Research on the Temporal Evolution Characteristics of High-Quality Development of Manufacturing Industry in the Pearl River Xijiang Economic Belt

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Abstract: *Based on the five major development concepts, this paper constructs the high-quality development level index of the manufacturing industry, measures the high-quality development level of the manufacturing industry in the Pearl River Xijiang Economic Belt from 2012 to 2020, and explores the temporal and spatial evolution characteristics of the high-quality development of the manufacturing industry in the river basin. The results show that the characteristics of high-quality development level of manufacturing industry in the basin show an inverted "U" curve trend, which is manifested as the development characteristics of "one axis and dual core" in Guangxi and Guangdong in terms of regional development differences. Finally, by summarizing the development characteristics of "one axis and two cores" in the river basin and drawing on the development ideas of metropolitan areas, this paper proposes to build four functional development zones of green innovation, cooperation and collaboration, structural transformation and openness and sharing, so as to provide a theoretical basis for the high-quality development of manufacturing industry in the river basin.*

Keywords: Pearl River Xijiang Economic Belt, Manufacturing, High-quality development

1. Introduction

In the face of the impact of the new crown epidemic on the global economy, China's traditional manufacturing export demand has fallen sharply, and the advantage of labor demographic dividend has gradually decreased, resulting in the gradual decline of the dominant position of labor of China's manufacturing enterprises. As the lifeblood of China's real economy, accelerating the transformation and upgrading of traditional manufacturing is an urgent need to improve the core competitiveness of the market and cope with the normalization of the new crown epidemic. In particular, the "14th Five-Year Plan" period is a period for China to leapfrog from an industrial power to an industrial power, and the improvement of manufacturing innovation capabilities and the realization of transformation and upgrading will provide important support for China to become a manufacturing power. To achieve a manufacturing power, it is not only necessary for the developed regions represented by the Yangtze River Delta and the Pearl River Delta to maintain an innovative development trend, but also to give full play to the coordinated development role of cross-regional economic belts such as the Pearl River Xijiang Economic Belt, realize the interconnection of industrial chains in the east and west, enhance the economic resistance of less developed regions to uncertainty risk tension, and make full use of the Pearl River Xijiang River Basin to "learn from the east and coordinate with the west" The location development advantages provide a variety of resource support for the realization of the manufacturing industry in the basin to climb to the high-quality development level. As a connecting belt connecting developed eastern regions and less developed western regions, the Pearl River Xijiang Economic Belt is in a critical period of transformation and upgrading of the manufacturing economy to high-quality development. Exploring the temporal and spatial evolution characteristics of the high-quality development level of manufacturing industry in the river basin since the "plan" was proposed, which is conducive to local governments to provide policy guidance for high-quality development according to local conditions, and provide theoretical support for the transformation and upgrading of manufacturing industry in the river basin.

Therefore, this paper analyzes the high-quality development characteristics of manufacturing industry in the Pearl River Xijiang Economic Belt from the basic fluctuation characteristics, grade level characteristics and regional characteristics according to the measurement results.And on the basis of summarizing the previous research, four functional areas of green innovation, cooperation and collaboration, structural transformation, and openness and sharing were proposed to empower the

internal system of the basin rovide theoretical support for the high-quality development of the manufacturing industry.

2. The Variable Measurement of the High-Quality Development Level of Manufacturing Industry in the Pearl River Xijiang Economic Belt

2.1. Construction of an Index System for Evaluating the High-Quality Development Level of the Manufacturing Industry

This paper is based on the five major development concepts, and draws on the basic ideas of Li Qun[1] scholars to construct indicators, and to innovate, coordinate, green, open and share the five dimensions of its high-quality development level evaluation index system of manufacturing industry.

Table 1: Construction of high-quality development level evaluation index system of manufacturing industry.

