

Article

Comparison of Competitiveness of the Textile Industry between China and the World's Three Major Textile Centers

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Abstract: From the results of China's "13th Five-Year Plan". Scientific and technological innovation has achieved remarkable results, and the textile industry has achieved the development of the entire industrial chain. Therefore, this article analyzed the international competitiveness of China's textile industry by comparing China's textile industry with the countries related to the world's three major textile centers. Firstly, based on the niche theory and the Michael Porter Diamond model, an evaluation index system for the textile industry niche was constructed. For countries, related to the three major centers of the textile industry, analyzed the relative niche and comprehensive niche scores of each dimension from 2016 to 2019. The world textile industry was measured according to the niche theory. The Vulnerability Index was calculated from normalized data. The aim was to explore the competitiveness of the textile industry in various countries as well as the future development potential and trends. According to the research results, the textile industry competitiveness of the 10 countries was divided into three levels. The first level was China, the second level was the United States, and India and the remaining seven countries were at the third level. The results showed that as of 2019, the comprehensive competitiveness of my country's textile industry was far ahead of other countries, and development potential and trends were better than in other countries in the future. However, at the same time, to further improve the international competitiveness and comprehensive strength of the textile industry, there was also necessary to pay attention to the coordinated development of social and government support.

Keywords: Niche Theory, Industry competitiveness, Textile industry, Vulnerability index

1. Introduction

At present, the world has formed three major centers of the world textile industry¹ (after this omitted as "three major centers"). Currently, there was the only country with a complete industrial chain in China which was among three major textile centers. In addition, around the world, China was the most important textile production and trading country. Although the export scale of my country's textile and garment products was large, it still lacked absolute brand advantages and core technologies. At the same time, sino-US trade frictions and various international issues occur frequently, which have a certain degree of impact on the sustainable development of the world's textile industry. Therefore, it is of great significance to study the competitiveness and sustainable development potential of China's textile industry and the textile industry of the countries related to the three major centers for developing the world textile industry.

Every living thing has its place in nature. In the long-term evolution process, different organisms have gradually formed a unique developmental system through competition and cooperation (Cheng and Fang, 2015). Scholars gradually discovered the regularity, and gradually formed the concept of ecological niche theory (Colinvaux, 1986; He and Peng, 2021; Li et al., 2006; Li and Luo, 2015; Li, 2017). With the continuous enrichment of the theory, its application in measuring regional industrial competitiveness was becoming more and more prominent. The application was also more and more extensive in our country (Liu, 2018; Macarthur and Pianka, 1966). The study found striking similarities in the textile industry and biology across the regions. This provided the possibility and scientificity to use the ecological niche theory to evaluate the competitiveness of the regional textile industry. However, there were still some differences between socioeconomic ecosystems and natural ecosystems. The main reason was that the former was more prone to fluctuations and less stable². This feature quantified the competitiveness of the textile industry. Vulnerability was one of the research topics of regional sustainable development which origins in natural hazard science and was widely used in many areas of ecology and sustainability science. To better explore the problems that arise in the process of regional

¹ Three major centers of the world textile industry: The China-led "China+South Asia+ASEAN" region, the EU and North America.

sustainable development(Ren, 2015). Therefore, With the help of vulnerability theory and niche vulnerability index. The differences in the textile industries of the three countries related to the center were analyzed and put forward targeted scientific suggestions.

