INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN ECONOMICS & MANAGEMENT SCIENCES

OPEN ACCESS JOURNAL

Vol 12, Issue 2, (2023) E-ISSN: 2226-3624

Research on the International Competitiveness and Influencing Factors of Digital Service Trade: Evidence from Zhejiang Province, China

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To Link this Article: http://dx.doi.org/10.6007/IJAREMS/v12-i2/17226 DOI:10.6007/IJAREMS/v12-i2/17226

Published Online: 14 July 2023

Abstract

In today's ever-changing international situation, the role of digitalization and digital technologies in accelerating economic recovery is becoming increasingly evident. Digital service trade has gradually become a key driving force for international trade and global economic recovery and growth. With its favorable policy environment and infrastructure, Zhejiang Province has witnessed rapid development in digital services trade. Based on data of China and Zhejiang Province from 2013 to 2022, this paper first analyzes the current situation of digital services trade in Zhejiang Province and its international competitiveness. The results show that the overall scale of digital services trade has expanded over the past decade, but its structure is relatively unreasonable. Moreover, its competitiveness is relatively strong and has an overall upward trend, but has weakened in recent years due to the decrease in export and the increase in import. This paper further conducts an empirical study on the influencing factors of digital services trade competitiveness in Zhejiang Province based on Porter's theory of national competitive advantage. The analysis shows that the export of services trade is most closely related to the digital services trade, while the foreign investment in actual use has a relatively weak correlation with the digital service trade due to its unclear driving effect on the export. R&D level, fixed asset investment, disposable income per capita, export of services trade, and the openness of digital services trade have a positive impact on its competitiveness, while the foreign investment in actual use has a negative effect. Finally, based on the research results, this paper puts forward corresponding recommendations.

Keywords: Digital Service Trade, International Competitiveness, Influence Factors, China

Introduction

The global flow of goods and services is changing with the spread of digital technology. Developments in data transfer technologies have made it possible to digitize the production of goods. Through cross-border data transfers, multinational companies are able to produce and trade digital products in third countries, which has led to the creation of digital services trade (Lund and Manyika, 2016). The importance of digitization and digital technologies in increasing economic resilience is evidenced by the COVID-19 pandemic. Digital services trade

has become an important engine for driving global trade recovery and the quality development of services trade in countries around the world (Martincevic, 2022; Rudyk et al., 2022).

Most of the current studies focus on the development trend of digital services trade and the formulation of digital services trade rules, with fewer studies related to its international competitiveness. Among them, even fewer studies have been conducted on issues related to the provincial and regional levels. Therefore, in order to continuously explore theories related to digital trade in services, it is necessary to research and improve upon them.

The objectives of this paper are to

- Review a number of studies in relation to digital services trade.
- Assess the current situation of digital services trade in Zhejiang Province and its level of competitiveness.
- Explore the factors influencing digital services trade competitiveness in Zhejiang Province.
- Provide recommendations for the development of digital services trade in Zhejiang Province based on the study's results.

Reviewing the existing research literature, this paper clarifies the definition and classification of digital service trade. Firstly, it conducts a descriptive statistical analysis of the development of digital service trade in Zhejiang Province. Secondly, it analyzes the level of digital service trade competitiveness by calculating the trade competitiveness index, international market share, revealing comparative advantage index, and Michaely index. Then, it discusses the impact of digital service trade based on the diamond model framework. Furthermore, the relevant factors affecting the competitiveness of digital service trade are discussed based on the diamond model framework. Finally, relevant countermeasures are proposed for the development of digital service trade in Zhejiang Province.

Literature Review

As digital technologies are widely used in various fields, the way of realizing trade in services has changed, and digital services are becoming a new growth point for trade in services. Scholars have achieved fruitful results in their research on digital trade in services.

Regarding the definition of digital trade in services, the OECD defines digital services as services provided through the mobile internet and further expands the statistical framework from three perspectives: delivery methods, products, and participants. Based on the OECD-WTO-IMF conceptual framework, the China Digital Trade Development Report 2021 defines digital trade in services as cross-border trade in services delivered in whole or in part in digital form, including the digital delivery component of traditional services.

In terms of the classification of trade in digital services, UNCTAD subdivides trade in digital services into nine categories: communication services, computer services (including computer software), sales and marketing services (excluding trade and leasing services), information services, insurance and financial services, management administration and back-office services, licensing services, engineering and related technology R&D services, and education and training services. Wen et al (2021) included industries with a high degree of digitalization in the scope of digital services trade through the industry identification method. The study classifies digital services trade into six categories: telecommunications, computer and information services; insurance and financial services; personal, cultural and

entertainment services industries; patent and copyright licensing services; government services; and professional and technical services.

Based on more definitive definitions and classifications, scholars at home and abroad have made a series of research results on the international competitiveness of digital services trade and influencing factors.

In terms of the international competitiveness of digital service trade, Yue and Li (2020) chose the index measurement method to conduct a comparative analysis of the competitiveness of digital service trade development in eight economies based on the MS index, TC index, and RCA index. In addition, the factor analysis method and entropy value method were also used to construct a comprehensive competitiveness evaluation system for analyzing comparative competitiveness levels (Zhou and Zhang, 2021; Lan et al., 2020; Liu and Luo, 2022)

Regarding factors influencing trade in digital services, Hoekman et al (1991) demonstrated that an increase in per capita income significantly contributes to the competitiveness of trade in digital services. Gupta et al (2022) constructs a market data restriction index (MDRI) to examine a panel of 60 countries and show that the MDRI in partner countries is to some extent a barrier to ICT services exports and hence to digital trade development.

Additionally, the current situation of digital trade development at the provincial level in China have also been partly studied. The spatial development of digital trade in China is uneven, with the southeast region generally being higher than the northwest region. Among them, Zhejiang Province, with its excellent policy environment, infrastructure, and related industrial support, has a higher level of digital trade nationwide. (Zhang, 2020; Liu and Tao, 2021; Luo, 2022; Feng and Duan, 2022)

Current Situation of Digital Service Trade in Zhejiang Province

Based on the definition of digital services trade in the China Digital Trade Report 2021 and considering the availability of data, this paper combines the classification of Wen (2021) and the China Digital Trade Development Report (2021) to classify digital services trade into seven major categories. These categories include insurance services, financial services, intellectual property royalties, telecommunications, computer and information services, personal, cultural and entertainment services, government services, and other business services.

