Contents lists available at YXpublications

International Journal of Applied Mathematics in Control Engineering

Journal homepage: http://www.ijamce.com

Research on the Convergence of Cross-Border E-Commerce Network Retail Export Growth in Zhejiang Province

Jianyan Luo*, Jie Zhang

College of Zhijiang, University of Zhejiang Science and Technology, Shaoxing, 312030, PRC

ARTICLE INFO

Article history:
Received 4 November 2023
Accepted 13 January 2024
Available online 15 January 2024

Keywords:
Cross-border e-commerce entrepreneurial
Spatial pattern of growth
Mechanism of action Impact
Convergence of growth

ABSTRACT

Based on the cross-border e-commerce online retail export data of cities in Zhejiang Province from 2016 to 2020, this paper uses global and local autocorrelation methods to conduct a correlation test. The spatial distribution characteristics of the growth of cross-border e-commerce online retail exports in Zhejiang Province were discussed. On this basis, the convergence characteristics of cross-border e-commerce online retail export growth in Zhejiang Province were studied, the spatial condition convergence econometric model was constructed, and the convergence characteristics and the mechanism affecting the growth convergence were further discussed. The results show that the growth of cross-border e-commerce online retail exports in Zhejiang Province has obvious convergence characteristics, and the coefficient of variation decreases year by year. The convergence rate in northeast Zhejiang is faster than that of the whole province; and the convergence rate of the whole province is faster than that in southwest Zhejiang. The spatial clustering shows a significant "high to low" overlapping feature, with high-value area usually surrounded by low-value area. There are also spatial differences in the mechanism of the relevant control variables affecting the convergence of cross-border e-commerce export and retail growth in the province, northeast and southwest Zhejiang.

1. Introduction

Since the reform and opening up, the economy of Zhejiang Province has consistently sustained high-speed growth. It is not only a pivotal province with a robust economy in China, but it is also an early adopter of e-commerce development in China. Consequently, cross-border e-commerce also emerged early on. In 2012, Hangzhou became a pilot city for cross-border e-commerce services nationwide. In 2015, Hangzhou established the first comprehensive pilot zone for cross-border e-commerce in China. In 2016, Ningbo established the second batch of national cross-border e-commerce comprehensive pilot zones. Leveraging on these, Zhejiang Province stands great importance in promoting cross-border e-commerce growth. Local governments in the province have successively implemented relevant policies and incentive measures to systematically develop the cross-border e-commerce industry. Yiwu in 2018, Wenzhou and Shaoxing in 2019, Huzhou, Jiaxing, Quzhou Taizhou, and Lishui in 2020, Zhoushan and Jinhua in 2022 were successively approved by the state to establish cross-border e-commerce comprehensive pilot zones. By the end of 2022, a total of 39 provincial-level cross-border e-commerce industrial parks have been built in Zhejiang province, realized full coverage across various cities. Currently, Zhejiang Province has established a relatively comprehensive cross-border e-commerce industry, with not only large-scale enterprises, but also a relatively complete payment transaction system, overseas warehouse facilities and supporting service systems. However, the development of cross-border e-commerce across different regions within Zhejiang Province exhibits uneven distribution and disparities in level of advancement. Therefore, based on economic growth theory and international trade theory, also considering the current state of cross-border e-commerce retail exports in Zhejiang Province, the spatial econometric model method is used to study the convergence and impact mechanism of cross-border e-commerce retail export growth in Zhejiang Province. This research is conducive in enriching the connotation of contemporary economic growth theories and international trade theories.

2. Theoretical basis and research hypotheses

2.1 Concepts and research progress related to cross-border e-commerce

Currently, there are a few prevalent interpretations on the

* Corresponding author.
E-mail addresses: 357893890@qq.com (J. Luo)
Digital Object Identifiers: https://doi.org/10.62953/IJAMCE.552205

definition of cross-border e-commerce. Lai Youwei et al. (2014) believe that cross-border e-commerce refers to an international trade activity in which transaction entities from different customs areas reach transactions, conduct payment settlements through e-commerce platforms, and deliver goods and complete transactions through cross-border logistics. Zhang Xiaheng et al. (2016) and Jiang Tianyou et al. (2019) believe that cross-border e-commerce refers to the business activities of different countries or customs trading entities, which achieve the flow of goods through cross-border e-commerce platforms and logistics. This paper believes that cross-border e-commerce is a new form of international trade in which transaction entities from different countries (customs) complete transactions and payment settlements through e-commerce platforms, and complete transactions through cross-border logistics.