2. Literature Review

Over the years, the textile industry has been an indispensable pillar industry for the national economy and people's livelihood and economic development. Therefore, domestic research results were rich in the textile industry. The research was mainly aimed at the factors, evaluation, analysis, and improvement strategies that affected the competitiveness of the textile industry(Ren, 2015; Sun et al., 1987; Sun and Ren, 2020). Among them, Li (2010) based on the reality of development, starting from four dimensions of resource support, economic development, technological development, and coordinated development of society and environment. There was constructed an evaluation index system for the sustainable development capability of China's textile industry. There reflected the comprehensiveness of China's textile industry itself, the feasibility of data, and the combination of qualitative and quantitative characteristics. Zou (2014) based on comparative advantage theory, competitive advantage theory, and diamond model. There was considering the four elements of production factors, demand conditions, industrial structure, and enterprise management. There was making the textile industry more comprehensively reflecting the competitive situation of enterprises. Chen et al. (2019) reported that used the Porter Diamond Model analysis framework to divide the factors affecting the international competitiveness of the textile and garment industry into the following six categories, production factors, demand conditions, related and supporting industries, enterprise structure, and strategy, peer competition, government, and opportunity. Among them, the indicator of production factors was further divided into natural resources and labor resources, and related and supporting industries included raw materials, the textile machinery industry, textile research institutes, and industry associations. According to the Diamond Porter model, Liu (2018) reported divided primary indicators under production factors into primary production factors and advanced production factors. Also, there was divided demand into domestic demand and external demand, which was slightly different from Chen et al. (2019). Li (2017) also employed Porter's diamond system, known as the theory of competitive advantage. The current situation, advantages, and disadvantages of the international competitiveness of the textile industry were analyzed from six aspects of production factor conditions, demand conditions, supporting industries, enterprise strategic structure with competition, opportunities, and government-related conditions. There were abundant research results on the competitiveness of the textile industry, and different scholars have different research perspectives.

In ecological niche theory, domestic scholars have applied the theory to the competitiveness and strategic management of architecture, culture, tourism, and other industries. In the empirical studies, scholars have primarily conducted a quantitative analysis based on the ecological niche width, overlap degree, and the "state and potential" model and measured the industry ecological niche score. A higher score indicates a more competitive industry. For example, Li (2015) quantitatively analyzed the development of Shanghai's cultural and creative industries from three perspectives: ecological niche width, ecological niche overlap, and ecological niche "state" and "potential" based on ecological niche theory. Based on the ecological niche perspective, Cheng (2015) compared the competitiveness of cultural tourism and creative industries with 16 cities in the Yangtze River Delta as empirical research objects. There established a competitiveness evaluation model and form an evaluation system for industrial ecological conditions. Based on the ecological position theory, Sun et al. (2020) constructed an evaluation index system for cultural and creative industries. There was taking the cultural and creative industries of 31 provinces and cities in China as the analysis object. The ecological niche model was used to measure its evolution from the space-time dimension. Li et al. (2019) used a multi-dimensional super volume ecological niche model to comparatively analyze the ecological niche of tourism industry competitiveness of each province in four aspects, such as ecological niche value, ecological niche width, ecological niche overlap and ecological niche suitability based on the statistical data of nine provinces in the New Silk Road Economic Belt. Due to different research directions, scholars have adopted different methods and applied them to the competitiveness research of multiple industries. However, there were relatively few empirical studies applied to the textile industry, especially the lack of research on the international competitiveness of China's textile industry from a regional perspective.

Therefore, the research took the world's top ten traditional textile powers as examples. There was using the ecological niche theory for reference, through the ecological niche "state" model, "potential" position, and comprehensive ecological niche. To the comprehensive analysis of the development trend of the textile industry in various countries. The article combined Porter's diamond model, the status quo of the textile industry, and the index system constructed by predecessors(Wang et al., 1984). Finally, an evaluation system including 5 dimensions and 22 indicators was constructed. From 2016 to 2019, the ecological status values of different dimensions were measured and calculated in each country. There was studying the international competitiveness of the textile industry and conducted a comparative analysis in various countries. Then, with the support of the vulnerability theory, the ecological niche vulnerability values of different dimensions in different countries were calculated through the vulnerability

model (Macarthur and Pianka, 1966). There was discussed the trend and potential of sustainable development of the textile industry in various countries. There were provided feasible suggestions for the future development of China's and the world's textile industry.

3. Study Design

3.1. Textile Industry Eco-location Evaluation Index System

Based on the ecological niche theory and Porter's diamond model, this paper synthesizes previous scholars' results on the textile industry's competitiveness and the evaluation index system. Finally, it constructs an index system to evaluate textile industry competitiveness with 5 dimensions, including economic development dimension, science and technology development dimension, social coordination development dimension, resource support, and government support dimension, totaling 22 indicators, as shown in Table 1, by reviewing information and collecting data, taking into account the principles of scientificity, authenticity, accessibility, representativeness, and feasibility.