Development Scale of Digital Service Trade in Zhejiang

Relying on its inherent advantages, Zhejiang Province has made significant efforts to develop its digital services trade, resulting in remarkable achievements. As shown in Figure 1, in the past decade, the total import and export of digital services trade and its share in the services trade have increased, indicating that the scale of digital services in Zhejiang Province is expanding.

Based on the current statistical methods of the Ministry of Commerce of Zhejiang Province, the total import and export of digital services trade in Zhejiang Province reaches 3.147 billion dollars in 2022, accounting for 41.55% of the total services trade. Its export amounts to 1.367 billion dollars, and the import amounts to 1.780 billion dollars. Compared to the total of 703.5 billion dollars in 2013, the total export and import of digital services in 2022 have grown at an average annual rate of 18.11%.

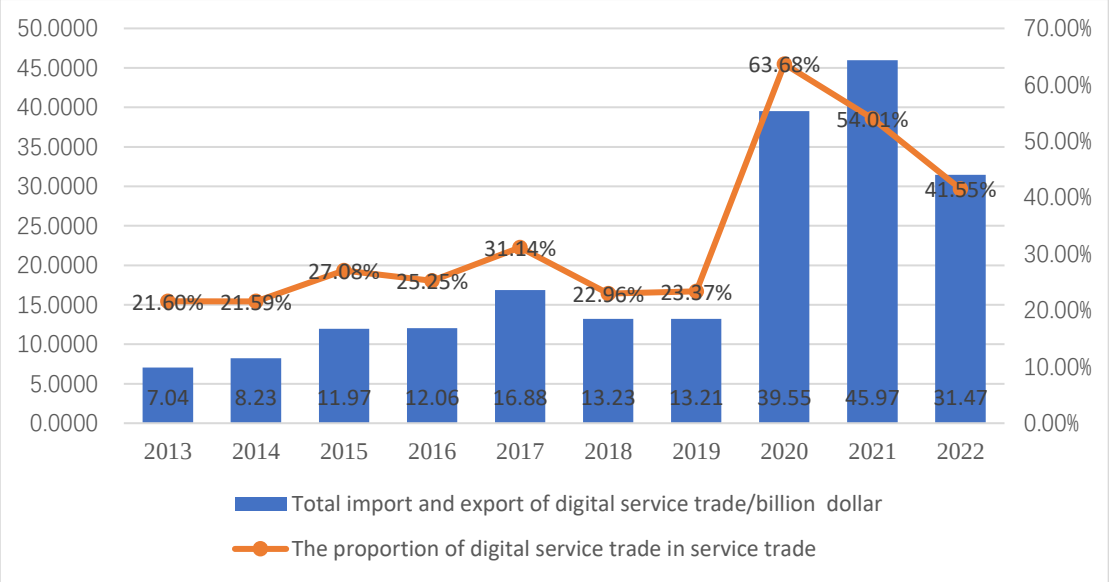

Figure 1: The import and export of digital service trade (2013-2022)
Data source: calculated according to Zhejiang statistical yearbooks

Structure of Digital Service Trade in Zhejiang

As can be seen from the figure, the structure of digital services trade in Zhejiang Province is unbalanced, with imports and exports mainly concentrated in telecommunications, computer and information services (see Figure 2). In 2022, telecommunications, computer and information services, other business services, and intellectual property royalties ranked the top three among all digital services trade sectors in Zhejiang Province, with total imports and exports reaching 1.715 billion dollars, accounting for 92.01%. Telecommunications, computer and information services accounted for 54.91% of the total exports and imports of digital services trade, but their import and export value decreased by 22.24% compared to the previous year. Intellectual property royalties accounted for 8.79% of total exports and imports, with an increase of 33.00% over the previous year. However, both had a trade deficit. Imports of telecommunication, computer and information services were approximately 1.90 times as much as exports, and imports of intellectual property royalties were 2.56 times as much as exports. Among them, telecommunications computer and information services accounted for 54.91% of the total exports and imports of trade in digital services, but their import and export value decreased by 22.24% compared to the previous year. Intellectual property royalties accounted for 8.79% of total exports and imports, with an increase of 33.00% over the previous year. However, both had a trade deficit. Imports of telecommunication computer and information services were approximately 1.90 times the value of exports, and imports of intellectual property royalties were 2.56 times the value of exports. This indicates: on the one hand, the accelerated pace of enterprise upgrading and the increased awareness and strength of intellectual property protection. The telecommunications, computer and information services and intellectual property market have a broad outlook. On the other hand, the competitiveness of Zhejiang digital services industry digital services trade exports needs to be improved.

