https://doi.org/10.21186/IPR.2024.9.4.481

디지털 무역의 발전이 중국 무역의 수출 규모에 미치는 영향에 관한 연구

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Research on the Influence of Digital Trade Development Level on China's Export Trade Scale

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요 약 글로벌화가 가속화되면서 디지털 발전은 디지털 기술과 혁신에 의존하고 있으며, 이는 점점 더 경제발전의 새로운 동력이 되고 있다. 경제활동의 자원배분의 핵심 고리인 무역은 디지털화에도 큰 변화를 겪고 있다. 이를 바탕으로 본 논문은 2010년부터 2022년까지의 중국 성의 관련 데이터를 연구 샘플로 삼고, 실증 테스트를 통해 디지털 무역의 발전 수준이 중국 수출 무역 규모에 미치는 영향을 분석하였다. 엔트로피 방법은 디지털 무역 발전 수준 지표를 구축하기 위해 관련 지표를 선택하는 데 사용하였다. 본 연구에서 요구하는 실증 테스트 모형을 구축하기 위하여 기술 통계, 상관 분석 및 회귀 분석을 수행하였다. 실증 테스트를 통하여 디지털 무역의 발전 수준이 중국의 수출 규모에 상당한 긍정적인 영향을 미치고 있으며, 양자 간에는 양의 U자형 관계가 있음을 알 수 있다.

주제어 : 디지털경제, 디지털화, 디지털무역, 수출규모, 엔트로피법

Abstract With the acceleration of globalization, digital development is relying on digital technology and innovation as the driving force, which has increasingly become the new driving force of economic development. Trade, as a key link in allocating resources in economic activities, is also undergoing profound changes in digitalization. Based on this, this paper takes the relevant data of Chinese provinces from 2010 to 2022 as research samples, and explores the impact of the development level of digital trade on the scale of China's export trade through empirical tests. The entropy method is used to select relevant indicators to build digital trade development level indicators. On the basis of building the empirical test model required by this paper, descriptive statistics, correlation analysis and regression analysis are carried out. Through the empirical test, it is found that the development level of digital trade has a significant positive impact on China's export scale, and there is a positive U-shaped relationship between the two.

Key Words : Digital Economy, Digitalization, Digital Trade, Export Scale, Entropy Method

Received 10 Sep 2024, Revised 09 Oct 2024
Accepted 14 Oct 2024
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ISSN: 2466-1139(Print)
ISSN: 2714-013X(Online)

1. Introduction

International trade plays a vital role in the sustainable development of national economy. Since its accession to the WTO in 2001, China has successfully become a global "manufacturing factory" with its cheap labor and land advantages. After more than two decades of rapid development, China has made remarkable achievements in the field of global trade, and has become one of the world's trading powers. By the end of 2021, China's total export volume of commodities will exceed 21,734.8 billion yuan, an increase of 706.6% over 2002. The expansion of export trade has not only directly promoted economic growth, but also effectively narrowed the income distribution gap among domestic residents. With the evolution of the international political and economic landscape, China's trade structure is undergoing a profound transformation. However, China's export trade is facing enormous development pressure at present. Problems such as decreasing domestic demographic dividend, rising labor cost and pressure on resources and environment have become increasingly apparent. How to promote the scale of China's export trade and give full play to the driving role of export coach in China's economic development has become an inevitable problem in China's development.

In 2023, the added value of core industries of China's digital economy will account for 10% of GDP; the size of China's cloud computing market will reach 616.5 billion yuan, an increase of 35.5%; and the total amount of data production will reach 32.85 zettabytes, an increase of 22.4%. A steadily growing digital economy lays a solid foundation for the reform and innovative development of digital trade. The 20th National Congress of the Communist Party of China has stressed the importance of promoting high-quality development and actively promoting all-round opening up to the outside world[1]. Therefore, to improve the high-quality development of export trade is of great importance to China's trade innovation and progress. With the advent of the digital era, global economic development is at a critical stage of transformation. Digital economy, relying on digital technology and innovation, has gradually become the core force driving economic growth[2]. While trade plays an important role in the allocation of economic resources, it is undergoing profound digital transformation. In November 2019, the Guiding Opinions of the CPC Central Committee and The State Council on High-quality Development of Trade gave clear instructions to accelerate the development of digital trade. In recent years, digital trade has risen to prominence in the global trade landscape and become a strategic plateau for future international trade competition. At present, digital trade is in a period of vigorous development, and at a time when the strategic vision of traditional global trade powers has weakened, China's unique path of seeking to build a trade power in the era of digital economy appears particularly critical and far-reaching. Will digital trade, as a new engine for trade development, create new opportunities for the scale of China's export trade? Therefore, this paper aims to analyze the current situation of the development of digital trade and the scale of export trade in various regions, and deeply explore the correlation between the two, and explore the new power source to promote the increase of China's export trade scale from the perspective of digital trade.