Table 1. The index system for evaluating the niche of the textile industry.

	Tier 1 Indicators	Secondary Indicators
The comprehensive ecological niche of textile industry competitiveness	Economic Development Dimension	E1 GDP (Billions of dollars)
		E2 Industrial value added (Billions of dollars)
		E3 Textile and apparel manufacturing value added (Billions of dollars)
		E4 Textile exports value (Billions of dollars)
		E5 Apparel export value (Billions of dollars)
	Technology Development Dimension	T1 Number of textile patent technologies (pcs)
		T2 Number of R&D personnel per million people (persons)
		T3 R&D investment (Billions of dollars)
	The socially coordinated development dimension	S1 Energy intensity level of primary energy (Millions of dollars/2017 PPP GDP)
		S2 Carbon dioxide emissions (kg/2017 PPP GDP)
		S3 Renewable energy consumption (Percentage of total final energy consumption)
	Resource Support Dimension	R1 Crude oil production (Millions of barrels)
		R2 Container port throughput (10,000 cases)
		R3 Air Transport: Cargo Turnover (Million ton kilometers)
		R4 Labor force population (10,000 persons)
		R5 Number of employees in the textile industry (1000 persons)
		R6 Natural fiber planting area (million hectares)
		R7 Natural fiber production (million tons)
	Government Support for Maintenance	G1 Export Compliance Costs (USD)
		G2 Import compliance costs (USD)
		G3 Number of start-up procedures for registered businesses (pcs)
		G4 Ease of Doing Business Score

3.2. Textile Industry Eco-location Measurement Model

In this paper, according to the ecological niche "state" and "potential" model, relative ecological niche, and comprehensive ecological niche model, the textile industry competitiveness ecological niche is measured, and the calculation formulae are as follows.

$$T_i = \sum_{i=1}^q (X_i * \alpha_i) \quad (1)$$

$$S_i = \sum_{i=1}^q (Y_i * \alpha_i) \quad (2)$$

$$Z_i = \frac{T_i + A_i * S_i}{\sum_{i=1}^p (T_i + A_i * S_i)} \quad (3)$$

T_i means "state" and S_i means "trend", so T_i was calculated as the value for a particular year in the region, and S_i was calculated as the average of the changes in recent years, where X_i and Y_i were the values normalized according to the Min-Max method, respectively, and α_i was the weight of each indicator calculated using the entropy value method. Z_i means the relative ecological niche of country i . A_i was the dimensional transformation coefficient. In this study, all the indicators were dimensionless evaluation indicators after being standardized in the previous section, so A_i was constant at 1.

$$ST_i = \frac{\sum_{j=1}^m P_{ij}}{m} \quad (4)$$

ST_i is the comprehensive ecological niche of the textile industry in country i , P_{ij} is the relative ecological niche of country i in each dimension of the evaluation index system, m is the Number of ecological niche evaluation indicators and $m = 5$ in this study.

3.3. Textile Industry Niche Vulnerability Evaluation Model

According to the ecological niche evaluation index system constructed above, the data have been standardized in the previous calculation of ecological niche state and potential. The index weights have been calculated using the entropy value method, so in this step, only the comprehensive index of vulnerability for each dimension in each country needs to be calculated according to the comprehensive index method. The formula is shown below.

$$S_{ij} = w_j * X_{ij} \quad (5)$$

$$S_i = \sum_j^n S_{ij} \quad (6)$$

In the above formula, S_i means the textile industry's ecological niche vulnerability, X_{ij} is the standardized value, w_j is the weight of each indicator calculated above, and n is the Number of indicators.

4. Analysis of Results

4.1. Textile Industry Competitiveness Niche Measurement

In academic research, the measure of the "situational" niche varies according to the focus of the research. There was considering data availability, data from 2016–2019 were taken. The "potential" value of a niche was measured by the average value-added of each indicator. Firstly, Data were normalized using the extreme value method. Then, the processed data was substituted into the above model. There were computed the niche value of the textile industry competitiveness of the three center-related countries. As shown in Table 2, China's textile industry competitiveness ecological niche score ranks first among the sample countries, with an ecological niche score greater than 0.2. The second and third places are the United States and India, whose ecological niche scores are between the U.S. and India, respectively. The niche scores were between 0.1 and 0.2. The ecological niche scores of the competitiveness of the textile industry in the remaining seven countries were below 0.1.