Level 1 indicators	Secondary indicators	How indicators are calculated	unit	Metric properties
innovation	Investment in innovation	R&D expenses internal expenditure (million yuan) / number of manufacturing enterprises above designated size (items).	million yuan/item	Positive
	Innovation output	Number of new product development projects (items) / number of manufacturing enterprises above designated size (items).	item	Positive
harmonize	Growth	Growth rate of added value of manufacturing above designated size (%)	%	Positive
	Business efficiency	Total operating profit of manufacturing / main business income	%	Positive
green	Wastewater treatment	Total industrial wastewater discharge (10,000 tons)	Tons of tons	Negative
	Solid waste disposal	Comprehensive rate of industrial solid waste utilization (%).	%	Positive
opening	Capital correlation	Manufacturing: Hong Kong, Macao, Taiwan and foreign-invested enterprises: output value/total manufacturing output value	%	Positive
	Trade interconnectedness	Merchandise exported by manufacturing / gross output value of manufacturing	%	Positive
share	Employment status	Number of employees in manufacturing (10,000)	10,000 people	Positive
	Tax situation	Total profits and taxes of manufacturing enterprises (million yuan)	million	Positive

Innovation is the first source of power to achieve development, and the steady advancement of high-quality development should focus on innovating science and technology, adhering to the innovative concept of constantly equalizing excellence, and realizing the upgrading and reengineering of technology sources. And continue to strengthen scientific and technological innovation investment, optimize product design and creation, and improve the quality of final products, therefore, the innovation dimension mainly takes innovation input and innovation output as the secondary indicators to measure innovation.The intrinsic requirement of coordination is sustainable development, reflected in the high-quality development of the manufacturing industry, to maintain the integrity and balance of the manufacturing production process, especially the manufacturing enterprises above the scale, more need to focus on the level of coordinated development, therefore, the coordination dimension is mainly based on the growth rate, business efficiency as the secondary indicators to measure coordination. Green development is reflected in the high-quality development of the manufacturing industry in the symbiosis of environmental pollution and enterprise production and discharge. The manufacturing industry is obliged to take responsibility for the pollution discharge problem in the production and manufacturing process, and solve the environmental pollution problem caused by the waste discharge in the surrounding area. Therefore, the green dimension mainly takes wastewater treatment and solid waste treatment as secondary indicators to measure green.Opening up is the only way to promote high-quality development, and the degree of domestic and foreign trade relations and capital correlation will be re-evaluated from the perspective of the international market to the local high-quality level, and this kind of internal and

external linkage exchanges and cooperation is the key to ensuring the steady improvement of high-quality development. Therefore, the openness dimension mainly takes the degree of capital correlation and trade correlation as the secondary indicators to measure openness. Sharing is mainly concerned with social equity issues, manufacturing enterprises should contribute to improving people's happiness and satisfaction while creating economic benefits, and uphold the principles of sharing by the whole people, comprehensive sharing, joint construction and sharing, and asymptotic sharing, so as to continuously improve the happiness index of people's lives. Therefore, the shared dimension takes employment and tax status as the secondary indicators to measure sharing.

Based on the connotation of high-quality development of manufacturing industry and the actual development of manufacturing industry in Xijiang Pearl River[2-3], and considering the principles of systematic, comparability and data availability of index selection, this paper takes the level of innovation, coordination, green, openness and sharing as 5 first-level indicators, and 11 self-built indicators such as innovation input As a secondary index, build a high-quality development level evaluation index system for the manufacturing industry, and the specific results are shown in Table 1.

2.2. Evaluation Methods for the High-Quality Development Level of the Manufacturing Industry

Based on the 10 indicators of the high-quality development level of the manufacturing industry, the entropy value of the primary index is determined by the extreme entropy method [4-5]for the secondary index, and then the entropy value of the first-level five-dimensional index is determined by the same method, and the high-quality development level of the manufacturing industry can finally be calculated. The specific steps are as follows:

(1) Determine the index properties and standardize them using the range method.

Positive indicator standardized formula:

$$X_{ij} = \frac{x_{ij} - \min(x_{1j}, x_{2j}, \dots x_{nj})}{\max(x_{1j}, x_{2j}, \dots x_{nj}) - \min(x_{1j}, x_{2j}, \dots x_{nj})} \quad (1)$$

Negative indicator standardization formula:

$$X_{ij} = \frac{\max(x_{1j}, x_{2j}, \dots x_{nj}) - x_{ij}}{\max(x_{1j}, x_{2j}, \dots x_{nj}) - \min(x_{1j}, x_{2j}, \dots x_{nj})} \quad (2)$$

Among them, X_{ij} represents the value of the ith evaluation index after normalization, and X_{ij} is the original data.

(2) Determine the information entropy.

