Study on the synergistic effect of industrial structure differentiation of urban agglomeration in the Greater Bay Area

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Abstract. In order to promote the overall development of the Greater Bay Area, it is important to optimize the regional development plan, reduce the differences in the industrial structure of the Greater Bay Area urban agglomeration, promote the coordinated development of the industrial structure of this area and improve scientific & technological innovation of the Greater Bay Area. There are many advantages in the development of the urban agglomeration of Guangdong-Hong Kong-Macao Greater Bay Area, but there are also some obstacles, such as the serious differentiation of industrial structure, the adverse factors affecting economic development under the framework of "one country, two systems", and the development limitations of the unique system of "three currencies, three legal frameworks, three customs territories and four core cities", which all affect the progress of the economy of the Greater Bay Area to a great extent. Therefore, it is necessary to take advantages of the industrial strengths of the Greater Bay Area urban agglomeration, strengthen the economic interconnection between cities and improve the industrial structure coordination, so as to promote the development and construction of Guangdong-Hong Kong-Macao Greater Bay Area and form the development configuration of economic integration.

1. Preface

This paper attempts to conduct an in-depth analysis of the industrial structure differences of the Greater Bay Area urban agglomeration from an all-round perspective, collect the latest representative data, draw on the experience of the three major Bay Areas in the world, compare the industrial structure differences of Guangdong–Hong Kong–Macao Greater Bay Area, utilize the production–possibility frontier and the theory of comparative advantages of resource endowments, analyze the synergistic effect of industrial structure differences among Guangdong, Hong Kong, and Macao.

2. Current Situation of Industrial Structure Development of the Greater Bay Area Urban Agglomeration

The Guangdong-Hong Kong-Macao Greater Bay Area consists of the Hong Kong Special Administrative Region, the Macao Special Administrative Region and nine cities in the Pearl River Delta, namely Guangzhou, Shenzhen, Zhuhai, Foshan, Huizhou, Dongguan, Zhongshan, Jiangmen and Zhaoqing(Fig.1). The differences, repeatability and imbalance in the development of the industrial structure of the Greater Bay Area are the main obstacles of urban agglomeration. In recent years, the industrial structure of the Greater Bay Area urban agglomeration has been gradually improved. Development trends of industries are relatively positive, and the advantages of the Greater Bay Area continue to be strengthened[1].

Fig. 1. Location Diagram of Guangdong–Hong Kong–Macao Greater Bay Area (9+2) Urban Agglomeration
Data source: Baidu Wenku

2.1. Industrial Development Status of Hong Kong & Macao

Hong Kong.

Hong Kong is an international financial center and one of the world's five major trade ports in the world. The tertiary

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industry of Hong Kong contributes more than 80% to its GDP, which drives the economic development of the whole Greater Bay Area as an important economic engine. The proportion of the three industries in Hong Kong was 0.08:13.4:86.52 in 2001 and 0.06:6.5:93.44 in 2018. It can be seen that Hong Kong's industrial structure tends to transform from the secondary industry to the tertiary industry[2]. From figure 2, the growth of GDP in Hong Kong was increasing with the proportion of the tertiary industry. In recent years, the proportion of the tertiary industry has tended to be flat.

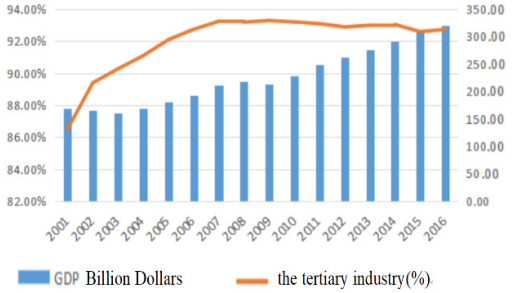

Fig. 2. Trends of Hong Kong's GDP and the tertiary industry from 2001 to 2016
Data source: Industrial Information Network

Macao.

Macao takes the gambling industry as the leading position in its industrial development. In 2018, the gambling industry accounted for half of Macao's overall industrial structure proportion. In recent years, driven by the development of the gambling and tourism industries, the proportion of gambling and non-gambling industries in Macao has fluctuated, but the overall trend is that the steady development of the gambling industry promotes the development of non-gambling industries; However, due to the dominance of the gambling industry, the industrial structure in Macao still presents a single development situation. Figure 3 shows that Macao's industrial structure tends to be single. In recent years, the development of industrial structure has only involved the secondary and tertiary industry. The gaming industry leads to the fluctuation of Macao's economy to a great extent, which brings challenges to Macao's economic growth.