Regarding the topics of research on cross-border e-commerce, the current academic community mainly focuses on the transaction models, development status, logistics models, cross-border payments, foreign exchange management, and customs supervision of cross-border e-commerce.

(1) Transaction modes: The most common e-commerce modes are: Business-to-business(B2B), Business-to-consumer(B2C), and consumer-to-consumer(C2C); the former two being the most common.

(2) Logistics model: In lieu of the rapid development of cross-border e-commerce, new problems arise within cross-border logistics, such as high transportation costs, inadequate warehousing and other infrastructure, low distribution efficiency, and difficulty in returning and exchanging goods (Cao Qian, 2018; Du Jiyou et al.2018). Some scholars believe that it is necessary to strengthen the coordinated development of cross-border e-commerce and cross-border logistics (Wu shouxue et al., 2018; Zhang Xiaheng et al., 2016). Other scholars chose to further explore the cooperation mechanisms of cross-border e-commerce and cross-border logistics; as well as investigating ways to bolster the quality and efficiency of cross-border logistics, in order to further enhance competitive advantages from grounded theory, logistics performance, global value chain, global cross-border logistics service chain, and fuzzy analytic hierarchy process (Wang Chunzhi et al., 2015; Xu Xiaoli, 2018).

(3) Credit system, foreign exchange management, and customs supervision: The emergence of cross-border digital transactions and cross-border remote warehousing, has disrupted the conventional, cumbersome supply chain model of international trade. This has had an impact on the traditional trade regulatory model and posed numerous challenges to the country's foreign exchange management and customs supervision. Scholars have proposed viable strategies and trajectories, with a focus on the construction of credit systems, improvement of payment systems, foreign exchange management, and customs supervision. (Wang Liping, 2021; Yuan Cuiping, 2022).

2.2 Progress in Economic Growth Theory and Convergence Research

The issue of economic growth has long been a topic of debate in society and academia. Economic growth rates vary across different countries, making it difficult to reach a unified conclusion. Most of the existing research only focuses on the convergence of economic growth, without examining growth and convergence as a interconnected phenomenon. Consequently, there is a lack of research on the relationship between the two. Given the evolution of the global economic pattern, scholars may have to reconsider the actual problem of convergence of global economic growth.

2.2.1 Economic growth theory

Economic growth is an enduring topic of social development, different schools emerged and researched on the same issue. The classical economics dismissed the existence of economic growth (Adam Smith, 1776; David Ricardo, 1817); Marshall (1920) believed that the both internal and external economic growth of enterprises play an important role in economic growth. Since Schumpeter (1942) proposed technological progress as the main factor driving economic growth, subsequent Western scholars have further demonstrated and underscored that technological progress is indeed an endogenous factor in economic growth (Arrow, 1962; Romer, 1986).

2.2.2 Research on Convergence

Conventionally, There are three research methods for examining the convergence of economic growth: δ convergence, β convergence, and club convergence. δ Convergence mainly reflects the narrowing of absolute quantity differences such as per capita income. Lin Guangping (2006) argues that China exhibit δ convergence characteristics, including absolute convergence and conditional convergence. Scholars such as Barro (1992) and Salai Martin (1998) have verified the existence of β convergence within rich and poor countries. Chinese scholars have engaged in many heated discussions about the mechanism and stage characteristics of China's economic convergence, and their views have not reached a common consensus (Lin Yifu et al., 2003; Fu Xiaoxia et al., 2009; Chen Fenglong et al., 2018). Club convergence refers to the internal convergence of developed and underdeveloped economies within their respective groups, as well as the divergence between groups. Whether economies can achieve convergence is determined by the fulfillment of certain specific conditions. Compared to δ convergence and β convergence, club convergence did not gain as much attention until the 1990s. Zhang Hongwu (2007) and Qin Chenglin et al. (2012) confirmed on the existence of club convergence in China.

3. Research on the Spatial Pattern of Cross border E-commerce Network Retail Export in Zhejiang Province

3.1 Data Sources and Processing

This paper researches on and utilizes the data on eleven cities in Zhejiang Province, sourced from the online public data information of the Zhejiang Provincial Department of Commerce, the Zhejiang Statistical Yearbook, and the statistical yearbooks of the relevant cities (2017-2021). All economic indicators in the paper have been adjusted based on 2016, the import and export volume has been converted into RMB using the average exchange rate of that year.

