Study on Comprehensive Competitiveness of Foreign Trade of 95 Cities in Western China—Based on Factor Analysis

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Abstract: The comprehensive competitiveness of foreign trade is the key factor to measure the ability of a region's economy to participate in international competition and international division of labor. Improving the comprehensive competitiveness of foreign trade is a new opportunity for the western region to expand its opening-up and smoothly integrate into the new development pattern in the new period. Selecting 25 indicators from five dimensions, using factor analysis method, this paper analyzes the comprehensive competitiveness of foreign trade of 95 prefecture-level and above cities in 12 provinces and cities in the western region and puts forward policy suggestions. Using Arc GIS software to carry out density analysis on the total score, it is proved that the comprehensive competitiveness of foreign trade of provincial capital cities in southwest China is strong, and the differentiation of foreign trade development among cities in western provinces is serious. The foreign trade development of cities along “the belt and road initiative” is strong.

1. Introduction

With the deepening of China's regional coordinated development strategy, the construction of “the belt and road initiative” and the new channel of land and sea trade in western China has brought unprecedented opportunities for the development of foreign trade in western China, and the opening-up of western China has ushered in a period of late advantage. How to conform to the new requirements of the new era and new stage, build a new pattern of western development with domestic circulation as the main body and domestic and international double circulation promoting each other, and study the comprehensive competitiveness of foreign trade in the western region under the strategic background of western development, the belt and road initiative and new land-sea channel in the west is particularly important for the accurate positioning of western cities in their development. At the same time, stabilizing the basic foreign trade in the western region is of great significance for promoting them to undertake the transfer of eastern industries and realize economic catch-up.

2. Literature Review

2.1 Research on Foreign Trade in Western China

Comparatively speaking, there are still some problems in the research of foreign trade development in western China, such as insufficient attention, insufficient attention and insufficient research results. In terms of research content, the research on western China's foreign trade mainly focuses on the analysis of foreign trade dependence. Yu Shengguo et al. (2017) empirically analyzed the relationship between foreign trade dependence and economic openness to economic growth by using panel data of western provinces [1], and considered that import and export trade and social fixed assets investment are the two main driving forces for economic growth in western provinces of China. Chen Xin (2020) concluded that the technological level and traffic level in the western region have a positive impact on the dependence of foreign trade from three dimensions: technological research and development, traffic conditions and labor costs [2]. In addition, the research theory of the impact of foreign direct investment on the development of the western region

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is gradually maturing. Wu Haiying (2004) analyzed that foreign direct investment has a significant correlation with the growth of foreign trade in the western region. On this basis, Xu Aiwu (2011) and Gu Manyuan (2015) verified the win-win effect of foreign direct investment and economic development in the western region through model supplement [3-4].

In terms of research methods, the index system method is mainly used to measure the western foreign trade research, and the specific research methods include linear regression model method, quantitative evaluation method [5], grey correlation analysis method [6] and so on. The research object covers the comparative study of foreign trade in western provinces and cities, between provinces and cities, and between western provinces and cities and international and domestic regions. Some scholars focus on the theoretical research of foreign trade in the western region. Lu Wei (2019) thinks that the western region's expansion and opening-up has the characteristics of low dependence on foreign trade and obvious differentiation of foreign trade growth between and within provinces [7]. Zhou Kequan (2020) suggests that Gansu Province should be developed as the most important import and export target market from the aspects of political stability, economic development level, business environment, culture and consumption tradition, and trade facilitation [8]; Yang Yaoyuan (2021) thinks that the construction of the new land-sea channel under the new development pattern of “double circulation” will speed up the layout of the western region and link up the efficient grid logistics channel, and become an important engine to drive the double circulation of the inner and outer regions of the western region [9].