The initial index matrix of n regions and m evaluation indicators is constructed, and the information entropy E_j of each evaluation index X_{ij} is calculated.

$$E_j = \ln \frac{1}{n} \sum_{i=1}^{n} \left(\frac{X_{ij}}{\sum_{i=1}^{n} X_{ij}} \ln \frac{X_{ij}}{\sum_{i=1}^{n} X_{ij}} \right) \quad (3)$$

(3) Determine the weight of the indicator.

Based on the obtained entropy value E_j, calculate the weight W_j: of the jth index of high-quality development of the manufacturing industry.

$$W_j = (1 - E_j) / \sum_{j=1}^{m} (1 - E_j) \quad (4)$$

(4) Determine the indicator score.

The linear weighting method is used to measure the composite index of high-quality development of the manufacturing industry I_i:

$$I_i = \sum_{j=1}^{m} W_j X_{ij} \quad (5)$$

The calculated comprehensive index score of high-quality development of manufacturing industry is the comprehensive level of high-quality development of manufacturing industry in the Pearl River Xijiang Economic Belt, and the larger the I value, the stronger the city's high-quality development level of manufacturing industry, and can play a leading role in actively leading development in the river basin. On the contrary, it means that the city's manufacturing industry quality development level is worse.

2.3. Sample Data of High-Quality Development Level of Manufacturing Industry

This paper takes the high-quality development level of manufacturing in 11 cities in the Pearl River Xijiang Economic Belt from 2012 to 2020 as the research sample, and since the concept of the Pearl River Xijiang Economic Belt was proposed in 2012, the starting point of the sample research time was selected as 2012, considering 2020 ,the uncertain impact of the new crown epidemic event on the high-quality development of the economy last year, so the sample research time was intercepted to 2020. The original data were compiled from the National Bureau of Statistics and the statistical yearbooks of various provinces and cities in China, and some missing values were supplemented by linear interpolation.

3. Characteristics of High-Quality Development of Manufacturing Industry in the Pearl River Xijiang Economic Belt From 2012 To 2020

3.1. Basic Fluctuation Characteristics

This chapter selects 11 cities in the Pearl River Xijiang Economic Belt (including Guangzhou, Foshan, Zhaoqing, Yunfu, Nanning, Baise, Liuzhou, Wuzhou, Guigang, Laibin, Chongzuo, etc.) from 2012 to 2020 as research objects for measuring the level of high-quality development, so as to maximize the horizontal differences in high-quality development of each city. The results of the high-quality development level and mean comprehensive score of the manufacturing industry are shown in Table 2. According to the calculation method of the high-quality development level of the manufacturing industry, the higher the comprehensive score, the higher the high-quality development level of the manufacturing industry; Conversely, the lower the level of high-quality development of the manufacturing industry.

Table 2: High-quality development level and average comprehensive score of manufacturing industry in Pearl River Xijiang from 012 to 2020.

Year \ City	2012	2013	2014	2015	2016	2017	2018	2019	2020	mean
Zhaoqing	0.337	0.244	0.304	0.312	0.191	0.181	0.236	0.279	0.211	0.255
Yunfu	0.265	0.231	0.254	0.248	0.197	0.187	0.241	0.245	0.236	0.234
Wuzhou	0.250	0.231	0.197	0.208	0.294	0.231	0.137	0.222	0.241	0.223
Nanning	0.384	0.381	0.422	0.409	0.423	0.304	0.255	0.319	0.265	0.351
Liuzhou	0.405	0.410	0.362	0.397	0.407	0.369	0.338	0.300	0.248	0.360
Laibin	0.103	0.137	0.142	0.109	0.118	0.132	0.112	0.106	0.180	0.127
Guigang	0.150	0.176	0.262	0.261	0.232	0.210	0.217	0.203	0.199	0.212
Guangzhou	0.779	0.834	0.716	0.756	0.696	0.796	0.774	0.833	0.805	0.777
Foshan	0.472	0.703	0.595	0.624	0.556	0.527	0.525	0.535	0.683	0.580
Chongzuo	0.231	0.268	0.359	0.345	0.428	0.367	0.400	0.289	0.238	0.325
Baise	0.127	0.097	0.168	0.134	0.174	0.171	0.108	0.153	0.131	0.140
Zhuxi Economic Belt	0.318	0.337	0.344	0.346	0.338	0.316	0.304	0.317	0.313	0.326