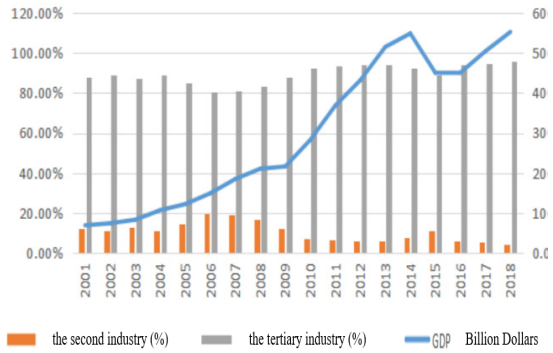

Fig. 3. Trends of Macao's GDP and the Proportion of three Industries from 2001 to 2018
Data source: Industrial Information Network

2.2. Industrial Development Status of Nine Cities in Guangdong–Hong Kong–Macao Greater Bay Area

Guangzhou.

Guangzhou is the provincial capital city of Guangdong Province and the national central city in China. The major industries of Guangzhou are medicine, chemical manufacturing, and food manufacturing. The pillar industries of Guangzhou are mainly heavy industries such as automobile, ship, and heavy machinery manufacturing. It can be seen from figure 4 that the GDP of Guangzhou has increased year by year, the economic development is quite positive. The proportion of the primary and secondary industry is gradually decreasing, and the proportion of the tertiary industry is gradually increasing, and the industrial structure of Guangzhou has been further improved and developed these years.

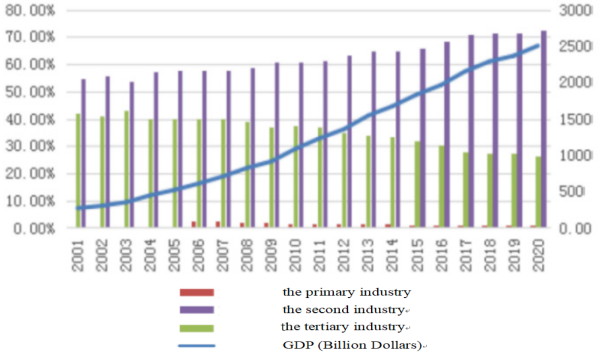

Fig. 4.GDP Trends and the Proportion of Three Industries in Guangzhou from 2001 to 2020
Data source: Guangdong Provincial Statistical Yearbook

Shenzhen.

From table 1, we can see that Shenzhen has integrated and innovated the secondary and tertiary industry these years. Affected by the COVID-19, although the growth rate of added value of the industry has declined, the country focuses on the resumption of work and production after the epidemic is controlled, and the overall economy is recovering.

Table 1. List of Shenzhen's GDP and Proportion of the Three Industries

billion yuan

Year	GDP	Primary Industry (%)	Secondary Industry (%)	Tertiary industry (%)
2001	195.41	0.90	54.10	45.00
2002	223.94	0.80	55.20	44.00
2003	286.51	0.60	58.90	40.50
2004	342.28	0.40	61.60	38.00
2005	492.69	0.20	53.20	46.60
2006	568.44	0.10	53.20	46.70
2007	676.54	0.10	50.90	49.00
2008	780.65	0.10	48.90	51.00
2009	820.12	0.10	46.70	53.20
2010	951.09	0.10	47.50	52.40
2011	1150.21	0.10	46.50	53.50
2012	1295.01	0.10	44.30	55.70
2013	1450.02	0.10	43.40	56.60
2014	1600.20	0.10	42.70	57.30
2015	1750.30	0.10	41.20	58.80

2016	1949.26	0.10	39.50	60.50
2017	2243.84	0.10	41.30	58.60
2018	2422.20	0.10	41.10	58.80
2019	2692.71	0.10	39.00	60.90
2020	2767.02	0.10	37.80	62.10

Data source: Guangdong Provincial Statistical Yearbook

Pearl River Delta Urban Agglomeration

It can be seen from Figure 5 that the GDP of the nine cities in the Guangdong–Hong Kong–Macao Greater Bay Area has been generally increasing in the past 15 years.

The GDP of Guangzhou has grown rapidly. In 2017, the GDP of Shenzhen exceeded that of Guangzhou and ranked first among the nine cities in the Greater Bay Area. GDP of Foshan and Dongguan grew rapidly, while the GDP of Zhuhai, Jiangmen, Zhongshan, Huizhou and Zhaoqing grew slowly.