3.2 Research Method

3.2.1 Spatial autocorrelation test

Global spatial autocorrelation measures the spatial autocorrelation between adjacent regions in the entire region. The global Moran's index (I) is generally used to measure the overall correlation degree of all spatial objects. The value range of Moran's I is (-1,1). When the index is greater than zero, it indicates a positive correlation between the development and agglomeration of cross-border e-commerce between regions; conversely, when the index is less than zero, it suggests a negative correlation. When the index I is equal to zero, there is no correlation.

To further explore the spatial clustering characteristics of local regions, the local spatial autocorrelation method (Getis Ord Gi *) was

used to classify hot spots using the ArcGIS 10.2 spatial statistical tool.

3.2.2 Space weight matrix setting

Drawing on existing research literature, this paper adopts two types of spatial weight matrices: adjacency weight matrix (W_1) and geographic weight matrix (W_2). This approach is used to mitigate estimation bias caused by a single spatial weight matrix. In the adjacency weight matrix, the value 1 is assigned if there is a common boundary between the city *i* and the city *j*, otherwise the value is 0. In the geographic distance weight matrix, the reciprocal of the square of the distance between cities is used.

3.3 Spatial distribution characteristics of cross-border e-commerce online retail exports

From the statistical data (Fig.1.), it can be observed that the spatial distribution of cross-border e-commerce online retail exports in Zhejiang Province is unbalanced. In 2016, there were four high-value areas: Jinhua, Hangzhou, Ningbo, and Wenzhou. The second highest value areas were Huzhou, Shaoxing, and Taizhou. The median area consists of three cities: Jiaxing, Quzhou, and Lishui. The low value area is Zhoushan. The high value and low value areas are located in a staggered manner. The rapid development of cross-border e-commerce online retail exports lead Jiaxing to rose to the second highest value area in 2020, while Huzhou fell to the low value area.

From reading the mean value of cross-border e-commerce online retail exports in various regions (Tab.1.), it is evident that the cross-border e-commerce online retail exports in the eleven regions of Zhejiang Province displayed an consistent upward trend annually, from 2016 to 2020; although the overall level remain still relatively low. Although the numerical changes in the annual growth rate reveals a declining trend year by year. Notable, the top three cities with the highest annual growth rate are Jiaxing, Zhoushan, and Taizhou; whereas the bottom three cities are Jinhua, Quzhou, and Huzhou. This indicates that in recent years, some cities with lower levels of cross-border e-commerce online retail exports have made rapid progress and are narrowing the gap with high-level regions.

Tab. 1. Growth rate of cross-border e-commerce online retail exports in Zhejiang

Region	2016-17	2017-18	2018-19	2019-20	Average annual growth rate
Hangzhou	42.44%	33.30%	41.19%	37.71%	38.66%
Ningbo	43.04%	32.54%	37.60%	52.88%	41.52%
Wenzhou	52.18%	28.62%	35.50%	35.68%	37.99%
Jiaxing	425.20 %	28.13%	33.25%	70.51%	139.28%
Huzhou	-59.02%	27.08%	34.56%	90.07%	23.17%
Shaoxing	36.48%	29.38%	40.37%	56.40%	40.66%
Jinhua	26.33%	25.65%	25.93%	15.30%	23.30%
Quzhou	37.81%	29.17%	20.82%	29.63%	29.36%
Zhoushan	137.44 %	22.19%	16.62%	5.90%	45.54%
Taizhou	53.86%	27.55%	36.24%	51.84%	42.37%
Lishui	75.36%	26.36%	24.69%	30.81%	39.30%

Based on respective cities, the exports of cross-border e-commerce online retail of the 11 cities can be divided into four major sectors: with Jinhua, Hangzhou, Ningbo, and Wenzhou having the highest overall level; Shaoxing, Taizhou, and Jiaxing have cross-border e-commerce online retail exports higher than the provincial average; while Quzhou, Lishui, and Huzhou are slightly lower than the provincial average; However, Zhoushan is significantly lower than the provincial average level. Furthermore, Jinhua City's cross-border e-commerce online retail exports has always took a lead in the province, with export value exceeding 18 billion yuan over the years.

