33 (1), 1-28.
- [7] Zhang H. S., Liu Q. Q., Wei Y. L. Digital product imports and export product quality: Firm-level evidence from China [J]. *China Economic Review*, 2023, 79: 101981.
- [8] Yang L, Yang W, Nan L, et al. The Impact of Digital Trade on the Export Competitiveness of Enterprises—An Empirical Analysis Based on Listed Companies in the Yangtze River Economic Belt [J]. *Systems*, 2024, 12 (12).
- [9] Liu Y, Hu W, Luo K, et al. How does digital trade promote and reallocate the export technology complexity of the manufacturing industry? Evidence from 30 Chinese provinces, 2011–2020 [J]. *Plos one*, 2023, 18 (9): e0291464.
- [10] Wang F, Guo B, Wang Z, et al. The impact of digital economy on the export competitiveness of China's manufacturing industry [J]. *Mathematical Biosciences and Engineering*, 2023, 20 (4): 7253-7272.