2.2 Research on Comprehensive Competitiveness of Foreign Trade

Hu Yi and Wu Hong (2007) calculated China's foreign trade competitiveness after China's entry into WTO by using the indicator of competitive advantage (RCA index) [10], Jiang Heping and Wu Ming (2010) analyzed China's foreign trade statistics from 1992 to 2007 by using four indicators of foreign trade growth quantity, quality, benefit and potential [11], Chen Haibo et al. (2014) used principal component analysis method to select three dimensions of foreign trade scale and development, foreign trade structure optimization and competitive advantage, foreign trade foundation and potential to construct foreign trade competitiveness evaluation index [12], and Yan Jianghui and You Lijuan (2019) used diamond model to establish index system to study foreign trade competitiveness of cultural industry [13].

From the above research, the evaluation system of comprehensive competitiveness of foreign trade is still incomplete at this stage, especially the research on foreign trade development in western China is still lacking. Therefore, under the background of western development and “the belt and road initiative”, it is particularly urgent to realize the gap analysis of foreign trade development among cities in western China and put forward corrective measures for the gap. On the basis of the above-mentioned scholars' research, this paper constructs an index system to evaluate the comprehensive competitiveness of foreign trade, makes an empirical analysis of 95 prefecture-level and above cities in 12 provinces and cities in the western region by using factor analysis and Arc GIS software, and makes visual processing of the data, so as to promote the promotion and coordinated development of foreign trade in the western region.

3. Construction of Research Method and Evaluation Index System

The evaluation of comprehensive competitiveness of foreign trade is an extremely complicated project, involving all aspects related to foreign trade, which requires the analysis method used to comprehensively examine multiple index variables and eliminate the influence of interference factors. Factor analysis can avoid the errors caused by various subjective scoring preferences. In table 1. It extracts a few common factors and a linear combination that only acts on a certain variable from the variables with complicated relationships, and is widely used in the analysis of multiple indicators or variables. Based on the principles of scientific, systematic, objective and rigorous research, taking into account the availability of data, this paper selects 25 positive indicators from five aspects: macro-economic environment, micro-economic environment, foreign economic and trade environment, foreign trade traffic conditions, and scientific and technological

environment, which affect the development of foreign trade, and combines the index construction methods adopted in the literature.

Table 1 Comprehensive Foreign Trade Competitiveness Evaluation Index

Primary index	Secondary index	unit	Index attribute
Macroeconomic environment	Gross regional product X_1	Ten thousand yuan	Forward
	Total retail sales of social consumer goods X_2	Ten thousand yuan	Forward
	The proportion of secondary industry in regional GDP X_3	%	Forward
	The proportion of tertiary industry in regional GDP X_4	%	Forward
	Regional GDP growth rate X_5	%	Forward
Microeconomic environment	Employment population X_6	Person	Forward
	Number of enterprises X_7	Individual	Forward
	Total enterprise income tax X_8	Ten thousand yuan	Forward
	Total profit of enterprise X_9	Ten thousand yuan	Forward
Foreign economic and trade environment	Total import and export trade of goods X_{10}	Ten thousand yuan	Forward
	Foreign direct investment contract project X_{11}	Individual	Forward
	Number of foreign-invested enterprises X_{12}	Individual	Forward
	Actual amount of foreign capital used in that year X_{13}	Ten thousand dollar	Forward
Foreign trade traffic conditions	Civil aviation passenger traffic X_{14}	Ten thousand people	Forward
	Passenger traffic X_{15}	Ten thousand people	Forward
	Highway passenger traffic X_{16}	Ten thousand people	Forward
	Highway freight volume X_{17}	Ten thousand ton	Forward
	Freight volume X_{18}	Ten thousand ton	Forward
	Civil air cargo and mail volume X_{19}	ton	Forward
	Actual urban road area at the end of the year X_{20}	Ten thousand square meter	Forward
Science and technology environment	Patent application X_{21}	Individual	Forward
	Researchers X_{22}	Person	Forward
	Research and development of internal expenditure X_{23}	Ten thousand yuan	Forward
	Ordinary colleges and universities X_{24}	Individual	Forward
	Science and technology expenditure X_{25}	Ten thousand yuan	Forward