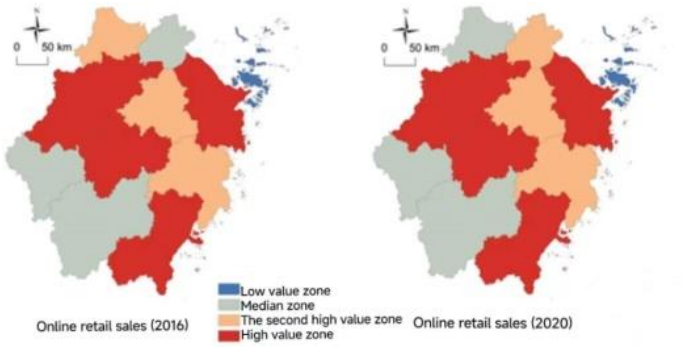

Fig. 1. Cross-border e-commerce online retail exports in Zhejiang

3.4 Spatial correlation test of cross-border e-commerce network retail export volume

Under the aforementioned two spatial weight matrices, this paper analyzes the global spatial autocorrelation of cross-border e-commerce online retail exports in cities and regions of Zhejiang Province (Tab. 2.). Under the adjacency weight matrix, the P-value of the logarithm of cross-border e-commerce online retail exports in Zhejiang Province is relatively large. Under the geographical weight matrix, the logarithm of cross-border e-commerce online retail exports in Zhejiang Province did not pass the 10% significance test, although the P-value was remained roughly within 12%.

Tab. 2. Spatial autocorrelation test

Year	Adjacency weight matrix (W_1)				Geographic weight matrix (W_2)			
	I	E(I)	Z-value	p-value	I	E(I)	z-value	p-value
2016	-0.231	-0.100	-0.716	0.474	-0.329	-0.100	-1.449	0.147
2017	-0.261	-0.100	-0.868	0.385	-0.349	-0.100	-1.556	0.120
2018	-0.259	-0.100	-0.858	0.391	-0.351	-0.100	-1.561	0.118
2019	-0.253	-0.100	-0.822	0.411	-0.353	-0.100	-1.572	0.116
2020	-0.228	-0.100	-0.690	0.490	-0.363	-0.100	-1.644	0.100

To delve deeper into the spatial clustering characteristics of cross-border e-commerce network retail export regions in Zhejiang Province, this study uses the local spatial autocorrelation method (Getis Ord Gi *) and the hot spot analysis method in the ArcGIS10.2 spatial statistical tool classification. Using adjacency spatial weights as an example, the Z-value scores of the Gi * statistic for 2016 and 2020 are calculated, and the Z-value is divided into four levels using the Jenks natural breaks optimization to generate the cold and hot spot maps of cross-border e-commerce network retail exports (Fig.2.). The maps illustrate more clearly, the significant clustering characteristics of cross-border e-commerce network retail exports in Zhejiang Province. Jinhua, Hangzhou, Shaoxing, Taizhou, and Lishui are the main hot spots. The cold spot cluster are mainly concentrated in Huzhou, Ningbo, Quzhou, Wenzhou, Jiaxing, Zhoushan, etc. The sub hotspots and sub cold spots are generally distributed in the middle of the hotspots and cold spots, showing a gradient distribution trend extending outward around the hot spots. This is consistent with the conclusion of the previous analysis.

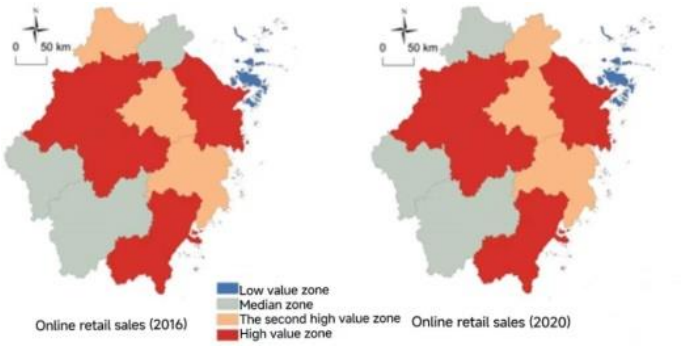

Fig.2. Z-value of Gi* statistical measure for cross-border e-commerce online retail exports in Zhejiang