2. Literature Review

Zhang Qing and Yu Jinping[3] verified the impact and mechanism of digital input on

domestic value added of enterprises' exports by measuring digital input indicators. Using China's provincial panel data from 2008 to 2017, Yu Shan et al.[4] analyzed the existence of spatial spillover and nonlinear marginal increase in the impact of digital economy on high-quality manufacturing going global, which indicates that digital economy and its positive spatial spillover effect can promote the quality of China's inter-provincial exports, and this impact presents a dynamic nonlinear driving effect. Regions with a higher level of export trade can obtain more dividends of digital economy. By studying the development of digital finance and the quality of export products of enterprises, Zhang Mingxin et al.[5] found that the development of digital finance can improve the quality of export products, and digital finance will have a greater impact on the quality of export products of smaller and private enterprises. Wang Yu[6] constructed an urban digital economy measurement index based on the data of 41 cities in the Yangtze River Delta from 2011 to 2019, analyzed the relationship between digital economy and urban export quality, and believed that the digital economy level in the Yangtze River Delta region significantly promoted the upgrade of export quality to cities. And compared with core cities, this effect has a stronger effect on non-core cities. Based on the New and new trade theory, Xie Jing and Wang Shaohong[7] established a relationship model between digital economy and export quality, and conducted an empirical study with micro-trade data, finding that digital economy has a significant positive effect on the export product quality of manufacturing enterprises.

Li Yabo and Cui Jie[8] constructed the development level of provincial digital economy, studied the impact of digital economy on the quality of China's export products and its internal mechanism, and found that digital economy can significantly improve export quality, and its improvement path mainly comes from the effect of intra-product quality upgrading and product reallocation. Ou Jiayu and Zhang Naili[9] conducted an in-depth study on the impact of digital economy on the quality of China's export products from the perspective of industrial agglomeration, and found that digital economy has a steady and positive impact on the upgrading of the quality of China's export products, especially in the fields of technology and capital-intensive industries, mature and robust enterprises, and low-grade and medium-grade technology export products.

Zhou Nianli and Yao Tingting[10] analyzed the trade effects of restrictive measures on digital service trade adopted by 45 economies in the world, and concluded that a country's restrictive measures on digital service trade would have a negative impact on its import and export of digital services respectively, and compared with the import, the restraint on the export of digital services is more obvious. Yao Zhanqi[11] analyzed the impact of digital trade comprehensive competitiveness on the technological complexity of China's exports by using the relevant data of 30 provinces (municipalities directly under the central government and autonomous regions), and found that the impact of digital trade on the technological complexity of exports is mainly through the indirect effects of human capital and R&D intensity. Based on OECD-DSTRI and WIOD-WIOTS databases, Qi Junyan and Qiang Huajun[12] analyzed the impact of digital service trade barriers on

service industry export complexity by using panel data of 18 service industries from 37 countries, and concluded that digital service trade barriers have a significant negative impact on the improvement of service industry export complexity. Yuan Qigang and Wang Minzhe[13] took the comprehensive pilot zone of cross-border e-commerce as a "quasi-natural experiment" and studied its mechanism and effect of promoting the quality improvement of China's manufacturing industry. They found that the comprehensive pilot zone of cross-border e-commerce has a significant promoting effect on the TFP of China's manufacturing industry, which is conducive to the quality improvement of Chinese manufacturing enterprises, and compared with non-export enterprises, the comprehensive pilot zone of cross-border e-commerce has a significant promoting effect on the TFP of China's manufacturing industry. Digital trade has a stronger promoting effect on the quality improvement of China's export enterprises. Yang Huiying et al.[14] based on the data of various countries in RCEP from 2011 to 2020, found through empirical research that the impact of digital trade on a country's position in the global value chain presents a U-shaped curve and is positively regulated by trade facilitation.

