# Study on the Convergence of Industrial Structure—From the Evidences of Tertiary Industries in Pearl River Delta

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**Abstract.** Pearl River Delta region is an important economic central region in China. It is crucial to reduce isomorphism between industries, improve industrial structure and strengthen competitiveness. This paper employs similarity coefficient of industrial structure to measure the degree of convergence between 9 cities in Pearl River Delta. The results illustrate there is an obvious industrial structure convergence in the three industries. The author figured out the measure respectively based on the internal industrial structure convergence among three industries. It was found that internal industrial structure similarity coefficient of the secondary industry is higher than the other two and the tertiary industry is larger than the primary industry. Therefore, more attention should be paid to achieve differentiation development of tertiary industry and primary industry and to promote the division of labor and cooperation of internal industries between cities.

**Keywords:** similarity coefficient of industrial structure, Pearl River Delta, tertiary industries.

## 1. Introduction

On February 18, 2019, "Guangdong, Hong Kong and Macao Dawan District Development Plan Outline" put forward that Pearl River Delta Region was endowed new strategic mission about Pearl River Delta City Group. How to improve he division of labor and cooperation of internal industries and to use their comparative strengths and reduce the degree of convergence in industries, having become a key topic of the Chinese government in the economic development of Pearl River Delta. Some experts believe Division of labor within the process of industrial upgrading in Pearl River Delta region contributes to isomorphism between industries in the Pearl River Delta [1,2] (2018, Tan&Pan, 2010, Feng&Shao). Other scholars support that the identical choice in leading industries lead to isomorphism between industries [3,4] (2006, Weng, 2010, Huang& Zheng). However, from the author's perspective, previous scholars excessively valued the influence that manufacturing industry had on industrial structure convergence in Pearl River Delta region and neglected primary industry and tertiary industry. In addition, they didn't analyze the internal industry convergence of primary industry and tertiary industry. Moreover, the research on the convergence of the three industrial structures in Pearl River Delta lacks the support of new data. On the basis of the relevant data of 2011-2017, this paper will use the industrial structure similarity coefficient to judge the degree of convergence of the three industrial structures in Pearl River Delta, and analyze the reason that contributes to convergence of industrial structures by comparing the similarity coefficients of the internal industrial structure of the primary industry, secondary industry and tertiary industry respectively. we should provide effective advice to how to demolish the isomorphism between industries in Pearl River Delta and which industry's structural upgrading should be paid more attention.

## 2. Identifying the Convergence of Industrial Structure in Pearl River Delta

### 2.1 Static Analysis

This paper uses the structural similarity coefficient proposed by the United Nations Industrial Development Organization to measure the structural convergence of the tertiary industries. The formula is as follows:

$$S_{ij} = \frac{\sum_{k=1}^{n}(X_{ik} \cdot X_{jk})}{\sqrt{(\sum_{k=1}^{n} X_{ik}^2 \cdot \sum_{k=1}^{n} X_{jk}^2)}}$$

$S_{ij}$ indicates the similarity coefficient of industrial structure of region $i$ and region $j$. $X_{ik}$ and $X_{jk}$ indicate the proportion of department $k$ in the industrial structure of region $i$ and region $j$. If $S_{ij}$=1, it indicates that the industrial structure of the region $i$ and region $j$ is exactly the same; if $S_{ij}$ =0, it indicates that the industrial structure of the two places is completely different; if the value $S_{ij}$ is between 0 and 1, the larger the value is, the more similar the industrial structure of the two cities are. Based on the calculation formula of the similarity coefficient of industrial structure, the author calculated the similarity coefficient between the two cities in Pearl River Delta region from 2011 to 2017. The data comes from the *Guangdong Statistical Yearbook of 2010-2018*. The calculation results are as follows:

Table 1. Similarity Coefficient of Industrial Structure between Three Industries in Pearl River Delta in 2017

| | Guangzhou | Shenzhen | Zhuhai | Foshan | Huizhou | Dongguan | Zhongshan | Jiangmen | Zhaoqing |
|---|---|---|---|---|---|---|---|---|---|
| Guangzhou | 1 | | | | | | | | |
| Shenzhen | 0.9712 | 1 | | | | | | | |
| Zhuhai | 0.9251 | 0.9886 | 1 | | | | | | |
| Foshan | 0.8373 | 0.9432 | 0.9822 | 1 | | | | | |
| Huizhou | 0.8714 | 0.9618 | 0.992 | 0.9968 | 1 | | | | |
| Dongguan | 0.9291 | 0.9904 | 0.9997 | 0.98 | 0.9896 | 1 | | | |
| Zhongshan | 0.9081 | 0.9814 | 0.9991 | 0.9893 | 0.9961 | 0.9984 | 1 | | |
| Jiangmen | 0.8889 | 0.9689 | 0.9938 | 0.9902 | 0.9982 | 0.9909 | 0.9959 | 1 | |
| Zhaoqing | 0.9348 | 0.9682 | 0.9685 | 0.9295 | 0.9559 | 0.9645 | 0.9623 | 0.9719 | 1 |

Table 1 shows that the industrial structure similarity coefficients of the nine cities in Pearl River Delta are all greater than 0.8, from which indicates that the three industrial structures of the nine cities are highly convergent from the view of three tertiary industries levels. The similarity coefficients of industrial structure between Zhuhai, Dongguan, Zhongshan and Jiangmen are higher than 0.99, especially between Zhuhai and Dongguan reaching 0.9997.

### 2.2 Dynamic Analysis

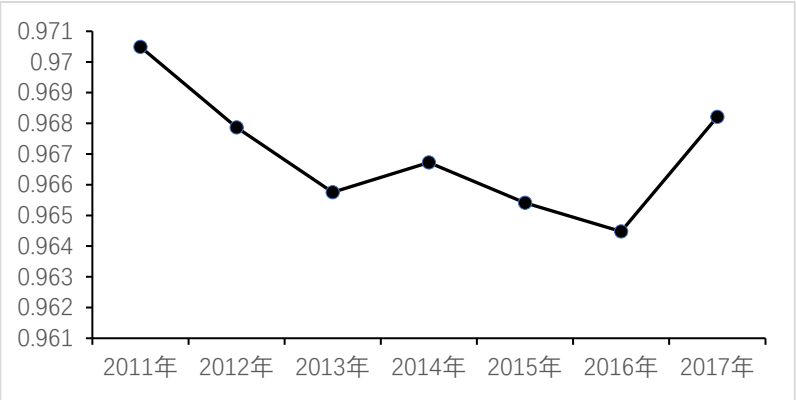


Fig. 1 Trends in the mean value of the similarity coefficient of industrial structure in Pearl River Delta region from 2011 to 2017

Figure 1 presents the average change in the industrial structure similarity coefficients of the nine cities in Pearl River Delta region from 2011 to 2017, that is, the average number of structural similarity coefficients between two cities in each year changes with time. It can be seen that (1) the average number of industrial structure similarity coefficients in Pearl River Delta region decreased slightly in 2011-2013, but began to rise in 2014. In 2015-2016, it had a decline again and rebounded in 2017. The author believes that the decline of the structural similarity coefficients is closely relevant to the “double transfer strategy” of Guangdong Province which has promoted the close relationship between the labor-intensive industries from Guangdong to the west coast and the east coast. During this period, these cities also developed different leading industries in the light of their comparative advantages. These industries including Guangzhou's automobile manufacturing and modern logistics, Zhaoqing's metal products and leather, fur, down (hair) and its products, as well as Foshan's non-metallic mineral products promote the diversification of the industry. (2) However, the rise and fall are overall not large, and the lowest number in 2016 (0.9645) also exceeds 0.9, indicating that the whole industrial structure of Pearl River Delta from 2011 to 2017 is converging and the convergence is growingly large. The "Planning Outline of the Reform and Development Plan of Pearl River Delta Region" required cities to develop strategic leading industries for developing electronic information, bio-computing, new materials and opt-mechatronics. This is also one of the reasons that similarity coefficients of industrial structure remained high in recent years.