4 An empirical analysis of the growth mechanism of cross-border e-commerce online retail exports in Zhejiang Province

4.1 σ Convergence test of cross border e-commerce network retail exports

Based on the convergence assumption of economic growth, this paper analyzes the growth convergence of cross-border e-commerce online retail exports in Zhejiang Province from the perspectives of σ convergence and β convergence. Firstly, the logarithm of the export volume of cross-border e-commerce online retail in Zhejiang Province was used for convergence testing. The mean value, standard deviation, and coefficient of variation of the cross-sectional data from 2016 to 2020 were calculated, as shown in Fig.3. The standard deviations in 2016 and 2020 were 1.84 and 1.77, respectively indicated a significant decrease in the value of the standard deviation. This reduction indicates a narrowing gap in cross-border e-commerce online retail exports among various cities in Zhejiang Province between 2016 and 2020, it is indicative of convergence. Furthermore, the coefficient of variation in 2016 and 2020 were 0.95 and 0.55, respectively, further confirming that the gap in cross-border e-commerce exports among cities in Zhejiang Province is narrowing. In summary, there are significant spatial differences in the export of cross-border e-commerce online retail in Zhejiang Province. The regions with high levels of cross-border e-commerce online retail export are usually economically developed regions, and are aligned with and reliant on the gradually expanding peripheries of Hangzhou, Ningbo, Shaoxing, and Wenzhou.

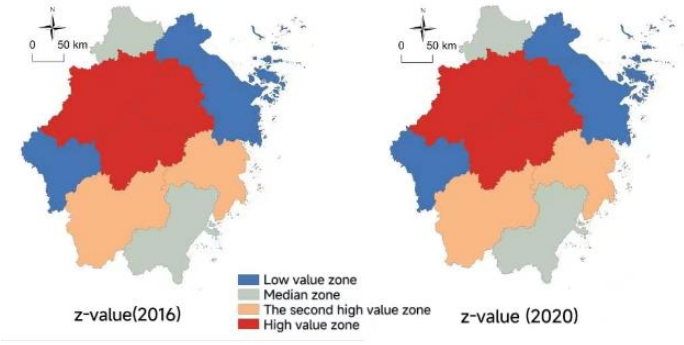

Fig.3. The σ convergence of the growth of cross-border e-commerce online retail exports in Zhejiang Province

Although the convergence and variation coefficients of cross-border e-commerce online retail exports in Zhejiang Province have been tested, the impact on the growth of cross-border e-commerce export retail cannot be analyzed yet. Therefore, further analysis is needed in the following text using convergence model.

4.2 Construction of spatial econometric models and variable selection and processing

4.2.1 Construction of spatial econometric models

According to the theory of spatial econometrics, there are two forms of spatial correlation in the export and retail activities of interval cross-border e-commerce: firstly, the export and retail activities of cross-border e-commerce in a certain region may be related to its surrounding area, or the export and retail activities of cross-border e-commerce in the entire region; Secondly, the cross-border e-commerce export and retail activities in a certain region may also be related to the initial activity level of the region. This paper draws on existing literature to construct a Spatial Lag Model (SLM):

$$Y_{it} = \rho W Y_{it} + \beta ln Re_{i,0} + \theta X_{it} + u_{it} \quad (4.1)$$

$$u_{it} = \lambda W u_{it} + \varepsilon_{it} \quad (4.2)$$

Among them, $Y_{it} = (lnRe_{it} - lnRe_{i,0})/T$, β is the convergence speed. When $\beta<0$,which indicates that the growth of cross-border e-commerce online retail exports has converged, otherwise there is divergence. The convergence speed is $\mu = -\ln(1+T\beta)/T$, ρ is the spatial lag term, $\beta<0$ is the spatial weight matrix.

$lnRe_{it}$ is the logarithm of cross-border e-commerce export retail sales in various cities which is taken as 1 in this paper, Y_{it} represents the difference between the logarithm of cross-border e-commerce export retail sales in various cities in the current period and the previous year.

4.2.2 Selection and processing of other variables in spatial econometric models

Drawing on previous literature research, this paper selects the following control variables:

（1）Regional wage levels: The theory of comparative advantage suggests that production costs play an important role in international trade, and fluctuations in the prices of labor factors can affect the growth patterns of imports and exports. For this purpose, this paper selects the average salary of employed individuals as an indicator, with the index taking the logarithm.