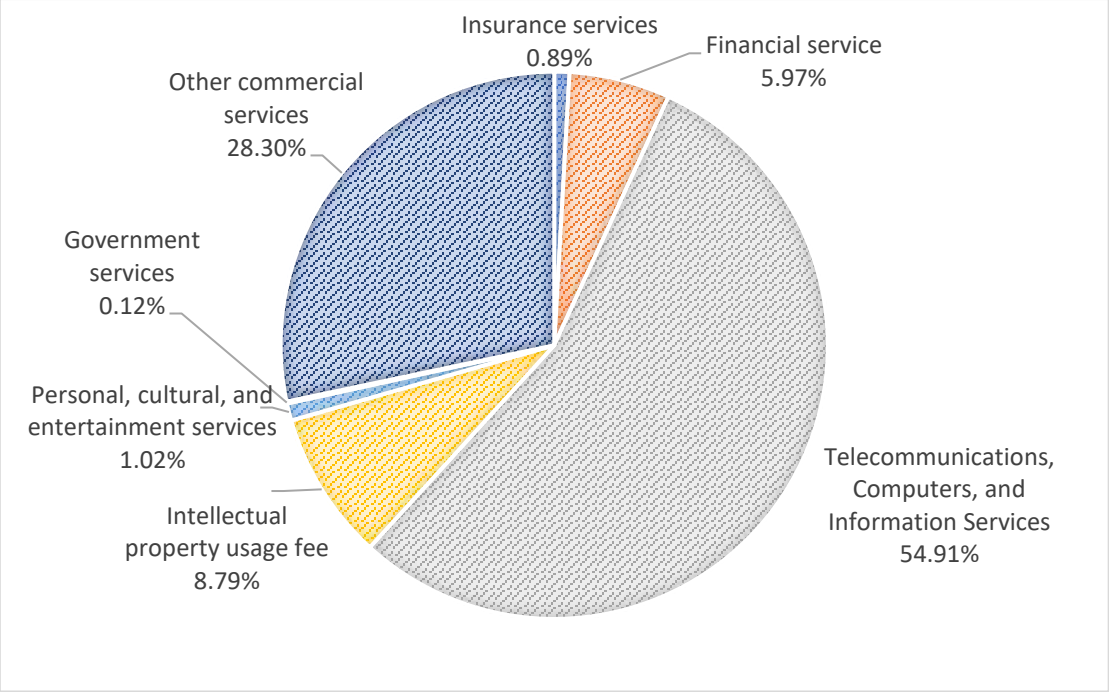

Figure 2: Composition of the import and export of digital service trade in Zhejiang Province in 2022
Data source: calculated according to Zhejiang statistical yearbooks

Measurement of International Competitiveness of Digital Services Trade in Zhejiang Province

Referring to existing literature, the main indexes for measuring the international competitiveness of digital services trade include Trade Competitive Advantage (TC), Revealed Comparative Advantage (RCA), International Market Share (MS), and Michaely Index (MI). The paper evaluates the international competitiveness of digital services trade in Zhejiang Province using the data of import and export of digital services trade in Zhejiang Province from 2013 to 2022.

Trade Competitive (TC)

Trade competitiveness index (TC) is a measure of a country's net exports of a product as a proportion of its total export and import trade. When this index is used to assess the international competitiveness of a product or industry, the effects of country and time are excluded. It is calculated as follows

TC = Net Exports / Total Trade = (Exports - Imports) / (Exports + Imports)

The range of this index is (-1,1). If the value is positive, the industry is internationally competitive. The closer it is to 1, the more competitive this industry is. If the value equals 1, the industry is export-only, and has a strong competitiveness. If the value equals 0, the industry's competitiveness lies in the international average. If the value is negative, the industry lacks competitiveness. The closer it is to -1, the lesser competitive this industry is. If the value equals -1, the industry is import-only, and has a weak competitiveness (see Table 1).

Table 1
Explanation of TC index value

0.6≤TC<1	Very strong international competitiveness
0.3≤TC<0.6	Fairly strong international competitiveness
0<TC<0.3	Strong international competitiveness
TC=0	Intermediate international competitiveness
-0.3≤TC<0	Weak international competitiveness
-0.6≤TC<-0.3	Fairly weak international competitiveness
-1<TC<-0.6	Very weak international competitiveness

This paper uses the import and export values of Zhejiang's digital services trade as data to measure the TC Index of Zhejiang's digital services trade from 2013 to 2022. The results are shown in Table 2 below, which illustrates the changes in the TC value of Zhejiang's digital services trade from 2013 to 2022. As can be seen from the table, the TC Index remained around 0.56 from 2013 to 2017, indicating that the competitiveness of Zhejiang's digital services trade was at a fairly strong level. In 2018 and 2019, the TC Index dropped to a negative value, indicating that the competitiveness level became weaker. This decline may be due to the adjustment of statistical caliber, which affected the data. Although the TC Index briefly rebounded to 0.23 in 2020, it subsequently decreased continuously, falling to -0.13 in 2022, indicating that the competitiveness of Zhejiang's digital services trade has become weaker. In the past two years, with the development of the digital economy, the demand for information services and intellectual property rights has increased among enterprises, leading to an increase in the import of digital trade services. At the same time, the growth of domestic and foreign competitors may lead to a decrease in market share, resulting in a decrease in digital trade services exports. These factors may cause a decline in the TC index. The average TC Index for Zhejiang's digital services trade over the past ten years is 0.29, which indicates a competitive advantage. From an overall perspective, the TC Index is likely to rebound in the future, and the international competitiveness of Zhejiang's digital services trade will improve accordingly.

Table 2
TC of digital service trade in Zhejiang Province (2013-2022)

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Export (billion dollar)	5.50	6.36	9.31	9.39	13.26	6.43	5.94	24.31	27.04	13.67
Import (billion dollar)	1.54	1.87	2.66	2.67	3.62	6.79	7.28	15.23	18.93	17.80
TC index	0.56	0.55	0.56	0.56	0.57	-0.03	-0.10	0.23	0.18	-0.13

Data source: calculated according to Zhejiang statistical yearbooks

Revealed Comparative Advantage (RCA)

Revealed comparative advantage (RCA) refers to the ratio of the share of a country's industry in the country's export trade compared to the share of that industry's trade in export trade worldwide. The index represents the relative competitiveness of the country's exports in such

an industry relative to the world average. The formula for calculating the RCA index is as follows:

$$RCA_{ij} = \frac{(X_{ij}/X_j)}{(X_{iw}/X_w)}$$

Xij is the export volume of industry i in country j, Xj is the total export volume of all industries in country j, Xiw is the total export volume of industry i in all countries in the world and Xw is the total export volume of all industries in the world. If the RCA index is less than 0.8, the country's international competitiveness in this industry is weak. If the RCA index is in the range of 0.8 to 1.25, it means that the competitiveness is intermediate. If the RCA index is in the range of 1.25 to 2.5, then the competitiveness is strong. If the RCA index is greater than 2.5, the country is extremely competitive in this industry (see Table 3).