### 2.3 Individual Analysis

Table 2. Mean value of industrial structure similarity coefficients of 9 cities in Pearl River Delta.

| | Guangzhou | Shenzhen | Zhuhai | Foshan | Huizhou | Dongguan | Zhongshan | Jiangmen | Zhaoqing |
|---|---|---|---|---|---|---|---|---|---|
| Mean value | 0.9227 | 0.9675 | 0.9828 | 0.9609 | 0.9716 | 0.9784 | 0.9794 | 0.9797 | 0.9599 |

In Table 2, having summarized the industrial structure similarity coefficients of each city and the remaining eight cities from 2011 to 2017, the author worked out the mean value and then analyzed the industrial convergence degree of the nine cities from the perspective of the overall situation in the past seven years. (1) In the light of city, the two cities with the lowest average industrial structure similarity coefficients are Guangzhou and Zhaoqing because Guangdong and Zhaoqing have more diversified industrial structures. In addition to the same leading industries like electronic information, chemical raw materials and chemical products manufacturing as other cities, Guangdong also vigorously develops the automobile manufacturing industry and the transportation and warehousing industry. Moreover, the “double transfer strategy” of Guangdong Province has promoted the transfer

of labor-intensive industries from Guangdong to the west coast and the east coast, which has led to a decline in the degree of structural convergence between Guangdong and other cities in recent years. Zhaoqing's metal products industry and leather, fur, down (feather) and their products are also very prosperous. The top three cities with the highest industrial structure similarity coefficients are Zhuhai, Jiangmen and Zhongshan. As the hometown of overseas Chinese, Jiangmen utilizes its advantages to attract a large amount of foreign capital, but there are no obvious comparative strengths. Because of being adjacent to Zhaoqing, the good geographical advantage is beneficial to use Zhaoqing's rich non-ferrous metal resources, thus Jiangmen established metal manufacturing as the leading industry. Zhuhai and Zhongshan have the same leading industries as other cities, electronic information and electrical machinery respectively. (2) Although Guangzhou has the lowest industrial structure similarity coefficients in the nine cities, it has an average value of 0.9227 in 2011-2017. It shows that although the average number of similarity coefficients of industrial structure in different cities is different, the values are very large, which proves that there is a great convergence phenomenon in the tertiary industrial structures in Pearl River Delta.

## 3. Analysis of the Reasons for the Convergence of Industrial Structure

The above analysis shows that there is a large industrial convergence in Pearl River Delta in 2011-2017, but to what extent how much impact on industrial convergence of tertiary industries and what the core factors and main reasons affecting industrial isomorphism are. This paper will analyze as follows.

### 3.1 Analysis on the Internal Industrial Structure of the Primary Industry

This paper selects forestry, animal husbandry and fishery as the composition of the primary industry. The author calculates the similarity coefficient of the internal industrial structure of the primary industry in Pearl River Delta in 2017 and the results show as follows.

Table 3. Similarity coefficients of internal industrial structure of the primary industry in Pearl River Delta in 2017

| | Guangzhou | Shenzhen | Zhuhai | Foshan | Huizhou | Dongguan | Zhongshan | Jiangmen | Zhaoqing |
|---|---|---|---|---|---|---|---|---|---|
| Guangzhou | 1 | | | | | | | | |
| Shenzhen | 0.747 | 1 | | | | | | | |
| Zhuhai | 0.4892 | 0.9427 | 1 | | | | | | |
| Foshan | 0.7881 | 0.976 | 0.9077 | 1 | | | | | |
| Huizhou | 0.9771 | 0.6053 | 0.3234 | 0.6807 | 1 | | | | |
| Dongguan | 0.9904 | 0.6741 | 0.3908 | 0.7038 | 0.9767 | 1 | | | |
| Zhongshan | 0.6447 | 0.9898 | 0.9789 | 0.9528 | 0.4863 | 0.5633 | 1 | | |
| Jiangmen | 0.8544 | 0.9383 | 0.8306 | 0.9868 | 0.7762 | 0.7771 | 0.8948 | 1 | |
| Zhaoqing | 0.9108 | 0.6252 | 0.3979 | 0.7304 | 0.94 | 0.8802 | 0.5212 | 0.8294 | 1 |

It can be seen from Table 3 that the similarity coefficients of internal industrial structure of primary industry are greater than 0.9 between the four cities of Shenzhen, Zhuhai, Foshan and Zhongshan , indicating that the internal structure of the primary industry of these four cities is converging;

meanwhile, the similarity coefficient of the internal industrial structure of the primary industry are also bigger than 0.9, while Zhaoqing and Jiangmen do not have the same degree of convergence within the primary industry as the other eight cities.