（2）Digital level: cross-border e-commerce is an international trade based on the open Internet. With the convenience of Internet digital technology for payment, cross-border e-commerce has greatly improved transaction efficiency and reduced transaction costs. Therefore, the level of industrial digitization has a significant impact on the development of cross-border e-commerce. To comprehensively reflect the level of digitization in various regions, a new comprehensive indicator was constructed based on the entropy method proposed by Zhang Yuzhen et al. (2013) for three different years of digital infrastructure in different cities. The steps for processing the entropy method are as follows:

1) Indicator selection: Set r year, n index, and m city, $x_{\theta ij}$ as the j indicator for the i region of the θ year.

2) Because the three characterization indicators of infrastructure have significant differences in dimensional magnitude and cannot be directly weighted by summing and weighting, it is necessary to standardize these three indicators and calculate the formula:

$$x'ij = \frac{xj - xmin}{xmax - xmin} \tag{4.3}$$

3) Determine the weight of the index and calculate the formula:

$$y_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}}, i = 1,2,\ldots,n, j = 1,2,\ldots,m \tag{4.4}$$

4) Calculate the entropy value of the second indicator using the following formula:

$$e_j = \frac{k}{\sum_{i=1}^{n} y_{ij} ln(y_{ij})}, \quad k = \frac{1}{ln(y)} > 0 \tag{4.5}$$

5) Calculate the information utility value of the second indicator using the following formula:

$$g_j = 1 - e_j \tag{4.6}$$

6) Calculate the weights of each indicator using the following formula:

$$w_j = \frac{g_i}{\sum_{j=1}^{m} g_i}, j = 1,2,\ldots,m \tag{4.7}$$

7) Calculate the comprehensive score of infrastructure development level in various cities using the following formula:

$$s_i = \sum_{j=1}^{m} w_j x_{ij}, i = 1,2,\ldots,m \tag{4.8}$$

The comprehensive level of digitization in each region was calculated using the entropy method, as shown in Tab.3..

Tab.3. Entropy Method Evaluation of Digital Level of Cross border E-commerce in Various Cities and Regions

Region	2016	2017	2018	2019	2020
Hangzhou	0.818	0.854	0.876	0.897	0.936
Ningbo	0.536	0.557	0.596	0.598	0.614
Wenzhou	0.277	0.531	0.581	0.579	0.586
Jiaxing	0.128	0.282	0.257	0.255	0.266
Huzhou	0.260	0.152	0.183	0.184	0.195
Shaoxing	0.001	0.287	0.273	0.258	0.268
Jinhua	0.510	0.379	0.469	0.403	0.405
Quzhou	0.344	0.040	0.047	0.052	0.052
Zhoushan	0.022	0.006	0.007	0.010	0.017
Taizhou	0.301	0.316	0.356	0.367	0.365
Lishui	0.046	0.045	0.051	0.058	0.062

（3）Openness to the outside world: The external economy is an important factor in promoting local economic growth. This paper selects the proportion of regional imports and exports to regional GDP to measure the degree of openness of the region to the outside world.

（4）Human capital level: According to the new trade theory, regions with abundant human capital often export products with intensive human capital or human skill factors in international trade. This paper selects the number of college students per 10,000 people in various regions.

（5）Transportation accessibility: Good transportation location advantages, such as coastal ports, airports, railway transportation hubs, high-grade highways, and other related supporting facilities, are conducive to the smooth flow of international trade. Therefore, this paper selects the total passenger and freight volume of railways, waterways, and aviation to represent the city's transportation accessibility, and the indicators are logarithmic.

（6）Industrial agglomeration degree: Krugman believes that industrial agglomeration can leverage the advantages of economies of scale and has significant external effects. Enterprises in industrial agglomeration areas are more competitive and can face a wider market. For this purpose, this paper selects the number of cross-border e-commerce enterprises in various regions and takes the logarithm of the indicators.

（7）Technological innovation level: The new trade theory also believes that if a country's industry and technological structure can fully utilize its resource endowment advantages, its production costs will be lower. Improving its competitive advantage in international trade will have a positive promoting effect on the economic development of a country or region. This paper selects the number of patent authorizations in each region and takes the logarithm of the indicators.