Through the combing of existing literature research can be found, although the current academic community on the digital economy, digital trade comprehensive competitiveness, digital technology and other impacts on exports, but most of the research is limited to the research sample for listed enterprises and the construction of digital trade and other indicators is relatively single and other limitations. Based on this, this paper is based on the macro perspective of China's provinces, and tries to construct comprehensive measurement indicators of the level of digital trade development in each province through the entropy value method, to explore the impact of the level of digital trade development on the scale of exports in each province in China.

3. Research hypothesis

The level of digital development can promote the increase of China's export scale. On the one hand, the trade theory of heterogeneous firms indicates that firms with higher productivity are more likely to occupy the export market, and the quality, cost and variety of products are all sources of heterogeneity[15]. The development of digital trade can promote the deep integration of digital technology with the foreign trade business of various provinces (municipalities directly under the central government and autonomous regions), thus creating a good export environment, which is conducive to promoting enterprises to improve export vitality and stimulate competitiveness, and thus increase the scale of China's foreign trade export. On the other hand, the theory of national competitive advantage shows that innovation is the source of competitiveness. In the digital context, enterprises with digital trade technology are more innovative than ordinary enterprises. That is to say, compared with traditional enterprises, digital enterprises will have a higher technical level in the process of trade, so the quality of their export products is relatively higher. In addition, digital trade has increasingly become the trend of the current global economic development, which will weaken the negative impact of geographical distance on international trade, reduce the intermediate

links of trade, reduce trade costs, and realize the direct connection between producers, operators and customers. This will not only make the competition in the export market more fierce, but also encourage enterprises to innovate. It will also enable producers to have a more accurate understanding of consumer demand and then provide consumers with customized products and services to meet consumer demand and increase the scale of export. Based on this, the following research hypotheses are proposed in this paper:

The development of digital trade has a significant positive impact on the scale of China's export trade.

4. Research and design

4.1 Sample selection and data source

Based on the explanatory variables and the year limits of the explained variables as well as the availability of data, this paper selects the annual data of 30 provinces, municipalities and autonomous regions except Tibet during 2010-2022 as the research samples. The empirical content of this paper is empirically analyzed by Stata software, and the data comes from the national database.

4.2 Definition of Variables

4.2.1 Explained variables

Export scale, the explained variable in this paper, is measured by taking the natural logarithm of the annual foreign export volume of each province in China.

4.2.2 Explanatory variables

The core explanatory variable identified in this paper is the Digital trade development level (Digital) of 30 provinces (municipalities directly under the Central government and autonomous regions) in China. The concept of digital trade was first proposed by the United Nations Conference on Trade and Development (UNCTAD) in the early 2000s. With the transformation of global trade model and the deep development of economic globalization, this concept has gradually been paid attention and recognition by industry and academia.Digital trade is characterized by

Table 1: Measurement indicators of digital trade development level in various regions of China

First-level indicators	Secondary indicators	Secondary indicator symbol	Units	Indicator properties
Digital network infrastructure	Number of domain names	X1	10 Thousand yuan	Positive
	Number of sites	X2	10 Thousand yuan	Positive
	Internet broadband access port	X3	10 Thousand yuan	Positive
	Long distance cable line length	X4	km	Positive
	Broadband access users	X5	10 Thousand persons	Positive
Logistics transportation	Logistics and transportation related practitioners	X6	person	Positive
	Number of trucks in highway operation	X7	10 thousand yuan	Positive
	The number of civil transport vessels owned	X8	ship	Positive
Digital trade capability	E-commerce sales	X9	100 million yuan	Positive
	Revenue from express business	X10	100 million yuan	Positive
	Total telecom business	X11	100 million yuan	Positive
	Software business revenue	X12	10 Thousand yuan	Positive
Digital technology innovation	R&D expenditure of industrial enterprises above designated size	X13	10 thousand yuan	Positive
	Total value of technology contract transactions	X14	10 thousand yuan	Positive
	Number of patent applications granted	X15	piece	Positive
Trade potential	GDP per capita	X16	yuan	Positive
	Market openness	X17	%	Positive
	Total imports and exports	X18	100 million yuan	Positive

digital ordering through the Internet platform

The review of relevant literature in this paper shows that infrastructure, digital technology and trade are taken as the key points of evaluation in most digital trade evaluation systems.At the same time, with reference to the relevant research content of Liu Yuanyuan and Tao Changqi [16], Wang Yafei and Liu Jing [17], this paper selects 18 secondary indexes from five dimensions of digital network infrastructure, logistics and transportation, digital trade capability, digital technology innovation and trade potential, and builds a comprehensive index system for the development level of digital trade in all provinces (municipalities directly under the Central Government and autonomous regions). The entropy method is used to calculate the digital trade development level of each province (municipality directly under the central government and autonomous region), and the measurement index of the digital trade development level constructed is shown in Table 1.