From the overall development level of Table 2, it can be seen that the comprehensive score of the high-quality development level of manufacturing in the main 1cities of the Pearl River Xijiang Economic Belt from 2012 to 2020 showed a fluctuating trend. Among them, the high-quality development level of manufacturing industry in Guangzhou and Foshan has been in a high position in the past ten years, and Guangzhou is the most prominent.[6] Taking 2012 as an example, the value of the high-quality development level of Guangzhou's manufacturing industry was even more than 7 times that of the lowest level of other cities in the basin that year, which may be due to the fact that the early foundation of Guangzhou's manufacturing development was better than that of other cities in the basin. [7-8]Except for Guangzhou and Foshan, the comprehensive score of high-quality development in the river basin in the past ten years is at a slightly lower level, and guests are the most among them. The high-quality development level of the manufacturing industry has always been around 0.100 from 2012 to 2020, and its level fluctuation value has not even exceeded 0.050. It has become the city with the slowest development of manufacturing industry in the Xijiang River Basin of the Pearl River.

Judging from the numerical fluctuation of the high-quality development level in the basin, since the proposal of the cooperation concept of the Xijiang River Basin of the Pearl River in 2012, the absolute

value of the high-quality development level has steadily improved, and it has achieved a good start with the absolute value of 0.318 in 2012, and has reached 2 In 2015, the first small peak of high-quality development in the past ten years was achieved, and the high-quality development level of manufacturing industry in the basin reached 0.346. To create a good momentum for the sustainability of the high-quality development of the manufacturing industry in the Pearl River Xijiang Economic Belt, affirm the development prospects and realization potential of other cities in the river basin, especially other cities with low levels of high-quality development of the manufacturing industry, and firmly believe in achieving high-quality development.[9-10] In the second half of the high-quality development of the manufacturing industry in the past decade, the high-quality development level of the manufacturing industry in 11 cities in the river basin showed a decline in the range, but it achieved a reverse decline in 2019. The high-quality development level of the manufacturing industry in the basin in 2018 was even lower than the development level of the opening year, as low as the absolute level of 0.304, which shows that the high-quality development level of the manufacturing industry may appear to be weak in the second half of the stage, and it needs effective external policies to support it. Therefore, under the policy instructions of the "Outline Development Plan for the Bay Area of Guangdong, Hong Kong and Macao" issued by the CPC Central Committee and the State Council in 2019,[11-12] the high-quality development level of the manufacturing industry in the basin regained growth in 2019, providing a solid boost for the sustainable development of the high-quality development of the manufacturing industry.
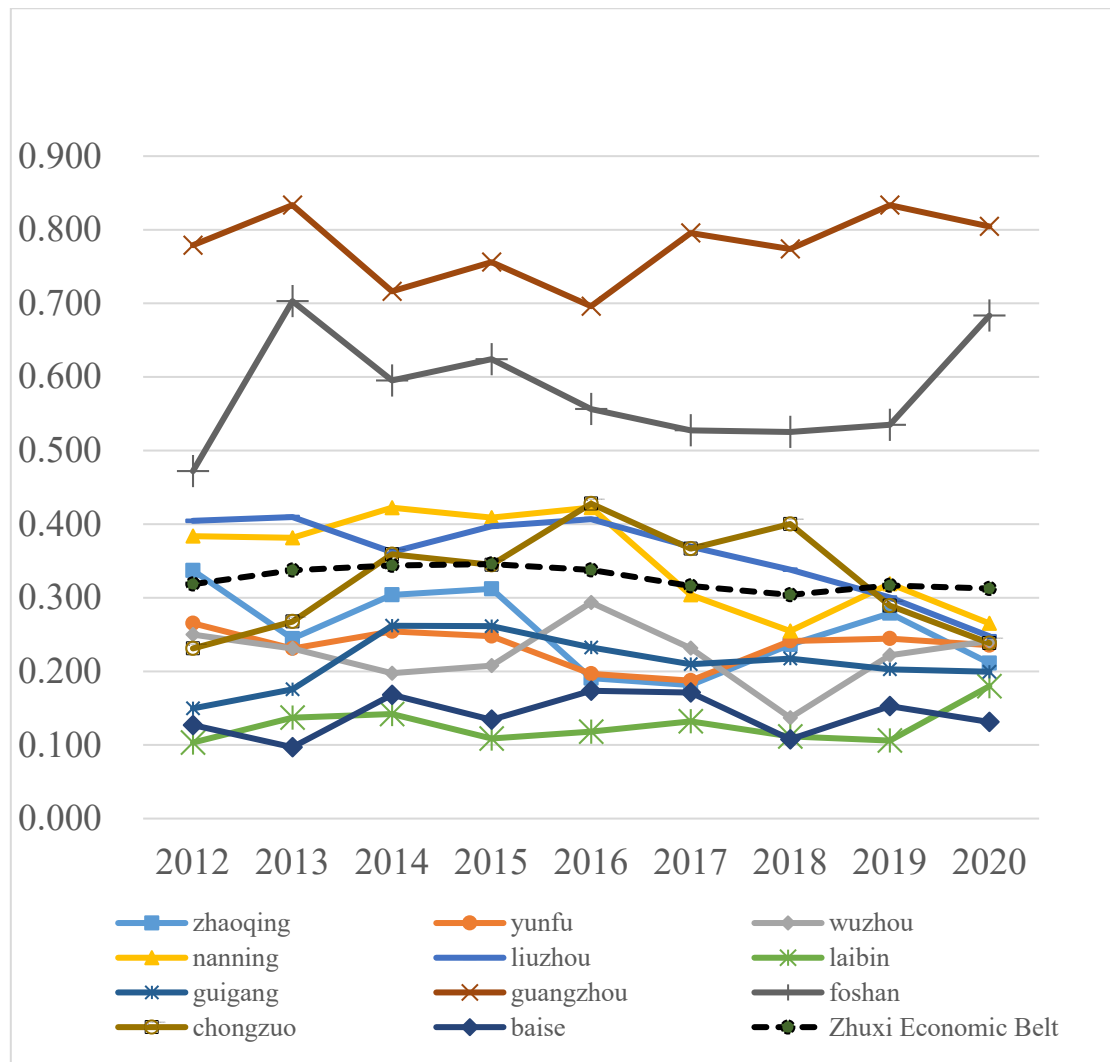