Tab.4. Descriptive statistics of cross-border e-commerce data in various cities and regions

variable	observations	mean value	standard deviation	minimum value	maximum value
y	44	0.3218	0.3077	-0.8921	1.6586
lnretail	44	2.4509	1.7489	-1.1087	5.9246
digital	44	0.3310	0.2625	0.0063	0.9361
lnwage	44	11.2636	0.1754	10.9360	11.6007
open	44	0.5152	0.2775	0.1782	1.1027
human	44	155.3314	99.5297	55.9446	449.6926
lnaccess	44	9.9346	0.6493	8.6039	11.1457
lnqiyeshu	44	9.2024	1.0588	7.2034	10.6982
lnpatents	44	9.8253	1.0011	7.5601	11.4339

4.3 Empirical Results Analysis of Spatial Lag Model

4.3.1 Model validation and convergence analysis

This paper uses Stata14.0 to estimate the spatial lag model (SLM) under the geographic spatial weight matrix. Through the Hausman test, the convergence model of spatial conditions in the province passed the 1% significance level test, the convergence model of spatial conditions in northeastern Zhejiang passed the 5% significance level test, and the convergence model of spatial conditions in southwestern Zhejiang passed the 10% significance level test. Random effects models were excluded and the time fixed model in the fixed effects was ultimately selected. The statistical results are shown in Tab.5. Except for the Zhejiang Southwest Spatial Absolute Convergence Model, the values of the other two models are generally well fitted.

According to Tab.5., convergence coefficient β, which means spatial conditions for the entire province, northeastern Zhejiang, and southwestern Zhejiang are -0.336, -0.830, and -0.252, respectively, all are significantly negative at the 1% level. The export value of cross-border e-commerce shows a convergent development trend. This indicates that various cities in Zhejiang Province have prioritized the development of cross-border e-commerce in recent years, leveraging their industries and resources to promote and propel its growth. In terms of convergence speed, the growth and convergence rates of cross-border e-commerce exports in the

province, northeast and southwest of Zhejiang are respectively 0.41, 1.77, and 0.29. Northeast Zhejiang exhibits a faster convergent rate than the entire province, while the provinces show a faster rate than southwest Zhejiang.

Tab.5. Estimation results of spatial externality growth convergence model

variable	Convergence of spatial conditions throughout the province	Convergence of spatial conditions in northeastern Zhejiang	Convergence of spatial conditions in southwestern Zhejiang
β	-0.336***(-4.87)	-0.830***(-6.40)	-0.252***(-3.83)
ρ	-1.055***(-5.22)	-0.409(-1.54)	-0.496*(-1.91)
lnwage	0.247(0.85)	0.236(0.57)	0.447**(2.31)
digital	2.142***(3.54)	1.074(1.03)	1.144***(3.63)
opening	0.717***(2.58)	-0.233(-0.42)	0.697***(3.94)
human	-0.001**(-2.35)	0.002(1.39)	-0.001(-0.59)
lnaccess	-0.404***(-3.40)	0.534*(1.79)	-0.208***(-3.14)
lnqiyeshu	0.151(0.91)	0.453*(1.65)	0.103(0.93)
lnpatents	-0.030(-0.16)	0.393(1.14)	0.013(0.17)
Sigma_2	0.027***(4.19)	0.024***(3.34)	0.001***(3.11)
convergence speed	0.41	1.77	0.29
Inter group R^2	0.4665	0.7945	0.0940
Observations	44	24	20
Log_likelihood	11.5696	9.8411	39.4231
Hausman test	116.82***	15.67**	13.42*

Note: *, * *, and * * represent significance levels of 10%, 5%, and 1%, respectively, with Z values in parentheses.

ρ value of the provincial convergence model is significantly negative at the 1% level, while ρ value of the convergence model in northeast Zhejiang is significantly negative at the 10% level. ρ value of the convergence model in southwestern Zhejiang is significant at the level close to 10%, and significant at the 12% level. ρ values of the three models are all negative, which is different from the phenomenon of positive ρ values in general spatial econometric models. This suggests that the growth of cross-border e-commerce exports between cities in Zhejiang Province lacks positive spatial spillovers, instead, it shows more mutual inhibition and a large number of restrictive relationships between cities.

3.3.2 Analysis of influencing factors

(1) In terms of labor wage levels, although the regression coefficients are positive for the province and Northeast Zhejiang, they are not significant. Conversely, the wage levels in the Southwest Zhejiang region have significant impact in the growth of cross-border e-commerce online retail in this region.