Table 3
Explanation of RCA index value

RCA≥2.5	Very strong international competitiveness
1.25≤RCA<2.5	Strong international competitiveness
0.8≤RCA<1.25	Intermediate international competitiveness
0.5≤RCA<0.8	Weak international competitiveness
RCA<0.5	Very weak international competitiveness

As for the digital services trade in Zhejiang Province, this paper uses an adjusted formula to calculate the RCA index. The adjusted formula is the ratio of Zhejiang's digital service trade exports to Zhejiang's total service trade exports compared to China's digital service trade exports to China's total service trade exports. The formula is as follows:

$$RCA_{iz} = \frac{(X_{iz}/X_z)}{(X_{ic}/X_c)}$$

RCAiz is the comparative advantage index of Zhejiang's digital services trade, Xiz is the export value of Zhejiang's digital services trade, Xz is the export value of Zhejiang's services trade, Xic is the export value of China's digital services trade and Xc is the export value of China's services trade. The results of the calculations are as follows (see Table 4):

Table 4
RCA of digital service trade in Zhejiang Province (2013-2022)

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
X_i / X	**Zhejiang**	0.27	0.26	0.33	0.30	0.37	0.40	0.35	0.70	0.58	0.38
	China	0.54	0.43	0.33	0.45	0.46	0.50	0.51	0.56	0.50	0.48
RCA		0.51	0.61	1.01	0.67	0.81	0.79	0.68	1.24	1.15	0.80

Data source: calculated according to the National and Zhejiang statistical yearbooks and Zhejiang Business yearbooks

The table above shows that the RCA index has generally increased over the past decade. From 2013 to 2015, the RCA index increased to 1.01. In 2018 and 2019, the RCA index decreased due to changes in the statistical methods of the Ministry of Commerce. In 2020, the RCA index reached 1.24, the closest to 1.25. Although it is still at an intermediate average level, its

competitiveness has improved. However, the RCA index has been declining year by year since then, falling to 0.8 in 2022. The average RCA index for Zhejiang's digital services trade is 0.83, indicating that its competitiveness is at an average level nationwide, and there is still room for improvement.

International Market Share (MS)

International market share (MS) is the share of a country's exports of an industry in the total exports of that industry worldwide. The higher the value of the MS index, the greater the country's market share in the industry and the stronger the industry's competitiveness. The calculation formula is as follows:

$$MS_{ij} = \frac{X_{ij}}{X_{iw}}$$

MSij is the international market share of industry i in country j, Xij is the export trade volume of industry i in country j in a certain year, and Xiw is the total export volume of industry i in the world in the same period.

The original calculation formula is adjusted to the share of Zhejiang's digital service trade exports in Zhejiang's total service trade exports. The adjusted formula is as follows:

$$MS_{iz} = \frac{X_{iz}}{X_{ic}}$$

MSiz is the international market share of Zhejiang's digital services industry, Xiz is the export value of Zhejiang's digital services trade, and Xic is the total export value of China's digital services trade in the same period. The calculation results are shown in Tables 5.

Table 5

IMS of digital service trade in Zhejiang Province (2013-2022)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
X_{iz} (billion dollar)	5.50	6.36	9.31	9.39	13.26	6.43	5.94	24.31	27.04	13.67
X_{ic} (billion dollar)	111.73	100.07	93.13	93.75	104.27	133.89	145.09	156.92	196.43	175.09
IMS	4.92%	6.35%	10.00%	10.02%	12.72%	4.81%	4.09%	15.49%	13.76%	7.81%

Data source: calculated according to the national and Zhejiang statistical yearbooks

In the past decade, the overall export of digital services trade in China and Zhejiang has increased by 56.70% and 148.75%, respectively. From 2013 to 2017, Zhejiang's export of digital services trade grew strongly, and the IMS index continued to rise. In 2018 and 2019, the IMS index of Zhejiang's digital services trade fell sharply, possibly due to statistical adjustments. With the widespread use of information technology, digital services trade has developed, and the IMS index surged to 15.49% in 2020. In the past two years, possibly due to intensified market competition with the maturing market, Zhejiang's export of digital services trade has decreased, and the IMS index has declined. The average market share of Zhejiang's digital services trade is about 9.00%. Zhejiang has a certain advantage in the market share of digital services trade, but it still needs to improve the quality of services to enhance its competitiveness.

Michaely Index (MI)

The Michaely Index (MI) is the difference between the share of a country's exports of a particular industry in the total exports of all domestic industries and the share of imports of that industry in the total imports of all domestic industries. The index measures the average annual fluctuation of an industry in a country. It is calculated by the following formula:

$$MI_{ij} = \frac{X_{ij}}{X_j} - \frac{M_{ij}}{M_j}$$

Mij is the Michaely Index for industry i in country j. Xij is the export value of industry i in country j, Xj is the total export value of all products in country j, $Mi\ jj$ is the import value of industry i in country j, and Mj is the total import value of all products in country j.

The range of the Michaely Index is (-1, 1). If MI is negative, the industry is at a competitive disadvantage; the closer the MI is to -1, the more significant the competitive disadvantage is. If the MI is positive, the industry has a competitive advantage; the closer the MI is to 1, the more significant the competitive advantage is.

The original formula is adjusted to the difference between the share of Zhejiang's digital services trade exports in the total exports of all industries in Zhejiang and the share of the industry's imports in the total imports of all industries in Zhejiang. The adjusted formula is as follows:

$$MI_{iz} = \frac{X_{iz}}{X_z} - \frac{M_{iz}}{M_z}$$

MIiz is the Michaely Index of Zhejiang's digital service trade. Xiz is the export value of Zhejiang's digital service industry and Xz is the total export value of Zhejiang's service industry. Miz is the import value of Zhejiang's digital service industry and Mz is the total import value of Zhejiang's service industry. The calculation results are shown in Table 6.