Table 2. The niche score of competitiveness of the textile industry in related countries.

Country	Economic Development Dimension	Ranking	Technology Development Dimension	Ranking	The socially coordinated development dimension	Ranking	Resource Support Dimension	Ranking	Government Support for Maintenance	Ranking	Integrated Ecological Niche	Ranking
USA	0.1553	2	0.2897	1	0.0939	4	0.2777	2	0.0974	5	0.1828	2
China	0.4461	1	0.2799	2	0.1401	3	0.3077	1	0.1405	2	0.2628	1
India	0.0917	3	0.0366	9	0.1468	2	0.1965	3	0.1585	1	0.1260	3
Japan	0.0463	6	0.0919	3	0.0748	7	0.0360	4	0.1122	4	0.0722	5
UK	0.0386	9	0.0497	6	0.0550	10	0.0312	7	0.0750	7	0.0499	9
Vietnam	0.0611	4	0.0197	10	0.1826	1	0.0359	5	0.1368	3	0.0872	4
France	0.0400	8	0.0520	5	0.0739	8	0.0260	9	0.0572	10	0.0498	10
Italy	0.0419	7	0.0438	8	0.0792	6	0.0251	10	0.0644	8	0.0509	8
Germany	0.0515	5	0.0884	4	0.0708	9	0.0305	8	0.0941	6	0.0671	6
Belgium	0.0275	10	0.0483	7	0.0828	5	0.0336	6	0.0640	9	0.0512	7

4.2. Measurement of the Vulnerability of Ecological Niche Dimensions

Ecological niche research was to observe the level and status of the sustainable development of the regional textile industry by calculating the scores of each dimension and the comprehensive score. Vulnerability research was to show the trend and potential of sustainable development of the regional textile industry by measuring the degree of vulnerability of the region. In vulnerability studies, normalized data were substituted into the models described above. From 2016 to 2019, there were calculated and kindred the five-dimensional vulnerability index and comprehensive ecological status of each country. As shown in Table 3, China's textile industry competitiveness niche has the highest composite index of vulnerability, between 0.6 and 0.8. Like the composite ecological niche score, the United States and Japan follow in second and third place with 0.2 to 0.4. The composite vulnerability index of the competitiveness niche of the textile industry in the remaining seven countries is below 0.2.

Table 3. Vulnerability index of ecological niches by dimension.

	Economic Development Dimension		Technology Development Dimension		The socially coordinated development dimension		Resource Support Dimension		Government Support for Maintenance		Vulnerability Composite Index	
Country	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking
USA	0.0674	2	0.1379	1	0.0213	4	0.2230	3	0.0433	4	0.4928	2
China	0.2420	1	0.1354	2	0.0484	1	0.2983	1	0.0424	5	0.7665	1
India	0.0339	3	0.0112	9	0.0387	2	0.2488	2	0.0480	3	0.3805	3
Japan	0.0209	6	0.0686	3	0.0119	7	0.0194	4	0.056	2	0.1770	4
UK	0.0097	9	0.0193	6	0.0041	10	0.0134	7	0.0273	7	0.0738	7
Vietnam	0.0122	7	0.0014	10	0.0363	3	0.0144	5	0.0619	1	0.1262	6
France	0.0115	8	0.0219	5	0.0103	8	0.0053	8	0.0115	9	0.0605	8
Italy	0.0213	5	0.0118	8	0.0094	9	0.0032	10	0.0128	8	0.0585	9
Germany	0.0252	4	0.0363	4	0.0122	6	0.0134	6	0.0420	6	0.1291	5
Belgium	0.0035	10	0.0152	7	0.0130	5	0.0042	9	0.0097	10	0.0457	10

4.3. Comprehensive Analysis of Ecological Niche Score and Vulnerability Index Measurement Results

The above results were clustered and analyzed by SPSS software, respectively. The results were shown in Fig. 1 below. According to the cluster analysis results, the total niche score and eco-location vulnerability index of the competitiveness of the textile industry in 10 countries were divided into three grades. Still, the grading results were the same, and all three grades were as follows:

- (1) China;
- (2) United States, India;
- (3) Japan, the U.K., Vietnam, France, Italy, Germany, and Belgium.