(2) In terms of digitization level, the regression coefficients for the whole province and southwestern Zhejiang are significantly positive, while the regression coefficients for northeastern Zhejiang are positive but not significant. Cross border e-commerce is ultimately a product that relies on industrial informatization and digitization, these levels and degree of digital infrastructure in the region has a significant impact on cross-border e-commerce trade.

(3) In terms of the level of opening up to the outside world, the regression coefficients for the whole province and southwestern Zhejiang are significantly positive, but the regression coefficients for northeastern Zhejiang are not significant. This indicates that there is spatial heterogeneity and uneven development in the degree of exposure the outside world between the whole province and southwestern Zhejiang. The level of openness to the outside world in the six cities in northeastern Zhejiang is relatively high, and the disparity between them is not significant.

(4) In terms of human capital level, the regression coefficient for the entire province is significantly negative, while the regression coefficients for the northeastern and southwestern regions of Zhejiang are not significant. This indicates that personnel engaged in e-commerce has exerted only restraining influence on the growth of cross-border e-commerce online retail. One reason for this observation may be that the overall professional quality of personnel engaged in e-commerce is not high, on the other hand, it may be that high-level personnel are concentrated in cities like Jinhua and Hangzhou. The clustering of a large number of talents has not fully capitalized the advantages of efficient allocation, but has instead caused a loss of efficiency.

(5) In terms of transportation accessibility, the regression coefficients for the whole province and southwestern Zhejiang are significantly negative, while the regression coefficients for northeastern Zhejiang are significantly positive. This indicates that the geographical location of transportation still has a certain constraining effect on cross-border e-commerce export trade. Northeast Zhejiang benefitted from an overall accessible transportation location, with the advantageous position of Hangzhou Bay Area for relatively convenient export trade activities. However, in Southwest Zhejiang, except for Wenzhou and Taizhou, which are adjacent to the sea to the east, most cities are located in mountainous inland regions, and the transportation location is relatively disadvantaged.

(6) In terms of industrial agglomeration degree, the regression coefficient of Northeast Zhejiang is significantly positive, while the regression coefficients of the whole province and Southwest Zhejiang are not significant. This indicates that the clustering of cross-border e-commerce enterprises can effectively promote the convergence of online retail growth in the local area. The agglomeration of cross-border e-commerce enterprises in the province and southwestern Zhejiang has not yet played a significant role.

(7) In terms of technological innovation level, the regression coefficients for the entire province, northeastern and southwestern Zhejiang are not significant, and the level of technological innovation currently cannot affect the convergence of cross-border e-commerce online retail growth.

5 Policy Recommendations

5.1 Government level

Fully leverage the advantages of the cross-border e-commerce comprehensive experimental zone, optimize industrial policies, encourage and support the development of cross-border e-commerce enterprises, and actively cultivate the agglomeration development of the cross-border e-commerce industry. Adjust and improve the supporting policies for the cross-border e-commerce industry, accelerate the construction of digital infrastructure and transportation technology facilities such as cloud computing, big data, artificial intelligence, and intelligent hardware; enhance the level of regional integration development, and achieve coordination and complementarity between different regions and industries. Promote the upgrading of the service industry, move towards high value-added services, promote high-quality development of the cross-border e-commerce industry in Zhejiang Province, and actively participate in international economic cooperation and labor. Improve the

vocational skills training system and accelerate the cultivation of cross-border e-commerce talents.

5.2 Enterprise level

Traditional foreign trade and manufacturing enterprises should actively engage in digital transformation, expand and strengthen cross-border e-commerce business. Intensify international market research, develop innovative products, strengthen quality management, cultivate independent brands, and expand marketing channels. Be attentive to and improve the vocational expertise of cross-border e-commerce professionals.

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Jianyan Luo *i*s currently a full professor at Zhijiang College of Zhejiang University of Technology. She received her MS degree of management from Zhejiang University in 2006 and her BS degree of economics from Nankai University. Her main research interests are in the areas of SMEs management, product management etc.

Jie Zhang obtained his Doctor of Management degree from Zhejiang University of Technology in 2019. He is currently an assistant professor at Zhijiang College of Zhejiang University of Technology. He main research interests are in the areas of regional economy, tourism economy and so on.