4. Empirical Analysis of Foreign Trade Competitiveness

4.1 Data Source

This paper selects 95 prefecture-level and above cities in 12 provinces and cities in western China to construct evaluation indexes of comprehensive competitiveness of foreign trade for factor analysis. The data come from statistical yearbooks of cities in western China and government official website, mainly from China Urban Statistical Yearbook (2020) and China Statistical Yearbook (2020). Among them, the data research scope of the secondary index is the whole city, and the research scope of the actual urban road area X_{20} at the end of the year is the municipal area; Due to the serious missing data of passenger volume X_{15} and freight volume X_{18} in some provinces, the average method was used to replace them in the research process[14].

4.2 Calculation Process and Results

SPSS22.0 software is used to measure the indexes, descriptive statistics are used to standardize the collected data, and correlation analysis, KMO test and Bartlett sphericity test are carried out on the standardized data. The test results are shown in Table 2.

Table 2 Kmo & Bartlett-Test

KMO Sampling suitability quantity		0.895
Bartlett 's sphericity test	Approximate chi-square	1571.023
	freedom	300
	significance	0.000

As can be seen from Table 2, the KMO value is 0.895, indicating that there is a strong correlation among the variables, which meets the conditions for factor analysis. Bartlett's sphericity test significance level value is less than 0.001, which indicates that there is a strong correlation among variables and the factor analysis is effective.

Principal component analysis is used to extract the common factor variance of 25 indexes that affect the comprehensive competitiveness of foreign trade. Through calculation, it is found that the extraction value of 22 indexes in 25 indexes is greater than 0.8. Select the factors whose eigenvalues are greater than 1 as common factors. The first five factors, whose eigenvalues are greater than 1 and the cumulative contribution rate of variance is more than 85%, are recorded as F_1, F_2, F_3, F_4 and F_5. The maximum variance method is used to rotate the load square sum. After rotation, it is shown in Table 3

Table 3 Variance Contribution Rate and Cumulative Variance Contribution Rate

Composition	Initial eigenvalue			Sum of squares of rotating loads		
	Total	Variance %	Accumulate %	Total	Variance %	Accumulate %
F_1	15.207	60.830	60.830	10.338	41.351	41.351
F_2	2.924	11.694	72.524	5.975	23.898	65.249
F_3	1.785	7.140	79.664	2.695	10.781	76.029
F_4	1.156	4.623	84.288	2.015	8.062	84.091
F_5	1.077	4.309	88.596	1.126	4.505	88.596

The calculated component matrix and component score coefficient matrix, the common factor F_1, have a high correlation with foreign direct investment contract items X_{11}, civil aviation passenger volume X_{14}, civil aviation cargo and mail volume X_{19}, R&D personnel X_{22} and R&D internal expenditure X_{23}, and the variance contribution rate reaches 41.351%, which is the primary factor to promote foreign trade development. Therefore, F_1 is set as foreign trade. Factor F_2 mainly explains five indicators: regional GDP X_1, number of employed people X_6, number of industrial enterprises X_7, total import and export trade of goods X_{10}, and number of foreign-invested enterprises X_{12}, which completely measures the overall scale and development speed of the city. The single variance contribution rate is 23.898%, so it is set as the quantitative factor of foreign trade growth. The public factor F_3 has a strong correlation with five indicators: the proportion of secondary industry to regional GDP X_3, total enterprise income tax X_8, total enterprise profit X_9, highway passenger volume X_{16} and highway freight volume X_{17}, which reflects the level of technical content of potential urban export products and the balanced and reasonable degree of market structure. F_3 is named as an index of foreign trade growth structure. The public factor F_4 has a high correlation with the total retail sales of social consumer goods X_2, the proportion of the tertiary industry in the regional GDP X_4, the actual urban road area X_{20} at the end of the year, and the number of patent applications X_{21}. These indicators are important factors for examining the progress and effectiveness of high-quality development of regional foreign trade, and F_4 can be set as the benefit factor of foreign trade growth. The public factor F_5 explains the growth rate of regional GDP X_5, the actual amount of foreign capital used in that year X_{13}, the highway passenger traffic X_{16}, the ordinary colleges and universities X_{24}, and the expenditure on science and technology X_{25}. It emphasizes the quality benefit of economic development in the process of regional development and is set as the quality factor of foreign trade growth. According to the component score coefficient matrix, the scores of main factors of F_1, F_2, F_3, F_4 and F_5 are calculated.