Table 6
MI of digital service trade in Zhejiang Province (2013-2022)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Xiz/XZ	0.274	0.260	0.327	0.301	0.369	0.398	0.350	0.696	0.577	0.385
Miz/Mz	0.123	0.137	0.169	0.161	0.198	0.164	0.184	0.561	0.495	0.443
MI	0.151	0.123	0.158	0.139	0.171	0.235	0.166	0.135	0.083	-0.058

Data source: calculated according to the National and Zhejiang statistical yearbooks and Zhejiang Business yearbooks

According to the table, from 2013 to 2021, the MI index remained positive, indicating a fairly strong competitive advantage. The index reached its highest point of 0.235 in 2018 and then declined to -0.058 in 2022, indicating a slight competitive disadvantage. The average value of Zhejiang's MI index for digital services trade over the past decade is 0.130, indicating a fairly low average volatility and a competitive advantage. In the last two years, the demand for information and computer services has increased as companies accelerate digitalization, resulting in an increase in imports and a decrease in exports of Zhejiang's digital services trade. This may have contributed to the decline in the MI index in 2022. However, with the development of Zhejiang's internet technology, infrastructure, and talent pool, the quality of service is expected to improve, and the MI index is expected to rebound.

Summary

In summary, it is found that from 2013 to 2022, Zhejiang's international competitiveness in digital services trade is relatively strong. Excluding some objective factors such as the statistical adjustment in 2018 and the impact of the pandemic, the competitiveness of Zhejiang's digital services trade is trending upward. From the IMS index, Zhejiang's digital services trade has certain advantages in the national market share. From the MI index, Zhejiang's digital services trade has developed steadily and has been in a competitive advantage for a long time. From the RCA index, the competitiveness of Zhejiang's digital services trade is at an intermediate level nationwide, but there is a trend of improvement. However, from the TC index, the competitiveness of Zhejiang's digital services trade has slightly decreased, indicating a relative decrease in digital services trade exports. From the timeline, Zhejiang's export of digital services trade has declined in the past two years, and its international competitiveness has weakened. Therefore, in the next chapter, this paper will focus on analyzing the key factors affecting the competitiveness of Zhejiang's service trade and providing feasible suggestions on how to enhance its competitiveness.

Empirical Study of the Factors Affecting International Competitiveness of Tourism Service Trade in Zhejiang Province

Based on Porter's theory of international competitive advantage, this section selects independent and dependent variables from its four main influencing factors and two auxiliary influencing factors to conduct an empirical analysis of the influencing factors of digital service trade in Zhejiang Province. It analyzes the relationship between the competitiveness of digital service trade and its influencing factors.

Index Selection

1. The dependent variable - the volume of exports of digital services trade.

The export value of digital service trade is used to represent the competitiveness of digital service trade. After reviewing a large amount of literature, it is found that many scholars use the export value of digital service trade when measuring the international competitiveness of digital service trade (Yin and Chen, 2009; Liu et al. 2019; Chen, 2020; Yue and Zhao, 2020). There is a positive relationship between the export value of a product of a country and its competitiveness. Generally speaking, the larger the export value of a country's certain industry, the greater its impact on the world market, i.e. the more competitive that industry is.

2.Independent variables - Based on the diamond model and taking into account the availability and rationality of indicators, the following variables are selected:

(1) Production conditions - the ratio of R&D expenditure to GDP and fixed asset investment. The development of digital services trade relies on the availability of advanced factors of production such as technology and infrastructure in a country. Therefore, R&D intensity and fixed assets were selected as explanatory variables. In terms of R&D intensity, there is a positive relationship between R&D expenditure and the level of science and technology, so the ratio of R&D expenditure to GDP is chosen as an indicator. In terms of fixed assets, the amount of investment in fixed assets can be divided into construction works, installation works, purchase of equipment and instruments and other expenses. The more investment in fixed assets, the better the space and equipment available for the development of digital services.

(2) Demand conditions - disposable income per capita. A higher level of consumer purchasing power in the domestic market will accelerate the pace of innovation and development of manufacturers in the industry, improve the production efficiency of the industry, and thus increase the international competitiveness of the industry. Disposable income per capita reflects to a certain extent the level of purchasing power and consumer demand in a country.
(3) Related and supporting industries - export of service trade. Digital services are part of the service sector. The development of the service industry plays an important role in the development of digital service trade. The export value of the service industry is positively correlated with the strength of the industry, so this paper expresses the strength of the service industry through the export value of service trade.
(4) Corporate strategy, structure, and competition - Foreign investment in actual use. Foreign investment in actual use reflects, to a certain extent, the degree of competition generated by a country's domestic industry after receiving foreign investment. Foreign direct investment facilitates enterprises in the inflowing country to learn advanced technology and management experience, thus enhancing the international competitiveness of digital service trade. In this paper, the proportion of FDI to GDP is used as an indicator to measure foreign investment in actual use.
(5) Government - opening scope of digital service trade. In addition to the above four basic factors, the development of digital services trade is also influenced by the government. When governments open up their markets and facilitate exchanges between domestic and foreign industries, fewer restrictions on trade in digital services will boost its development. Conversely, when governments increase regulation of the industry, this will have a negative impact on the development of the industry. Therefore, this paper uses openness to trade in digital services as a measure. Opportunities are difficult to measure, so no variables are selected to represent opportunity in this paper. The variable selection is shown in Table 7.

Table 7
Description of variable selection

Variable		Indicator	Representation	Code
Independent variable	Production factor	R&D level	The ratio of R&D funds to GDP (%)	X1
		Fixed asset investment	The volume of fixed asset investment (billion yuan)	X2
	Demand factors	Per capita disposable income	Per capita disposable income (yuan)	X3
	Related and supporting industries	Export of service trade	The export of service trade (billion dollar)	X4
	Enterprise competition	Foreign investment in actual use	The ratio of FDI to GDP (%)	X5
	Government	Openness of digital service trade	The ratio of digital service trade to GDP (%)	X6
Dependent variable	Competitiveness of digital service trade	Export of digital service trade	The export of digital service trade (billion dollar)	Y

Empirical Analysis

This paper utilizes data from Zhejiang Province spanning from 2013 to 2022 for empirical analysis. The data are obtained from the China Statistical Yearbook and Zhejiang Statistical Yearbook, and some missing data are from the Statistical Bulletin of National Economic and Social Development of Zhejiang Province. Table 8 displays the descriptive statistics for each variable.