4.2.3 Control variables

According to the existing literature and research content, this paper also selects other relevant control variables that may have an impact on export scale, including population size (Pop), which is represented by the natural logarithm of regional resident population. The level of economic development (GDP), represented by the natural logarithm of regional GDP. The degree of opening up to the outside world (Open) is expressed by the natural logarithm of foreign direct investment of each region. The urbanization rate (Urban) is expressed by dividing the urban population by the total population. And industrial structure (Ind), expressed by dividing the increase of the tertiary industry by the increase of the secondary industry. According to the main body of this study and the relevant variables determined, this paper constructs the following regression model:

$$Export_{i,t} = Digital_{i,t} + Pop_{i,t} = Gdp_{i,t} + Open_{i,t} + Urban_{i,t} + Ind_{i,t} \quad (1)$$

In the heterogeneity section, this paper analyzes heterogeneity by constructing a dummy variable for city size and eastern and western provinces, and subsequently grouping the samples using this dummy variable.

In the mediation effect test part, this paper constructs the following regression model:

$$Rate_{i,t} = Digital_{i,t} + Pop_{i,t} = Gdp_{i,t} + Open_{i,t} + Urban_{i,t} + Ind_{i,t} \quad (2)$$

$$Export_{i,t} = Digital_{i,t} + Rate_{i,t} + Pop_{i,t} = Gdp_{i,t} + Open_{i,t} + Urban_{i,t} + Ind_{i,t} \quad (3)$$

5. Empirical analysis

5.1 Descriptive statistics and correlation analysis

Table 2 shows the descriptive statistical results of this paper. From the descriptive statistical results of Table 2, it can be found that the average value of total Export is 17.047, the minimum value is 12.089, and the maximum value is 20.499, indicating that there is a large gap in the export scale among different provinces in China. The average value of Digital trade development level (Digital) is 1.004, the minimum value is 0.168, and the maximum value is 4.677, indicating that the development of China's digital trade is at a good level at present, but there are regional differences, and there is a big gap between the regions that develop faster and those that develop slower. In terms of controlvariables, the average size of population (Pop) is 8.205, the average level of economic development (GDP) is 9.813, the

average degree of openness to the outside world (Open) is 11.949, the average urbanization rate (Urban) is 0.595, and the average industrial structure (Ind) is 1.331.

Table 2: Descriptive statistics

Var Name	Obs	Mean	SD	Median	Min	Max
Export	390	17.047	1.635	17.208	12.089	20.499
Digital	390	1.004	0.716	0.761	0.168	4.677
Pop	390	8.205	0.742	8.278	6.333	9.448
GDP	390	9.813	0.910	9.902	7.042	11.772
Open	390	11.949	59.690	4.257	0.769	823.038
Urban	390	0.595	0.124	0.582	0.338	0.896
Ind	390	1.331	0.737	1.176	0.527	5.244

Table 3: Correlation analysis

	Export	Digital	Pop	GDP	Open	Urban	Ind
Export	1						
Digital	0.760***	1					
Pop	0.670***	0.571***	1				
GDP	0.870***	0.781***	0.845***	1			
Open	-0.021	-0.020	-0.157***	-0.069	1		
Urban	0.504***	0.419***	-0.137***	0.358***	0.091*	1	
Ind	0.056	0.019	-0.302***	0.016	0.266***	0.542***	1

***, **, and * are statistically significant at 1%, 5%, and 10% levels, respectively

Table 3 shows the correlation analysis results of this paper. From the correlation analysis results of Table 3, it can be found that there is a significant positive correlation between Digital trade development level (Digital) and Export scale (Export), and the correlation coefficient is 0.760, which is statistically significant at 1% level, indicating that the higher the digital development level (Digital), the higher the digital development level (Export). The higher the level of Export will be. In addition, it can be found that the correlation coefficient between the variables is small, indicating that there is no multicollinearity, and subsequent empirical regression analysis can be conducted.