From Figure 6, it can be found that the development trend is closely related to the development of the regional tertiary industry, and the development of the tertiary industry can boost the development of the primary and secondary industries. With the increasing proportion of the tertiary industry in cities, new breakthroughs have been made in the GDP. However, the growth rate of GDP in Zhuhai, Jiangmen, Zhongshan, Huizhou and Zhaoqing is not obvious. It is related to the basis of economic development of these cities in recent years.

There is a huge gap in industrial structure between cities. Cities with a large proportion of the primary and secondary sectors of the economy are difficult to drive industrial transformation, which is closely related to urban development planning, positioning, industrial division and industrial integration.

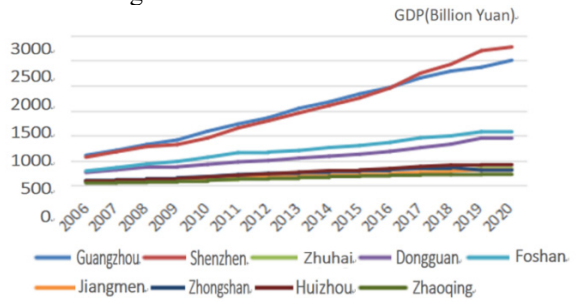

Fig. 5. GDP of Nine Cities in Guangdong–HK–Macao Greater Bay Area in Recent 15 Years
Data source: Guangdong Provincial Statistical Yearbook

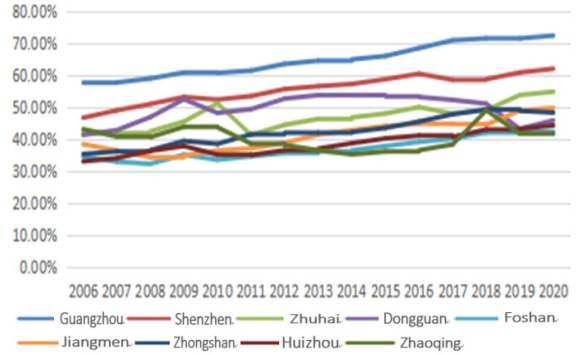

Fig. 6. Trends of Tertiary Industry in Nine Cities of Pearl River Delta from 2006 to 2020
Data source: Guangdong Provincial Statistical Yearbook

2.3. Analysis of Industrial Structure Differentiation of Guangdong–Hong Kong–Macao Greater Bay Area Urban Agglomeration

The characteristics of the urban agglomeration in the Guangdong–Hong Kong–Macao Greater Bay Area are industrial structure differentiation, unbalanced development among regions and different economic development foundation. The industrial development of Hong Kong and Macao tends to be dominated by the tertiary sector of the economy[3]; Nine cities are dominated by manufacturing in the secondary industry. There is a huge developmental imbalance in the development of industrial structure among urban agglomeration, but it is also conducive to complementary advantages and mutual development of different cities[4]. From Figure 7, the proportion of industrial structure of the nine cities in the Greater Bay Area is different, and the development of industrial structure still needs to be continuously improved and upgraded. Cities should cooperate with each other to narrow the gap. The service industry in Guangzhou, Shenzhen and Zhuhai accounted for more than 50%, and the proportion of the service industry in Guangzhou was up to 72.51% in 2020. In recent years, the proportion of the service industry in nine cities has increased year by year, the proportion of the first and secondary industry has declined, while the comprehensive strengths of the nine cities is still very different. The proportion of secondary industry of Huizhou, Foshan, Dongguan and Zhongshan was larger than that of the primary and tertiary sector of the economy, and the secondary industry of Foshan accounted for 56.40% in 2020. We can conclude that the main industry in the four cities is the secondary industry. The primary industry of Huizhou, Jiangmen and Zhaoqing accounted for more than 5%, and the primary industry of Zhaoqing accounted for 18.90% in 2020. It is the city with the highest proportion of the primary industry among the nine cities. Its industrial structure needs to be optimized to improve the overall economic strengths of the Greater Bay Area urban agglomeration.

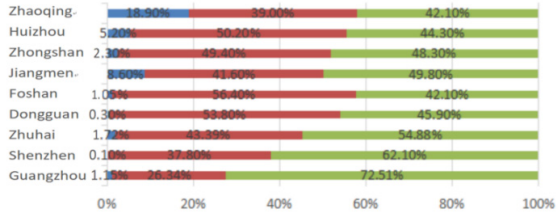

Fig. 7. Proportions of Industrial Structure of Nine Cities in Guangdong–Hong Kong–Macao Greater Bay Area in 2020
Data source: Guangdong Provincial Statistical Yearbook