According to the proportion of the cumulative percentage of each of the five main factors, the total score is weighted. Calculate the comprehensive scores of foreign trade comprehensive competitiveness of 95 prefecture-level and above cities in the western region and rank the scores.

$$F=0.467F_1+0.270F_2+0.122F_3+0.091F_4+0.051F_5 \quad (1)$$

Using Arc GIS software, the total score F of 95 cities is analyzed, and the total score is collectively plus 1. The darker part scored higher overall, while the lighter part scored lower.as show in fig.1.

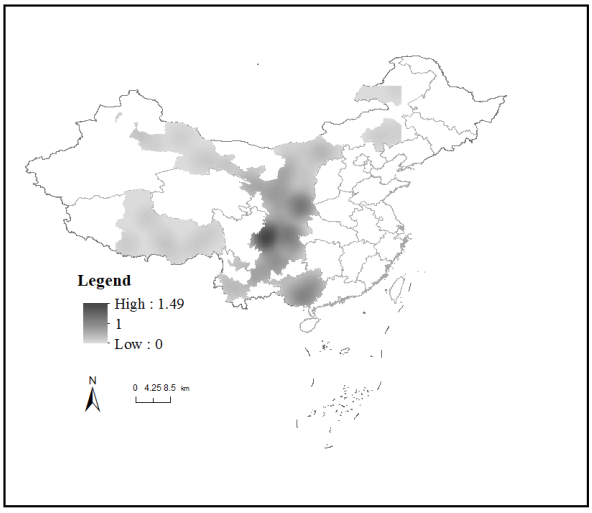

Fig.1 Analysis Results of Comprehensive Competitiveness Density of Foreign Trade of 95 Cities by Arc Software

5. Conclusion and Suggestion

5.1 Conclusion

On the basis of factor analysis, this paper constructs and analyzes the index system of 95 prefecture-level and above cities in the western region. The research shows that the foreign trade dependence of the western region is still at a low level. The comprehensive competitiveness of foreign trade of Chengdu, Chongqing, Xi 'an, Kunming and Guiyang ranks the top in the western region, and the growth and differentiation of foreign trade among and within western provinces are obvious. The core cities of urban agglomeration and provincial capitals form a strong “siphon effect”, while other peripheral cities and other peripheral cities. Chengdu, which ranks first, has a relatively high total score of F_1 factor, and its foreign trade growth potential is huge; Chongqing has the highest total score of public factor F_2, and the basic conditions for developing foreign trade are superior. From the perspective of urban distribution, among the top 30 cities, the cities in Southwest China are concentrated, showing the characteristics of massive cluster development, while the cities located in the northwest inland are few and scattered. The foreign trade comprehensive competitiveness of the node cities along the belt and road initiative in the western region is strong, relying on the provinces and cities along the China-Europe international train to occupy the advantages of foreign trade development.

5.2 Suggestion

Based on the empirical conclusion, some suggestions are put forward according to the indicators of foreign trade growth potential, foreign trade growth quantity, foreign trade growth structure, foreign trade growth benefit factor and foreign trade growth quality.

5.2.1 Adhere to Ecological Priority and Change the Extensive Development Structure.

To promote the development of the western region, construct a new pattern and achieve high-quality development, we must first keep the bottom line of ecological priority and green development unshakable. Affected by geographical location and extreme climate, the ecological environment in many areas of western China is fragile, and once destroyed, the treatment cost is extremely high. In the process of economic development, it is necessary to ensure local ecological

security, protect local ecological resources, strengthen source control, persist in protection in development, develop in protection, establish a circular thinking in development, promote the sustainability of raw materials and production equipment, improve the recycling transformation of production and consumption processes, strive to explore the path of transition to low-carbon emission reduction, and resolutely shoulder the important task of building and keeping the important ecological protection barrier in the western part of the country; Abandon the traditional extensive development path and promote the transformation and upgrading of traditional industries to the direction of high technology, high growth and high added value.