Table 8
Descriptive statistics of data

VARIABLE	N	mean	sd	min	max
X1	10	2.556	0.297	2.189	3.024
X2	10	3294.602	844.212	2019.407	4676.329
X3	10	44452.4	10499.336	29775	60302
X4	10	29.053	9.775	16.150	46.837
X5	10	2.055	0.396	1.498	2.471
X6	10	2.193	1.109	1.167	4.217
Y	10	12.120	7.730	5.496	27.035

In order to make the time series stable and reduce the influence of heteroscedasticity on the model, the logarithm method is adopted for each data. In order to understand the correlation among the variables, the paper makes the correlation analysis of seven variables with SPSS Statistics 27. The following table is the correlation analysis of the relevant indicators affecting the competitiveness of digital services trade in Zhejiang Province (see Table 9).

Table 9
Correlation analysis of variables

	lnX1	lnX2	lnX3	lnX4	lnX5	lnX6	lnY
lnX1	1						
lnX2	.965**	1					
lnX3	.974**	.994**	1				
lnX4	0.468	0.438	0.398	1			
lnX5	-.884**	-.818**	-.860**	-0.160	1		
lnX6	.821**	.767**	.768**	.793**	-0.597	1	
lnY	.712*	.665*	.657*	.882**	-0.463	.980**	1

*** p<0.01, * p<0.05*

As can be seen from the table, the six independent variables, X1 to X6, have a high correlation with each other. Of these, all the variables are positively correlated except X5 which is negatively correlated with the other variables. The variables that are significantly correlated with the dependent variable Y at the 5% level of significance: X1, X2 and X3. The variables that are highly significantly correlated with Y at the 1% level of significance: X4 and X6. The correlation between Y and X5 is not significant. Therefore, these six independent variables will be discussed in this paper through principal component analysis.

Principal Component Analysis

Principal component analysis is a statistical method for dimensionality reduction of multidimensional systems of variables. With the idea of dimensionality reduction, the method converts a large number of linearly correlated indicators into a small number of linearly uncorrelated indicators, thereby eliminating the covariance between variables and indicating the dominant component. In order to eliminate possible multicollinearity between the selected variables, this paper uses principal component analysis to calculate the indices of each variable.

1. The applicability of principal component analysis

In order to determine whether the data can be subjected to principal component analysis, the KMO test and Bartlett's sphericity test are first required to determine whether there is correlation between the variables. The results are as follows

Table 10

KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.689
Bartlett's Test of Sphericity	Approx. Chi-Square	79.297
	df	15
	Sig.	0.000

As shown in Table 10, the KMO value is 0.689, which is greater than 0.6, and the Bartlett's spherical test result shows that the sig value is 0.000, which is less than 0.05. This indicates that there is a strong correlation between the variables, which meets the requirements of the principal component analysis.

2. Principal component extraction

The value of the common factor variance extracted is the degree of representation of the principal components fitted to the variables. The degree of expression increases as the value increases. Generally, a degree of expression greater than 0.6 is sufficient to meet the requirements. The total variance explained table is the basis for determining the degree of explanation of the original data by the transformed principal components. Generally, when the cumulative contribution is greater than 80%, the loss of original information is relatively small. The principal components fitted in this paper all explained the initial variables with a degree of explanation greater than 0.6, indicating that the principal components were able to represent the information of the variables at a high level (see Table 11).

Table 11
Communalities table

Communalities

	Initial	Extraction
lnX1	1	0.98644
lnX2	1	0.94898
lnX3	1	0.973952
lnX4	1	0.974728
lnX5	1	0.906321
lnX6	1	0.939319

Table 12
Total variance explained table

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.672	77.859	77.859	4.672	77.859	77.859
2	1.058	17.637	95.496	1.058	17.637	95.496
3	0.171	2.848	98.344			
4	0.080	1.330	99.674			
5	0.017	0.289	99.963			
6	0.002	0.037	100.000			

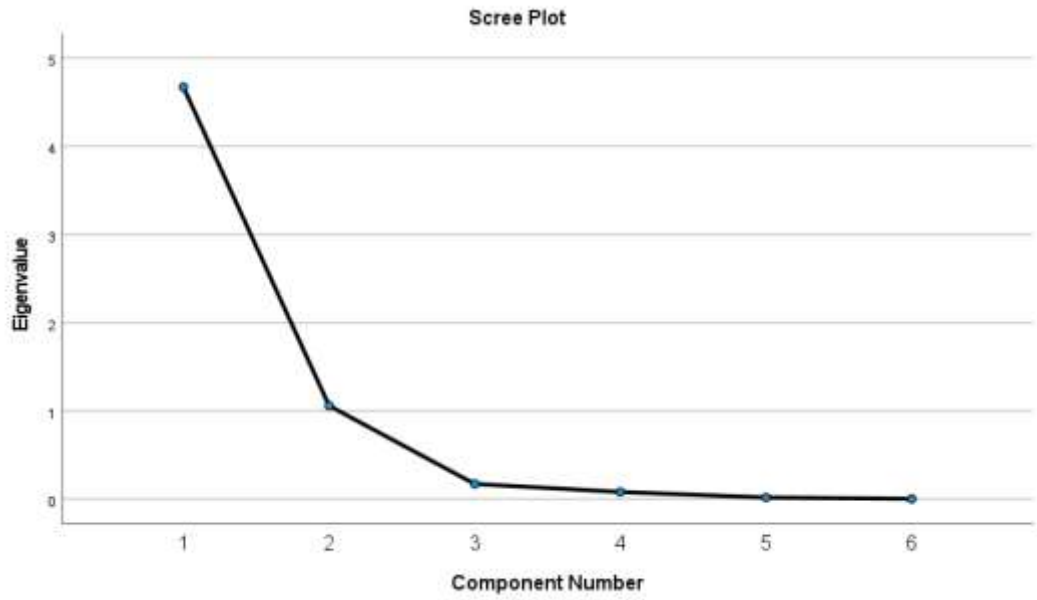

Figure 3: Scree plot of eigenvalue

Table 12 presents the total variance explained obtained from the principal component analysis. As shown in the table, the cumulative contribution rate of Factor 1 and Factor 2 reaches 95.496%, which indicates that the original information is almost fully preserved after dimension reduction. Moreover, from the scree plot of eigenvalues, the eigenvalues of the first two principal components are greater than 1 and the slope is relatively steep, while the subsequent four components are relatively flat (see Figure 3). The newly generated two factors can effectively represent the information content reflected by the original six variables. Therefore, this study can use these two new factors to replace the initial six variables for further analysis.