Figure 1: Trends of high-quality development level of the Pearl River Xijiang Economic Belt from 2012 to 2020

In order to further visually analyze the fluctuation trend of high-quality development level in the Pearl River Xijiang Economic Belt, this paper draws a line chart of the measurement results of the high-quality development level of manufacturing industry in 11 cities from2012 to 2020, and selects the average level of high-quality development in the Pearl River Xijiang Economic Belt basin as the basic standard line is

shown. On the whole, the high-quality development of manufacturing industry in 11 cities in the Xijiang Economic Belt basin of the Pearl River has undergone two turning points from 2012 to 2020, and the development trend has shown an inverted "U" shaped fluctuation. The absolute level of high-quality development of manufacturing industry in the basin is generally not high.

As can be seen from Figure 1, the comprehensive score of high-quality development level of the main 11 cities in the Pearl River Xijiang Economic Belt from 2012 to 2020 fluctuated, and the overall performance was an inverted "U" change curve, and there was a turning upward trend and transformed into "N" type development curve possible. The high-quality development level of most of these cities has a good development momentum in the early stage of planning and construction, which is reflected in the steady growth momentum from 2012 to 2015. Especially in the first two years of the cooperation concept of the Pearl River Xijiang River Basin, six cities achieved high-quality improvement in manufacturing in the basin, and almost achieved the peak development level of cities in the basin in 2015, and the overall average level of the Pearl River Xijiang Economic Belt also reached the highest level in ten years, at the apex of the inverted "U" curve of the development level. The possible reason is that 2015 is the first year of implementation of the Pearl River-Xijiang Economic Belt Development Plan (hereinafter referred to as the Plan), and cities in the eastern and western basins of the Economic Belt have actively responded to the requirements of the Plan, and have issued relevant policies to support economic development and fully realize the high-quality vigorous development of the manufacturing industry.[13] It is worth noting that the growth momentum of the second half of the high-quality development of the manufacturing industry from 2015 to 2019 has declined, but in 2019 ushered in a new fluctuation turn, the decreasing trend is still slow, and the development trend has shifted to "N", the possibility of curves.Moreover, 6 cities have achieved a high-quality reversal trend in the manufacturing industry in the basin, re-stimulating the momentum of high-quality development of the manufacturing industry in the Xijiang River Basin of the Pearl River, and laying a solid foundation for the impact of the new crown epidemic in 2020.