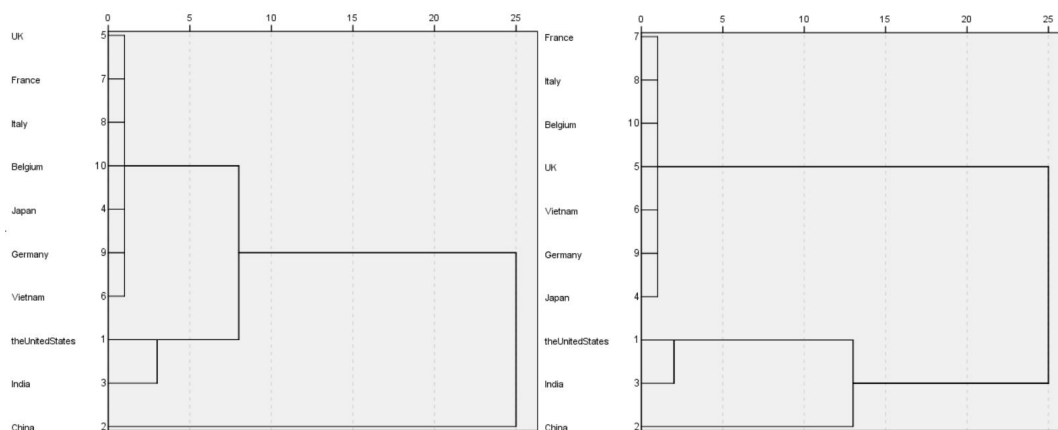


Fig. 1. Clustering spectrum of composite niche score (**left**) and niche vulnerability index (**right**) of textile industry competitiveness by country.

According to the study's results, in the case of China, an enormous contribution to the overall niche score of textile industry competitiveness was the economic development and resource support dimension, followed by the science and technology development dimension. However, the dimensions of government support and coordinated social development need to be improved. China's textile industry competitiveness comprehensive niche score and niche vulnerability index both ranked first, entering the "13th Five-Year Plan" period. The comprehensive competitiveness of China's textile industry was strong, and the future development potential was huge. Compared with other countries, the trend was better.

As far as the United States was concerned, in this paper, textile industry competitiveness ranked second among the ten countries studied in terms of comprehensive niche score and niche vulnerability index. The largest contribution to the comprehensive niche score was the dimension of technology development and resource support. In contrast, the economic development dimension, the social coordination development dimension, and the government support dimension need to be improved. India's textile competitiveness ranked third in both the Composite Niche Score and Niche Vulnerability Index. Among them, the three dimensions of coordinated social development, resource support, and government support contribute the most to the country's comprehensive niche score. The dimensions of economic development and technological development need to be focused on to improve the competitiveness of the national textile industry in the future. However, from a comprehensive perspective, the United States and India have an overall niche score higher than 0.1 and an eco-location vulnerability index higher than 0.3. The development status of the textile industry and its future development trend and potential were relatively good.

From the composite niche score and the niche vulnerability index. China's textile industry ranked first in terms of development trends. From a practical point of view, in the past two years, the improvement and efforts of China's textile industry have indeed helped to further enhance and consolidate international competitiveness. Among them, economic development and resource support affected the competitiveness of China's textile industry. These two dimensions have always had a strong competitive advantage. The rapid economic development, China's friendly relations with other countries, and the inherent advantages of its vast territory, as well as the resource advantages created by the latter. All have made great contributions to the future development of China's textile industry. However, China's textile industry, whether the current situation or the future development trend of science and technology innovation was not as good as the United States, so India in this regard should also pay particular attention. In addition, competition and confrontation between China and the United States restricted the import and export of textiles, clothing, and raw materials. Therefore, In the future, the development of the textile industry in various countries will be adversely affected. How this adverse effect affected the competitiveness of the textile industry depends on what measures governments took to deal with it. From

the results of this paper, even the competition and confrontation between China and the United States changed the global value chain and market structure. China's textile industry has a complete industrial chain and low dependence on foreign countries. The future development trend was still clear and less affected by Sino-US relations. In the future, if faced with tension in Sino-US relations. The United States lacks the support of China, a large trading partner. Its textile industry will be adversely affected to a certain extent. At the same time, India should also learn from China's "multilateral development" and promoted the balanced development of the industrial chain. In response to changes in the future global market structure and the value chain of the textile industry. There were enhanced the international competitiveness of the domestic textile industry.