5.2.2 Self-Sufficient Local Characteristics, Giving Full Play to Comparative Advantages.

To transform the western region into a high-quality development direction, we must properly handle the relationship between expanding the import and export quantity and improving the import and export quality. Processing trade is an important pillar of foreign trade in the western region. On the basis of developing export processing trade, the western region should be good at basing itself on local characteristics, gathering superior resources, making efforts to explore the processing industry and manufacturing industry of agricultural products with local characteristics, and promoting products with regional characteristics to go abroad and go global. Give full consideration to the coordinated development, coordinated development and common development between the western region and the developed areas in central and eastern China, and other countries and regions, and improve the interconnection level between the western region and Southeast Asia, Eastern Europe and other countries and regions, so that the advantages of natural resources, location and labor force in the western region can be better transformed into economic advantages of opening to the outside world.

5.2.3 Attach Importance to the Cultivation of Production Factors and Improve the Competitiveness of Attracting Foreign Investment and Technology.

When the economic conditions of western provinces are close, the traditional productivity factors such as labor, land, transportation, science and technology have become the competition focus of western provinces to attract foreign investment and undertake industrial transfer. The perfection of infrastructure has obvious multiplier effect for the western region with relatively backward economic conditions. The local government should speed up the completion of infrastructure shortcomings, expand the radiation range of China-Europe international trains, the new land-sea channel in the west and the economic belt along the Yangtze River, build an international comprehensive transportation hub, enhance the radiation linkage of transportation facilities, give full play to the role of the belt and road initiative, strengthen the radiation linkage of Chengdu-Chongqing Twin Cities Economic Circle, West Triangle Economic Circle and Beibu Gulf Urban Agglomeration, and form an open development matrix covering the western region with the linkage of land, sea and home, and mutual benefit between east and west.

5.2.4 Finish in Top-Level Design and Improve Laws and Regulations.

In terms of foreign trade policy, the western government should strengthen legislation to provide legal and regulatory protection for the development of foreign trade enterprises in the western region. The local government should closely cooperate with and actively implement the central policies, strive for and seize policy opportunities, undertake the industrial transfer in the eastern region in an orderly manner, vigorously promote the development of trains between China and Europe, enlarge and strengthen the construction of the south-west land-sea corridor, and enhance the agglomeration effect of export-oriented industrial chains. For a long time, the existence of tangible or intangible trade barriers in the western region has become an important reason why foreign investment is discouraged. To build a new highland for foreign investment in the western region and attract more foreign investment and trade orders, it is necessary to expand the opening up, continuously optimize the business environment and eliminate market access barriers.

5.2.5 Strengthen the Platform Construction and Improve the Level of Digitalization of Foreign Trade.

The unbalanced regional distribution, low efficiency and insufficient capacity of the western open platform for foreign trade lead to the limited effect of foreign trade expansion and quality improvement in the western region [14]. The western region should strive to catch up with the opportunity of Industry 4.0, promote the construction of the big data platform of the Internet of Things, shift to the direction of process design and optimization of manufacturing, intelligent logistics and intelligent manufacturing system, and promote data "going to the cloud" through platform construction to provide multi-angle, visual, shareable and guaranteed information services for related enterprises; Western foreign trade enterprises should attach importance to the construction of online comprehensive services and trading platforms, and build more professional and vertical cross-border e-commerce service platforms with outstanding local characteristics; The construction of digital platform in the western region will further improve the level of digitalization of foreign trade, improve the ability and level of foreign trade enterprises to make use of two markets and two resources at home and abroad, open wider, wider and deeper to the outside world, and promote the western region to better participate in international economic cooperation.

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