5.2 Baseline Regression

Table 4 is the baseline regression results of this paper, in which (1) is listed as the regression results without control variables, and (2) is the regression results with control variables. From the baseline regression results of Table 4, it can be found that when there are no control variables, the development level of Digital trade has a significant positive impact on Export scale. Its regression coefficient is 1.738, and is statistically significant at 1% level; after controlling relevant control variables, Digital development level still has a significant positive impact on Export, and its regression coefficient is 0.326, and is statistically significant at 1% level. It indicates that the development level of digital trade can increase the competitiveness of China's export products, improve the technical level of products, and promote the expansion of China's export scale. In this paper, the hypothesis is assumed to be verified.

Table 4: Regression results

	(1)	(2)
	Export	Export
Digital	1.738***	0.326***
	(23.069)	(3.991)
Pop		1.101***
		(5.750)
GDP		0.298*
		(1.699)
Open		0.001**
		(2.120)
Urban		6.467***
		(10.112)
Ind		0.169***
		(2.764)
_cons	15.302***	1.120*
	(164.803)	(1.780)
N	390	390
R2	0.578	0.829

***, **, and * are statistically significant at 1%, 5%, and 10% levels, respectively, with regression T-values in parentheses

Through Table 4 empirical test results have confirmed that the level of digital trade development has a significant positive impact on the level of exports, but this relationship may be non-linear, based on this, this paper by the level of digital trade development of the square term (Digital2) into the regression model, the regression results shown in Table 5. From the regression results in Table 5, it can be found that the square direction of the level of digital trade development has a significant positive impact on the export size, indicating that there is a significant positive U-shaped relationship between the level of digital trade development and the export size, both the level of digital trade development in the early stage of the level of exports will have a significant negative impact on the level of exports, but reach a certain degree of inflection point, there will be a significant positive impact, which may be due to the level of digital trade development The overall volume in the early stage is small, but the input is large, and it can only play its role in the enhancement of export scale after reaching a certain level of scale.

5.3 Heterogeneity

It has been confirmed above that the development level of digital trade has a significant positive impact on China's export scale, but whether the above impact is different in different regions and city scales remains to be verified. Based on this, this paper discusses whether the development level of digital trade has different impacts on China's export scale from the perspective of region and city scale.

5.3.1 By region

In this paper, the research samples are divided into three regions according to different regions: eastern, central and western regions, and the regression is carried out respectively. The regression results are shown in Table 5.

Table 5: Squared term regression results

	(1)	(2)
	Export	Export
Digital	3.872***	0.907***
	(19.424)	(3.660)
Digital2	0.599***	0.125**
	(11.333)	(2.480)
Pop		1.186***
		(6.135)
Gdp		0.111
		(0.587)
Open		0.001**
		(2.209)
Urban		6.480***
		(10.200)
Ind		-0.154**
		(-2.509)
_cons	14.068***	1.838***
	(103.879)	(2.669)
N	390	390
R2	0.683	0.832

***, **, * denote statistically significant at the 1%, 5%, and 10% levels, respectively, with regression t-values in parentheses

From the results of regional regression in Table 6, it can be found that there are significant differences between Digital trade development level and Export scale in different regions. Specifically, Digital trade development level and Export scale are not significant in eastern and western regions. However, in the central region, there is still a significant positive impact, and its regression coefficient is 0.476, which is statistically significant at the 10% level. This indicates that the impact of Digital trade development level on Export scale is significantly different in different regions. This may be because the central region is more limited in technical

resources and has a lower level of digital infrastructure and innovation than the eastern region. The marginal impact of the improvement of digital trade level on export scale is stronger in the central region.