The rankings of the 7 countries ranked third in the comprehensive niche score of textile industry competitiveness and the ranking of the niche vulnerability index was different. For example, Japan's textile industry competitiveness comprehensive niche score ranking (fifth) was second only to Vietnam (fourth). In the Textile Niche Vulnerability Index, Japan ranked (4th) ahead of Vietnam (6th). There were indications that the development process of Japan's textile industry from 2016 to 2019, was not as good as Vietnam these years, however, its development potential and future development trend were better than Vietnam's. For Vietnam and India, there was critical for the competitiveness of the textile industry to improve the ability of technological innovation in the future. After a long period of development and prosperity, the United Kingdom, France, Italy, and Germany have the traditional textile industry. Their technologies were more mature and their innovation capabilities were more substantial. Nevertheless, affected by the economic development and resource support of these countries, the textile industry was relatively weak at present. The revitalization of the textile industry has a long way to go in the future.

5. Conclusions

In this paper, firstly, based on the ecological niche theory and Porter's diamond model, and combined with the findings of previous scholars, we constructed an ecological niche evaluation index system for the competitiveness of the textile industry from five dimensions: economic development, resource support, scientific and technological development, collaborative social development and government support. The data from 10 major textile countries including the United States, China, Japan, and India from 2016 to 2019 were collected, and the relative ecological niche and comprehensive ecological niche of each dimension were calculated. Then, the vulnerability index of each country's ecological niche was measured by using the vulnerability theory model. The research results demonstrated that the competitiveness of China's textile industry ranked first in both the total niche score and the niche vulnerability index. The relative ecological niche of the technology development dimension was second only to the United States. In the textile industry, this showed that China's "Thirteenth Five-Year Plan" has achieved results in accelerating technological innovation. At the same time, in the future, efforts should be made to strengthen the dimensions of government support and coordinated social development. That is to say, the government should increase support, support the textile industry, optimize the business environment of enterprises, formulate preferential policies for import and export, increase the income of import and export trade, and further expand the international market.

As for the USA, textile competitiveness ranked second in terms of overall niche score and niche vulnerability index. The competitiveness and future development trends of the textile industry were relatively good. Nevertheless, we still need to pay attention to the influence of the government support dimension, socially coordinated development dimension, and economic development dimension on the competitiveness of the textile industry. Based on the advantage of low labor costs, India and Vietnam attracted many foreign investments into the country. The two countries for the development of science and technology and economic development in the future need to focus. On the contrary, the United Kingdom, Germany, Italy, Japan, and France were old textile powers. In the case of a weak national economy, the market demand was not strong. The focus of the market was too biased, targeting a certain market segment. At present, there was necessary to change the future development trend of the textile industry and enhanced international competitiveness. We should attach great importance to the impact of economic development and resource support on the development of the textile industry. As a veteran "carpet" powerhouse, Belgium should also strengthen scientific and technological innovation in the future. While expanding the richness and influence of products, there also expanded the possession and utilization of resources to promote economic development.

The COVID-19 outbreak occurred at the end of 2019. At that time, the number of cases at the social level was low. From the data collected, only a few indicators saw a slight decline in 2019. This did not mean that this was the result of the emergence of the new coronavirus. Therefore, this article believed that the impact on the national economy and textile industry was ignored. The real impact on the economy and the textile industry started with the outbreak of the epidemic in 2020. Because of this, the data of various countries were not disclosed normally, resulting in missing data. This was why the data collection for this article ends in 2019. The research on the competitiveness of the textile industry after 2020 was the short board of this paper. In the future, under the normalization of the epidemic situation, the impact of COVID-19 on the competitiveness of the textile industry was studied.

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