3.2. N-Type Dynamic Features

In order to improve the dynamic comparability of the evaluation results, this paper further adopts the vertical and horizontal grade opening method to empower the basic indicators, standardizes the original data by the power coefficient method, and finally uses the linear weighting method to calculate the high-quality development index of each city, and draws a normalized change trend chart to visually display the calculation results, the results are shown in Figure 2.

As can be seen from Figure 2, the comprehensive scores of high-quality development levels of the main 11 cities in the Pearl River Xijiang Economic Belt from 2012 to 2020 fluctuated, and the overall performance was an inverted "U" change curve, which turned upward and transformed into "upward-Falling-rising" with "N" shaped development curve possible. On the whole, the high-quality development level of manufacturing industry in 11 cities in the Xijiang Economic Belt basin of the Pearl River fluctuates from 2012 to 2020. The absolute level of high-quality development of manufacturing industry in the river basin is generally not high, which is manifested in three states: high is stable at a high level, low is slowly rising, and floating within the middle range.

From the perspective of hierarchical city division, the excellent graded cities represented by Guangzhou and Foshan have steadily ranked at a high level of development for the high-quality development of the manufacturing industry after normalization. In the past ten years, the high-quality development level of the manufacturing industry has fluctuated greatly, and its absolute value level is above 0.5, and the high-quality development rate of the manufacturing industry is relatively fast, [14]ranking the high-level leading development position in the river basin. The qualified cities represented by baise and guests are still at a low level of high-quality development of the manufacturing industry after normalization. In the past ten years, the high-quality development level of the manufacturing industry has fluctuated little, and its absolute level is below the 0.1 level, and the improvement rate of high-quality development of the manufacturing industry is relatively slow. In other cities at the intermediate level of development, the high-quality development level of the manufacturing industry fluctuates within the range of 0.1 after normalization, and the development and improvement speed is relatively stable.
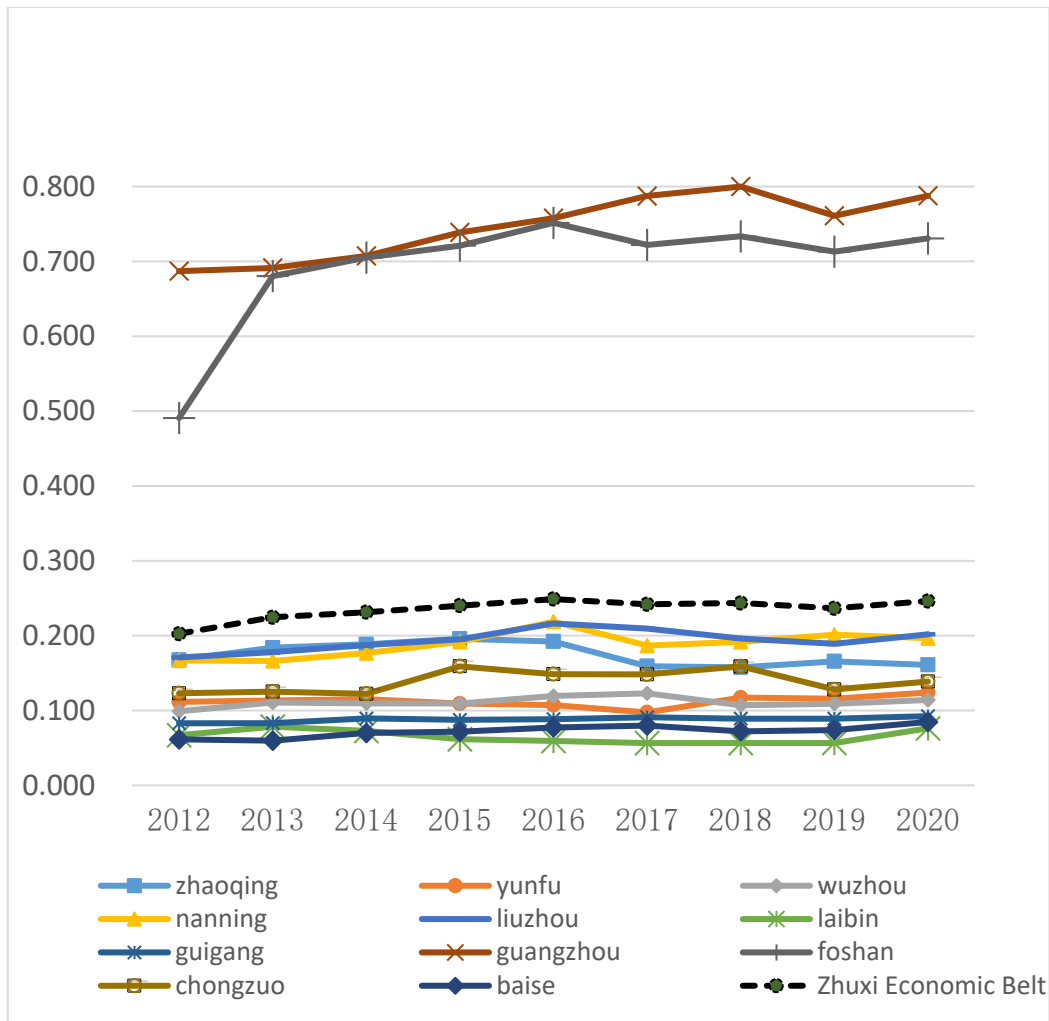
Figure 2: Normalized change trend of high-quality development level of the Pearl River Xijiang Economic Belt from 2012 to 2020