Table 6: Regression results by region

	(1)	(2)	(3)
	Eastern Export	Central Export	West Export
Digital	0.134	0.476 *	0.009
	(1.338)	(1.855)	(0.029)
Pop	0.017	0.573	0.475
	(0.068)	(0.704)	(0.912)
GDP	1.266 * * *	0.758	0.979 * *
	(5.673)	(1.456)	(2.053)
Open	0.001	0.152 * * *	0.030 *
	(1.358)	(4.016)	(1.928)
Urban	4.840 * * *	1.990	0.420
	(6.044)	(0.599)	(0.193)
Ind	0.393 * * *	0.913 * * *	0.882 * * *
	(6.079)	(2.712)	(3.027)
_cons	2.427 * *	3.289	3.853 * * *
	(2.243)	(0.816)	(2.798)
N	169	78	143
R2	0.866	0.786	0.734

***, **, and * are statistically significant at 1%, 5%, and 10% levels, respectively, with regression T-values in parentheses

5.3.2 By city size

In order to verify whether the impact of Digital trade development level (Digital) on Export size is different in different city sizes, this paper divides the research samples according to population size. When the sample size is greater than the sample median, it is defined as a large-scale city, and when it is less than or equal to the sample median, it is defined as a small-scale city, and grouping regression is carried out. The results of regression are shown in Table 7. From the regression results of city scale in Table 7, it can be found that the impact of Digital trade development level (Digital) on Export scale is significantly different among different city scales. In large-scale cities, digital trade development level (Digital) still has a significant positive impact on Export scale. However, the impact of Digital trade development level on Export scale is not significant in small-scale cities. This may be because the higher the degree of industrial agglomeration in large-scale cities, the higher the development level of digital trade will more easily have an impact on export scale.

Table 7: Regression results by city size

	(1)	(2)
	Large-scale Export	small-scale Export
Digital	0.436 * * *	0.266
	(4.636)	(0.808)
Pop	0.594 * * *	0.924 * *
	(2.823)	(2.478)
GDP	0.463 * * *	0.284
	(2.746)	(0.777)
Open	0.021 * * *	0.001
	(2.601)	(1.180)
Urban	5.091 * * *	6.602 * * *
	(6.376)	(5.590)
Ind	1.092 * * *	0.050
	(7.519)	(0.574)
_cons	5.425 * * *	2.262 * *
	(4.004)	(2.293)
N	223	167
R2	0.867	0.741

***, **, and * are statistically significant at 1%, 5%, and 10% levels, respectively, with regression T-values in parentheses

5.3.3 Intermediation effect test

Through the above empirical tests, this paper has confirmed that the level of digital trade development has a significant positive impact on the size of exports, and there is an inverted U-shaped relationship between the two, but the path through which this effect is realized is not yet clear. Based on this, this paper by exploring the total factor productivity (Rate) of each region in the above impact is to play what role to clarify the path of its impact. Therefore, this paper explores the mediating effect of total factor productivity (Rate) in each region through a three-step testing procedure, and the

regression results are shown in Table 8. From Table 8, it can be found that the level of digital trade development (Digital) has a significant positive effect on total factor productivity (Rate), and total factor productivity (Rate) has a significant positive effect on the size of exports (Export), the surface of total factor productivity (Rate) plays a positive mediating effect in the above impact. That is to say, the increase in the level of development of digital trade promotes the improvement of total factor productivity, i.e., production efficiency in each region, which in turn enhances the level of export scale in each region.

It has been proved above that Digital trade development level has a significant positive impact on Export scale. In order to ensure the robustness of the research conclusion, this paper conducts a robustness test by replacing variables, lagging one stage regression and shrinking the research sample.

Table 8: Mediation effect regression results

	(1)	(2)	(3)
	Export	Rate	Export
Digital	0.420***	0.334**	0.454***
	(4.398)	(2.064)	(4.794)
Pop	0.351**	1.071***	0.242
	(2.254)	(4.056)	(1.543)
Gdp	0.797***	-0.874***	0.886***
	(5.253)	(-3.400)	(5.833)
Open	0.063***	0.009	0.062***
	(7.002)	(0.610)	(6.989)
Urban	3.067***	1.655	2.898***
	(5.027)	(1.601)	(4.801)
Ind	-0.570***	0.065	-0.576***
	(-6.713)	(0.453)	(-6.884)
Rate			0.102***
			(3.423)
_cons	4.431***	0.399	4.391***
	(7.388)	(0.393)	(7.421)
N	390	390	390
R2	0.855	0.109	0.859

***, **, * denote statistically significant at the 1%, 5%, and 10% levels, respectively, with regression t-values in parentheses

5.4 Robustness test

The previous section has confirmed that the level of digital trade development (Digital) has a significant positive effect on the size of exports (Export), to ensure the robustness of the research conclusions, this paper through the replacement of variables, lagged one period of regression and reduce the research sample method to conduct a robustness test.