3. Obstacles to the Development of Urban Agglomeration in the Guangdong–Hong Kong–Macao Greater Bay Area

3.1. Industrial Planning with Severe Administrative System Obstacles

The unique system of "one country, two systems, three currencies, three customs territories and four major cities"

in the Guangdong–Hong Kong–Macao Greater Bay Area has hindered regional coordination, foreign trade, social management, implementation mechanism and free flow of production factors. The differences in social management and economic development systems between Hong Kong & Macao and the nine cities have made it difficult to manage these regions. It is difficult to coordinate these mechanisms among the cities. Lack of rapid measures leads to a series of problems in the process of economic development. There are three customs territories, three currencies and three law systems among Hong Kong, Macao and Guangdong Province, which to a certain extent hinder the economic communications and restrict the free flow of personnel and materials of these regions. The establishment of the Hong Kong–Zhuhai–Macao Bridge has promoted the exchanges of personnel and materials among these regions, but these resources are still restricted.

3.2. Severe Homogenization of Industrial Development and Imbalance of Economic Development

There is a serious problem of homogenization in the industrial development of cities in the Greater Bay Area. The industrial structure development among the nine cities in Guangdong Province is relatively similar, and similar industrial advantages have led to poor industrial competition and duplicate construction in the development of each city. The economic strengths, industrial advantages and other development differences among cities in the Guangdong–Hong Kong–Macao Greater Bay Area are huge. The development goals between developed cities and relatively backward cities are not synchronized, and there are also differences in economic interest demands. The development differences among cities are large, which leads to the vague positioning of industrial division among cities, and the coordinated development measures of industries among cities cannot play a more favorable role[5]. The issue of imbalanced economic and industrial development between the two sides of the Greater Bay Area, characterized by "strong in the east and weak in the west" is highlighted. The GDP created by the five cities on the east coast of the Greater Bay Area accounts for approximately 4/5 of the GDP in Guangdong Province, far exceeding that of cities on the west coast. The Guangdong–Hong Kong–Macao Greater Bay Area presents a pattern of "no core, multi center". Hong Kong takes the financial industry as its industrial advantage, and international finance occupies an influential position in the world; Guangzhou is a political center of Guangdong Province and a center of foreign trades with strong cultural influence; Shenzhen takes technological innovation as its development advantage; Macao's gambling industry is dominant; The four core cities have strong development advantages but also have their weaknesses, and their development characteristics are different from the three major Bay Areas in the world.

3.3. The Degree of Opening-up Needs to be Improved, and the New Driving Force of Innovation is Weak

Guangdong Province has a low degree of opening-up to the outside world. Its exports rely on the opening-up advantages of Hong Kong and Macao to some extent. The economic freedom development of cities in Guangdong Province is limited, and the opening-up of nine cities is difficult to optimize. As a result, the economic & cultural communications and international trades are restricted. The inability to better attract foreign capital and the inflow of talents are major obstacles to the S&T innovation and product R&D of nine cities in Guangdong Province. The overall industrial structure of nine cities is in the middle stage of the coordinated development of manufacturing and service industries, and their S&T innovation ability is relatively weak. In recent years, although the industrial structure tends to transform to the tertiary sector of the economy, the industrial structure of the Pearl River Delta is deeply rooted, and it is difficult to complete the industrial transformation in a short time[6].

3.4. Loss of Synergistic Agglomeration Effect and Weakening of the Overall Competitiveness of the Greater Bay Area

The agglomeration effect is divided into factor agglomeration and industrial agglomeration. The four core cities in the Guangdong–Hong Kong–Macao Greater Bay Area have stronger agglomeration effect than that of other cities. With their perfect infrastructure, complete transportation system, pleasant living environment and better development prospects, they attract many talents and product factors to flow in, promoting technological innovation and urban industrial transformation of these areas[7]. Although each of the four core cities has its own industrial advantages, the development strengths of a single core city are not sufficient to drive the development of the entire region. Due to the development differentiation between cities in the Greater Bay Area, the development foundation of other cities is relatively weak which results in relatively weak competitiveness of the whole Greater Bay Area[8]. The various factors affecting economic development in the Greater Bay Area are fundamentally different from the three major Bay Areas in the world. For example, the Tokyo Bay Area, with Tokyo as the core, focuses on capital, talents, product R&D and other factors to provide technical support, human capital and financial support for the economic development of the region through the agglomeration effect, radiating the driving force of economic development and innovative development factors to other cities. Moreover, there is a bidirectional radiation between the relatively backward areas around and the core city, which could lead to a bidirectional impact on the economic development of these two regions[9].