### 3.2 Analysis on the Internal Industrial Structure of the Secondary Industry

As industry and construction industry are two parts of secondary industry, this paper calculated the similarity coefficients of them between the nine cities as follows.

Table 4. Similarity Coefficients of Internal Industrial Structure of the Secondary Industry in Pearl River Delta in 2017

| | Guangzhou | Shenzhen | Zhuhai | Foshan | Huizhou | Dongguan | Zhongshan | Jiangshan | Zhaoqing |
|---|---|---|---|---|---|---|---|---|---|
| Guangzhou | 1 | | | | | | | | |
| Shenzhen | 0.9479 | 1 | | | | | | | |
| Zhuhai | 0.9999 | 0.9424 | 1 | | | | | | |
| Foshan | 0.6665 | 0.8693 | 0.654 | 1 | | | | | |
| Huizhou | 0.6562 | 0.8625 | 0.6436 | 0.9999 | 1 | | | | |
| Dongguan | 0.6044 | 0.8268 | 0.5911 | 0.9968 | 0.9978 | 1 | | | |
| Zhongshan | 0.7929 | 0.9458 | 0.7826 | 0.9827 | 0.9801 | 0.9647 | 1 | | |
| Jiangshan | 0.8971 | 0.9911 | 0.8897 | 0.9273 | 0.9221 | 0.8942 | 0.9805 | 1 | |
| Zhaoqing | 0.8161 | 0.9577 | 0.8063 | 0.9748 | 0.9716 | 0.9537 | 0.9992 | 0.9874 | 1 |

As Table 4 showed, (1) the similarity coefficients of the secondary industrial structure are overall higher and higher than that of the primary industry. The minimum similarity coefficients of the secondary industry in the nine cities are 0.6044, whereas among similarity coefficients of the primary industrial structure, some cities are between 0.3 and 0.6, so the degree of convergence in internal structure of the secondary industry in the nine cities is greater than the primary industry. (2) The similarity coefficients of the secondary industry between Guangzhou, Shenzhen and Zhuhai are greater than 0.94; the similarity coefficients between Foshan, Huizhou, Dongguan, Zhongshan, Jiangmen and Zhaoqing are higher than 0.89. Although Guangzhou, Zhuhai and Shenzhen all develop electronic information as leading industry, chemical raw materials and chemical products manufacturing are also the pillar industries of the latter two cities with the similarity coefficients of the secondary industry in the two cites reaching 0.9999 (approaching to1), so Guangzhou and Zhuhai have more isomorphism. The six cities including Foshan, Huizhou, Dongguan, Zhongshan, Jiangmen and Zhaoqing are led by electronic information, electrical machinery and textile industry. Among the cities, Zhaoqing which has rich non-ferrous metal resources vigorously develops the metal products industry. Jiangmen develops metal manufacturing by taking advantage of its geographical advantages.

### 3.3 Analysis on the Internal Industrial Structure of the Tertiary Industry

The paper chose transportation, post and telecommunications industry, wholesale and retailing industry, accommodation and catering industry and tourism as the representatives of the tertiary industry, and then calculated the similarity coefficients of the industrial structure of the tertiary industry in Pearl River Delta in 2017 as follows.

Table 5. Similarity Coefficients of Internal Industrial Structure of the Tertiary Industry in Pearl River Delta in 2017