5.4.1 Alternate variables

Table 9 shows the regression results of robustness test of alternative variables. In this paper, Export scale is re-measured by dividing Export value by regional GDP, and then the original export scale variable is replaced for regression. From the regression results of Table 9, it can be found that no matter whether the relevant control variables are controlled or not, the original export scale is replaced by export value. The development level of Digital trade has a significant positive impact on Export scale, and both are statistically significant at 1% level, which indicates that the conclusions of this study are robust.

Table 9: Regression results of alternate variables

	(1)	(2)
	Export	Export
Digital	0.018 * * *	0.013 * * *
	(14.381)	(8.105)
Pop		0.029 * * *
		(7.702)
GDP		0.026 * * *
		(7.479)
Open		0.000 * *
		(2.066)
Urban		0.180 * * *
		(14.046)
Ind		0.006 * * *
		(5.064)
cons	0.004 * *	0.075 * * *
	(2.518)	(5.979)
N	390	390
R2	0.348	0.596

***, **, and * are statistically significant at 1%, 5%, and 10% levels, respectively, with regression T-values in parentheses

5.4.2 One phase lag

Table 10 shows the regression results of robustness test with one-phase lag. From the regression results with one-phase lag, it can be found that Digital trade development level still has a significant positive impact on Export scale, and both are statistically significant at 1% level, which indicates that the conclusions of this study are robust.

Table 10: Regression results of one-period lag

	(1)	(2)
	Export	Export
L.Digital1	1.853 * * *	0.355 * * *
	(22.881)	(3.829)
Pop		1.001 * * *
		(4.700)
GDP		0.393 * *
		(1.998)
Open		0.001 * *
		(1.997)
Urban		6.035 * * *
		(8.646)
Ind		0.154 * *
		(2.428)
_cons	15.299 * * *	1.218 *
	(159.987)	(1.805)
N	360	360
R2	0.594	0.826

5.4.3 Changing Digital Trade Development Level Measurement Indicators

In order to ensure the robustness of the conclusions of this paper, this paper randomly deletes one secondary indicator under each primary indicator when calculating the level of digital trade development, and then recalculates the level of digital trade development and incorporates it into the regression model to carry out regression, and the regression results are shown in Table 11. From the regression results in Table 11, it can be found that after changing the digital trade development level measurement indexes for calculation, the level of digital trade development still has a significant positive impact on the export scale, which indicates that the conclusions of this paper are robust.

Table 11: Changing the regression results of digital trade development measurement indicators

	(1)	(2)
	Export	Export
Digital	2.098***	0.420***
	(27.904)	(4.398)
Pop		0.351**
		(2.254)
Gdp		0.797***
		(5.253)
Open		0.063***
		(7.002)
Urban		3.067***
		(5.027)
Ind		-0.570***
		(-6.713)
_cons	15.030***	4.431***
	(175.944)	(7.388)
N	390	390
R2	0.667	0.855

***, **, * denote statistically significant at the 1%, 5%, and 10% levels, respectively, with regression t-values in parentheses

6. Conclusions of the research

This paper uses the panel data of various provinces in China as empirical research samples to test the impact of China′s digital trade development level on export scale through empirical research, uses entropy method to select relevant indicators to build digital trade development level indicators, and conducts descriptive statistics, correlation analysis and regression analysis on the basis of building the empirical test model required by this paper. Through empirical test, it is found that, The development level of digital trade has a significant positive impact on China′s export scale. On the one hand, the higher the competitiveness of the core products of enterprises in various regions, the more likely they are to occupy the export

market, and digital trade can greatly improve the competitiveness of enterprises, and then increase the overall export scale of China's products. On the other hand, digital trade weakens the influence of geographical distance on international trade, reduces the intermediate links of trade, and realizes the direct contact between producers and consumers to provide customized services while reducing trade costs, which is also conducive to promoting trade between countries. China, as the world's largest exporter, will undoubtedly promote the increase of China's export scale. The above conclusion is still valid after the robustness test of replacing variables and lagging for one period. In addition, this paper also finds that the impact of digital trade development level on export scale is significantly different in different regions and different city scales. Specifically, the impact of digital trade development level on export scale is not significant in the eastern and western regions, but has a significant positive impact in the central region. The impact of digital trade development level on export scale has a significant positive impact in large-scale cities, but not significant in small-scale cities. In addition, this paper also finds that there is a significant positive U-shaped relationship between the level of digital trade development and the size of exports, and that the impact of the level of digital trade development on the size of exports is realized through the improvement of production efficiency. However, the use of entropy value method and the use of China's provincial data as a research sample still has some limitations, provincial data, although it can well represent the economic situation of the provinces, but it is not universally applicable to the cities. Therefore, the limitation of this paper is that there are some limitations in the sample selection, and the subsequent research direction can choose the Chinese prefectural cities or even counties as the research samples, in order to better explore the impact of the level of China's urban digital trade development on the scale of exports.