3. Calculation of principal components' scores

From the component matrix shown in Tables 13, it can be seen that the variables with larger absolute values of coefficients on the principal component F1 are X1 (the ratio of R&D expenditure to GDP), X2 (fixed asset investment), X3 (disposable income per capita), X5 (foreign investment in actual use) and X6 (openness of digital service trade). The variable with the larger absolute value of the coefficient on the principal component F2 is X4 (exports of services trade).

With the help of the eigenvalues of the principal components and the component matrix, the score coefficients of each variable can be calculated. Based on the matrix of coefficients shown in Table 14, the score expressions for the principal components can be obtained as follows:

F1=0.456lnX1+0.446lnX2+0.448lnX3+0.265lnX4-0.392lnX5+0.41lnX6

F2=-0.119lnX1-0.138lnX2-0.185lnX3+0.781lnX4+0.421lnX5+0.382lnX6

Table 13
Component matrix

	Component	
	1	2
lnX1	0.986	-0.123
lnX2	0.964	-0.142
lnX3	0.968	-0.190
lnX4	0.574	0.803
lnX5	-0.848	0.433
lnX6	0.886	0.393

Table 14
Component score coefficient

	Component	
	F1	F2
lnX1	0.456	-0.119
lnX2	0.446	-0.138
lnX3	0.448	-0.185
lnX4	0.265	0.781
lnX5	-0.392	0.421
lnX6	0.410	0.382

Multiple Regression Analysis

In the empirical study of this paper, the original six independent variables are grouped into two relevant factors: F1 and F2. Using the factor scores of these two factors as the data set, a multiple regression analysis is conducted on the dependent variable, exports of digital services trade, to analyze the factors affecting the exports of digital services trade.

Table 15
Parameter test
Parameter Test[b]

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson	Sig.
.982[a]	0.965	0.954	0.12293	1.702	.000[a]

a. Predictors: (Constant), F2, F1
b. Dependent Variable: lnY

Table 16
Result of regression analysis
Regression Analysis[b]

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	-3.617	0.828		-4.368	0.003		
F1	0.619	0.085	0.603	7.280	0.000	0.738	1.354
F2	0.810	0.128	0.526	6.349	0.000	0.738	1.354

b. Dependent Variable: lnY

According to the parameter test shown in Table 15, the p-value was less than 0.01, indicating that the model passed the F-test at the 1% level. The adjusted R2 was 0.954 and the degree of explanation of the model data was 95.4%, indicating a high degree of model fit.

According to the regression model shown in Table 16, the VIF value for both factors was 1.354. This indicates that there is no co-linearity between the two factors entering the regression equation, so both factors are suitable for simultaneous analysis. The p-values for both factors were less than 0.01, indicating that each had a significant effect on the dependent variable (see table 16). The multiple linear equation was as follows:

y =-3.617 +0.619 F1+0.81 F2

(y：the export of digital service trade)

Results Analysis

According to the regression results, both factors are significant, which indicates that the F1 and F2 factors have a significant impact on the export value of digital services trade. Both factors are significant to the extent of 1%, which indicates that the factor has a significant impact on the export value of trade in digital services. Based on the regression equation, the results of the analysis are as follows:

1. F1 has a positive effect on the export value of digital services trade in Zhejiang Province.

The variables with larger absolute coefficients on F1 are the ratio of R&D expenditure to GDP, fixed asset investment, disposable income per capita, foreign investment in actual use, and openness of digital services trade. Among them, foreign investment in actual use is negatively correlated with F1, while the rest of the variables are positively correlated with F1.

F1 is positively related to digital service trade exports at the 1% level, with a coefficient of 0.619. For every 1% increase in F1, the amount of digital service trade exports will increase by 0.619% accordingly. This may be due to the fact that with investment in R&D, updates in digital technology expand the tradable digital products and speed up the flow of digital services trade. When investment in fixed assets increases, the improvement of premises and equipment can effectively contribute to the development of the digital services industry. Disposable income per capita represents a country's per capita national income level and potential demand. The higher the level of income per capita, the greater the consumption capacity available to the population. A large local market will support the innovation and development of the digital services industry. The greater the openness of digital services

trade, the less regulated the development of digital services trade is. The negative impact of foreign investment in actual use on the export value of digital services trade may be because the foreign investment entering China's service industry is market-oriented, with the main purpose of occupying a larger market share. In the long run, foreign investment plays a more significant role in import substitution rather than export promotion (Yao, 2013). As the inflow of foreign investment intensifies competition within the digital services industry, enterprises in the inflowing country may lose certain market share and their development may be restricted, thus hindering the export of digital services trade in the inflowing country.

2. F2 has a positive impact on the export of digital services trade in Zhejiang Province.

The variable with the largest absolute value of the coefficient on F2 is the export value of service trade. The export value of service trade is positively correlated with F2. F2 is positively correlated with digital service trade exports at the 1% level, with a coefficient of 0.81. Each 1% increase in F1 is associated with a 0.81% increase in the value of digital service trade exports. This may be due to the strong association between the service industry and the digital service industry. Compared to the other five variables, the export value of service trade has the strongest correlation with the export value of digital services trade. As a new form of traditional service trade, digital services trade is essentially part of the service trade. The development of service trade can have a positive impact on the development of digital trade. On the one hand, services trade can help to consolidate trade partnerships and support the development of the digital service industry. On the other hand, services trade to some extent represents the level of development of the service industry. The development of the service industry can provide talent, infrastructure, and potential consumer markets for the digital service industry, encouraging its development.

Findings and Recommendations

Research Conclusions and Findings

Based on a review of relevant literature, this paper identifies research ideas to explore the international competitiveness of digital service trade in Zhejiang Province from two main perspectives.