From the perspective of regional differences, the high-quality development level in the basin after normalization still shows the difference characteristics of "high in the east and low in the west", and the difference gradient is basically consistent with the horizontal gradient. In the cities of the Pearl River Basin, represented by Guangzhou and Foshan, the high-quality level of normalized manufacturing is still at a high level; In other cities located in the Xijiang River Basin, the high-quality level of normalized manufacturing is generally not high. The possible reason is that the extreme value of the manufacturing high-quality development level before and after normalization has little impact, and the intermediate impact on the high-quality development level of the manufacturing industry is greater.[15] The performance shows that the development level ranking of 11 cities is basically the same as before normalization, but cities with Pearl River location advantages, such as Guangzhou and Foshan, are still stable at a high development level, and cities that lack location advantages and have a weak foundation in the early stage, such as baise and guests, remain at a low level. It further confirms that there are hierarchical differences in the high-quality development level of manufacturing industry in the river basin, and the "N" type dynamic trend of heterogeneous development growth rate between regions.

Overall, the high-quality development level of the Pearl River Xijiang manufacturing industry from 2012 to 2020 showed an inverted "U" curve shape, and the initial growth momentum was strong in the early stage of the Pearl River Xijiang Coordinated Development Concept, and in the first year of the implementation of the Plan (2015 year), the high-quality development level of the manufacturing industry has reached the apex of the curve. Although there was a certain degree of development fatigue in the subsequent evolutionary process, under the policy instructions of the CPC Central Committee and the State Council issued the "Outline Development Plan for the Bay Area of Guangdong, Hong Kong and Macao", the high-quality development level of the manufacturing industry in the basin achieved a reverse decline growth in 2019.[16-17] providing a solid boost for the sustainability of the high-quality

development of the manufacturing industry.

4. Conclusions

Based on the five major development concepts, this paper measures the high-quality development level of the manufacturing industry in the Pearl River Xijiang Economic Belt from 2012 to 2020 by constructing the high-quality development level index of the manufacturing industry, and draws the main research conclusions: First, the high-quality development level of the manufacturing industry in the basin is inverted as a whole "U" curve change trend, and using the calculation results, the high-quality development level of manufacturing industry in 11 cities is divided into four levels.The difference development level between cities in the river basin is further explored, and the results show that the characteristics of regional development difference are manifested as "one axis and dual core" in Guangdong, Guangxi development features.From the perspective of heterogeneity of cities at different levels, the high-quality level of manufacturing industry showed an "N" floating trend after replacing the index measurement of the entropy weight method of the power coefficient.

Second, from the perspective of the spatial development characteristics of high-quality development of manufacturing industry in the river basin, the basic spatial layout of "one axis and two cores" is formed in the river basin, and the high-quality development level of manufacturing industry in the region shows the agglomeration characteristics of "high in the east and low in the west". Based on the basic spatial layout of "one axis and two cores", this paper proposes to build four functional development zones of green innovation, cooperation and collaboration, structural transformation and openness and sharing, presenting the internal and external spatial layout of "one axis-two cores-four functional areas", [18-19] and providing practical ideas for the high-quality development of manufacturing industry in the Pearl River Xijiang Economic Belt.

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