References

[1] ZHANG Y, TANG M. IMPACT OF DIGITAL ECONOMY DEVELOPMENT ON CARBON EMISSIONS IN CHINA[J]. The Singapore Economic Review, 2024 69:03,1171-1194

[2] Leung T T C, Sizhu W, Ce Z. Understanding the digital economy in China: Characteristics, challenges, and prospects[J]. Economic and Political Studies, 2023, 11(4): 419-440.

[3] Ou Jiayu, Zhang Naili. Governance effect of digital economy on high-quality development of China's megacities: from the perspective of industrial agglomeration affecting export product quality [J]. Urban Problems, 2022, (03):84-94.

[4] Yang Huiying, Yang Hongju, Fu Jianhua. How does digital trade affect global value chain position climbing? -- Based on empirical evidence from countries within the framework of RCEP [J]. International Economic Cooperation, 2022, (02):76-87.

[5] Li Yabo, Cui Jie. Research on export mass effect of digital economy [J]. World Economic Research, 2022,(03):17-32+134.

[6] Xie Jing, Wang Shaohong. Digital economy and export product quality upgrading of manufacturing enterprises [J]. Journal of Wuhan University (Philosophy and Social Sciences Edition), 2022,75(01):101-113.

[7] Yuan Qigang, Wang Minzhe. Mechanism and effect of quality change in manufacturing industry enabled by digital trade: a quasi-natural experiment from cross-border e-commerce comprehensive pilot zone [J]. Industrial Technical Economics, 202,41(01): 62-70.

[8] The digitalization of manufacturing input and the rise of the middle and high end of global value chain: a re-examination based on the difference of input sources [J]. Research of Finance and Economics, 21, 47(09):93-107.

[9] Wang Y. Study on the impact of digital economy on the competitiveness of export products - A case study of the Yangtze River Delta urban Agglomeration [J]. Price Theory and Practice, 2021,(02):149-153.

[10] Qi Junyan, Qiang Huajun. Do digital service trade barriers affect service export complexity? An empirical analysis based on OECD-DSTRI database [J]. International Business (Journal of University of International Business and Economics), 2021,(04):1-18.

[11] Zhang Mingxin, Wang Yanan, Zheng Lekai, Shi Yue. Research on the impact of the Development of digital Finance on the quality of export products of enterprises [J]. Finance and Trade Research, 2021,32(06):12-27.

[12] Yu Shan, Fan Xiufeng, Jiang Haowen. The impact of digital economy on China's manufacturing industry going global with high quality: from the perspective of improving export technical complexity [J]. Journal of Guangdong University of Finance and Economics, 2021, 36(02):16-27.

[13] Zhou Nianli, Yao Tingting. Empirical study on the trade inhibition effect of restrictive measures on digital service trade[J]. China Soft Science, 2021,(02):11-21.

[14] Yao Zhanqi. Digital trade, industrial structure upgrading and export technical complexity: Multiple mediating effects based on structural equation model [J]. Reform, 2021,(01):50-64.

[15] Hottman, C. J., Redding, R. W, Weinstein, D. E. Quantifying the Sources of Firm Heterogenity[J]. Quarterly Journal of Economics, 2016, 130(3):129-136

[16] Wang Yifei and Liu Jing. A Study on the Effect of Carbon Reduction on China's Regional Digital Trade under the "Dual Carbon" Target[J]. Soft Science, 2023,37(12): 73-79.

[17] Liu Yuanyuan and Tao Changqi. Analysis on the Development Level of Digital Trade in 31 Provinces of China-Based on RAGA Projection Tracking Model[J]. Price Monthly, 2012,(04):69-76.

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