On the one hand, this paper presents descriptive statistics on digital service trade in Zhejiang Province. Based on the collected data, this paper discusses the current situation of digital services trade in Zhejiang Province and measures its competitiveness based on four indicators, namely TC, RCA, MS and MI. The main findings are as follows:

1. In the past 10 years, the total volume of import and export of digital services trade and its share in services trade have been on an upward trend, which means the scale of digital services trade in Zhejiang Province has been expanding. From 2013 to 2022, the total volume of import and export of digital services trade and its share in services trade have achieved an average annual growth of 18.11% and 7.54% respectively. This indicates that Zhejiang's digital service industry is playing an increasingly important role in Zhejiang's service trade.

2. The structure of digital service trade in Zhejiang Province is unbalanced. The development of the sub-sectors of digital services trade in Zhejiang province varies greatly, with imports and exports mainly concentrated on the telecommunications, computer and information services, and intellectual property royalty sectors. And there is a trade deficit in both of these sub-sectors in 2022. This is possibly due to the accelerated pace of upgrading of enterprises in Zhejiang Province and the increased demand for telecommunication, computer and information services and intellectual property rights.

3. According to the quantitative analysis of international competitiveness, digital services trade in Zhejiang Province has a certain market share in the country. The MI index shows that its competitiveness has an overall upward trend. However, due to the decline in export in the last two years, both the TC index and the RCA index have declined, and the competitiveness has slightly weakened.

On the other hand, based on Porter's diamond model, this paper selected six main factors affecting the international competitiveness of digital services trade in Zhejiang Province and conducted an empirical analysis using the data from 2013-2022. The main findings are as follows:

1. All six variables are correlated with the competitiveness of digital services trade in Zhejiang Province, including the ratio of R&D expenditure to GDP, fixed asset investment, disposable income per capita, foreign investment in actual use, openness of trade in digital services, and export of trade in services. Among them, the export of services trade has the strongest correlation with the competitiveness of digital services trade, while foreign investment in actual use has relatively weak correlation.

2. The factors that have a positive impact on the competitiveness of digital services trade in Zhejiang Province are: the ratio of R&D expenditure to GDP, fixed asset investment, disposable income per capita, export of services trade and openness of trade in digital services. This is because the development of the digital services industry depends on updated technology, sound infrastructure, a large scale of local market, favorable development of related industries and a high degree of trade openness.

3. Foreign investment in actual use has a negative impact on the competitiveness of digital services trade in Zhejiang Province. The entry of foreign investment into the service industry aims to capture a larger market share, and has no significant driving effect on exports. In addition, the inflow of foreign investment leads to intensified competition within the digital services industry, causing the loss of market share for local enterprises and limiting their development, which is unfavorable for the export of digital services trade in the inflow region.

Recommendations

1. Encourage independent innovation and upgrade science and technology

Digital services trade cannot be separated from science and technology. On the one hand, the transmission and delivery of digital services rely on information technology. On the other hand, technological updates will extend the products and content of digital services trade. The sub-sectors of digital services trade are mostly knowledge-intensive and technology-intensive. Both are closely related to the level of science and technology development. The government should further increase the financial investment in scientific research and provide supporting policies.

In terms of specific implementation, the government and universities in Zhejiang Province should take the lead by vigorously increasing investment in scientific research, encouraging independent innovation. In addition, the government should also pay attention to the innovation capacity of enterprises in the digital services sector and give corresponding subsidy policies to their R&D investment. Finally, the government should enact relevant laws and regulations to strengthen the protection of intellectual property rights.

2. Optimize the structure of digital services trade and create a synergy effect between industries

The structure of digital services trade in Zhejiang Province is relatively unreasonable. Industries such as finance, insurance, intellectual property royalties, personal culture and

entertainment services are lagging behind. Moreover, empirical research shows that the development of service industries has a positive effect on promoting the development of digital service trade in Zhejiang. Therefore, the government should firstly encourage service trade to expand digital trade industries and strengthen the effect of linking service trade with digital trade. Secondly, through the aggregation of related industries such as finance, insurance and intellectual property, the collaboration between industries should be strengthened, thereby optimizing the structure of digital service trade and enhancing the competitiveness of related industries.

3. Reasonably use foreign investment and promote the development of the digital services industry.

Although foreign investment may have a negative impact on local enterprises in the short term, it can also bring investment, technology, and experience to improve production efficiency. The government should reasonably use foreign investment to induce investment into relatively disadvantaged sectors and optimize the development of digital service industry. Relevant policies could be implemented to reduce foreign investment's control over technology or to require foreign enterprises to localize production.

4. Improve the statistics mechanisms of digital services trade

The statistical framework for digital services trade is still under development, and the government should establish a complete statistical system and a specialized statistical department to manage digital services trade data. This would meet the needs of enterprises, relevant researchers, and governments, and promote the development of research in the field of digital services.

Research Significance

In terms of theoretical value, due to the recent emergence of digital services trade, there is relatively limited research on this topic in academia, with most studies focusing on the development trends and formulation of rules for digital services trade, while relatively fewer studies examine its international competitiveness. Moreover, there is even less research on provincial-level issues. Therefore, it is necessary to continuously explore theories related to digital trade in services and further enhance them. In this paper, four indicators are selected to evaluate the competitiveness of digital services trade in Zhejiang Province using indicator measurement. Drawing on Michael Porter's "Diamond Model," factors are chosen from production factor conditions, demand conditions, related and supporting industries, organizational strategies, and competition. A multiple regression model is constructed to analyze the factors influencing China's services trade competitiveness. This study contributes to the existing literature in related fields and expands the research scope of provincial-level digital services trade competitiveness.

In terms of practical value, as a new market emerging from the development of service markets in the digital economy era, global competition in digital service markets significantly impacts the development potential of countries and regions worldwide. To seize these development opportunities, the Zhejiang Provincial government has clearly outlined plans to develop digital services trade and establish a digital free trade zone. With its favorable policy environment and robust infrastructure, digital services trade in Zhejiang Province has flourished. This paper analyzes the current status of digital services trade development in the province, assesses the international competitiveness of digital services trade, and examines the main factors influencing its development. Finally, based on the findings from the analysis,

this paper proposes corresponding countermeasures and suggestions, aiming to facilitate the advancement of digital service trade.

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