| | GuangZhou | Shenzhen | ZhuHai | Foshan | Huizhou | Dongguan | Zhongshan | Jiangmen | Zhaoqing |
|---|---|---|---|---|---|---|---|---|---|
| GuangZhou | 1 | | | | | | | | |
| Shenzhen | 0.9325 | 1 | | | | | | | |
| ZhuHai | 0.8635 | 0.8249 | 1 | | | | | | |
| Foshan | 0.9966 | 0.9573 | 0.8739 | 1 | | | | | |
| Huizhou | 0.8408 | 0.8849 | 0.835 | 0.8727 | 1 | | | | |
| Dongguan | 0.8173 | 0.9626 | 0.7124 | 0.8601 | 0.8957 | 1 | | | |
| Zhongshan | 0.894 | 0.9681 | 0.8118 | 0.9261 | 0.9674 | 0.9718 | 1 | | |
| Jiangmen | 0.8378 | 0.7953 | 0.7925 | 0.8525 | 0.9644 | 0.7776 | 0.8986 | 1 | |
| Zhaoqing | 0.8489 | 0.8049 | 0.7752 | 0.8622 | 0.9602 | 0.787 | 0.9039 | 0.9985 | 1 |

According to Table 5, (1) it was calculated that the average value of the similarity coefficient of the tertiary industry structure in 9 cities in Pearl River Delta in 2017 is 0.9213>0.934 (the average of the similarity coefficient of the secondary industry structure), so generally the degree of convergence in internal structure of the tertiary industry is higher than the primary industry but less than the secondary industry. The author believes that this is closely related to the large proportion of the secondary industry because Pearl River Delta still takes the development of advanced manufacturing as its strategic goal, which is caused by the division of labor within the industry during the upgrading of the manufacturing industry. (2) The similarity coefficient of the tertiary industry in Huizhou, Jiangmen, Zhaoqing and Zhongshan is higher than 0.89, especially in Jiangmen and Zhaoqing, because tourism development is more supported in all three cities. The similarity coefficient of the tertiary industry in Guangzhou, Shenzhen and Foshan is higher than 0.93. One of the reasons is that both Guangzhou and Shenzhen develop financial insurance industry and modern logistics industry as the leading industries of the tertiary industry.

## 4. Conclusions and Policy Recommendations

This paper utilizes the industrial structure similarity coefficient to analyze the industrial structure convergence degree among the tertiary industries in the nine cities of Pearl River Delta from the perspectives of dynamic, static, overall and individual. The results illustrate that there is obvious convergence in the industrial structure. The conclusions are as follows: (1) From the dynamic analysis of 2011-2017, it is found that the structural similarity coefficient decreased slightly in 2011-2013, and began to rise in 2014, but declined again in 2015-2016, reaching a trough in the past 7 years. It rose again in 2017. Although the industrial structure similarity coefficient has fluctuated every year, its change is slight with a range lower than 0.02. In addition, the industrial structure similarity coefficient of each city in the past seven years has been higher than 0.91. Therefore, the three industrial structures of Pearl River Delta emerged a convergence in the past seven years. (2) From the perspective of cities, the city with the lowest average coefficient of similarity in industrial structure is Guangzhou, which is inseparable from the “double transfer strategy” of Guangdong Province to promote labor-intensive industries from Guangdong to the west coast and east coast, while the highest similarity convergence of the top three cities are Zhuhai, Jiangmen and Zhongshan.

The author think that the issues should focus on how to give full play to the comparative advantages of these three cities and establish a special leading industry in the future. (3) The industrial structure within the secondary industry has the highest degree of convergence, followed by the tertiary industry and finally the primary industry. It suggests that the similar industrial structure in Pearl River Delta region is mainly caused by the similarity of the secondary and tertiary industries. More attention should be paid to the differentiated development of the secondary and tertiary industries in Pearl River Delta region and promote the intra-industry division of labor and cooperation between cities.

Based on the above analysis, this paper proposes the following policy recommendations for reducing the industrial isomorphism and optimizing the industrial structure of the Pearl River Delta: (1) To strengthen the horizontal division of labor and cooperation within the secondary industry, to further develop the electronic information industry on the east coast of the Pearl River Delta and the advanced manufacturing industry In the West Bank. Shenzhen should play its role in technology research and development, focusing on the development of high-tech industries, and Dongguan aims to become a computer manufacturing base; to strengthen vertical division of labor within the industry, identify different target markets through market segmentation, in order to enhance product differentiation, and form industries spatial gradient. (2) To establish different pillar industries of the tertiary industry. Guangzhou will further develop the modern logistics industry, Shenzhen vigorously develops the financial and insurance industry, and Jiangmen exerts its advantages as a hometown of overseas Chinese to develop its tourism.

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