4. The Experience and Enlightenment of Three Bay Area Urban Agglomeration in the World

The New York Bay Area benefits from finance, the San Francisco Bay Area is famous for science and technology, and the Tokyo Bay Area is famous for industrial manufacturing. The economic development history of the three major Bay Areas is inseparable from their special geographical locations and superior natural endowments, but their development history is different, and each Bay Area has its unique development advantages[10][11].

The emerging Guangdong–Hong Kong–Macao Greater Bay Area is relatively weak in economic development compared with the development history and development foundation of these major Bay Areas mentioned above. With the development experience of the three Bay Areas, it could be easier to accurately formulate policies and plans suitable for the development of the Guangdong–Hong Kong–Macao Greater Bay Area urban agglomeration[12].

From the successful development experience of the three Bay Areas, we could achieve the following four enlightenment: first, to formulate scientific development policies according to the actual development situation of the Guangdong–Hong Kong–Macao Greater Bay Area urban agglomeration; Second, to focus on the cultivation of talent education, technological innovation and environmental protection; third, to promote industrial transformation and upgrade regional coordinated development by utilizing the integration of three industries to develop emerging industries; fourth, to discover the unique development advantages of the Guangdong–Hong Kong–Macao Greater Bay Area urban agglomeration[13].

One of the characteristics of the Guangdong–Hong Kong–Macao Greater Bay Area is that due to different resource endowments, the development sequence of the primary, secondary and tertiary industries and the proportion structure of the three industries are inevitably different. It is suggested to develop the advantageous industries of different regions, and then promote the coordinated development of regional industries[14]. According to the theory of relative comparative advantage, each city should choose industries with relative comparative advantages that match its own resource endowments for priority. Cities with the endowment of agricultural resources in urban agglomeration should give priority to forestry, animal husbandry, fishery and other industries in the primary industry of the economy, and the proportion of mature primary industry could be increased appropriately. The proportions of the secondary and tertiary industries, whose resource endowments are relatively weak, could be reduced. Cities with high technology in the secondary industry could give priority to the development of manufacturing industry. Its proportion in the urban economic output could be increased appropriately, and at the same time, the proportions of the output of primary industry and tertiary industry of the economy with relatively inferior resource endowments could be reduced. Cities with tertiary resource endowments could give priority to the development of the industry, especially finance, trade services, education, tourism and other tertiary industries. In this way, the differentiated layout between urban agglomerations in the Greater Bay Area could generate a synergistic effect of industrial complementation. According to the marginal analysis of Production–possibility frontier, its logical composition is shown in Figure 8.

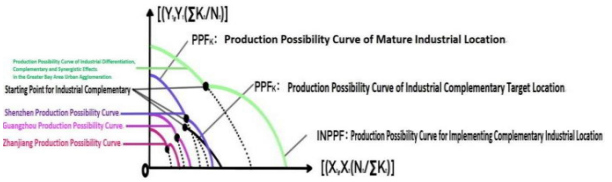

Fig. 8. Diagram of Production–possibility frontier of industrial location complementation

From Figure 9, we can see that differences in resource endowments and industrial differentiation layout in the Greater Bay Area urban agglomeration can enhance the agglomeration effect of industrial clusters. Through multiple technological leaps in the urban agglomeration, the technical parameters of the macro production function of the Greater Bay Area urban agglomeration could be improved, ultimately leading to the superimposed output effect of the Greater Bay Area urban agglomeration.

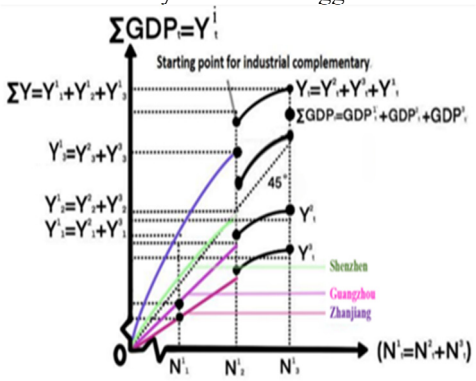

Fig. 9. Schematic Diagram of Superimposed Macro Output Level Curve

5. Countermeasures and Suggestions for the Coordinated Development of Industries in the Greater Bay Area Urban Agglomeration

5.1. Scientific Planning of Industrial Layout and Breaking Down Administrative System Barriers

Due to the particularity of regional systems in the Greater Bay Area, there are difficulties in the development of talent transfer, capital circulation, flow of goods, and information transmission among the cities in the Greater Bay Area[15]. Relevant policies should be formulated to coordinate the free flow of economic development factors among the three regions, and to reduce the negative impact of the slow development of the three regions caused by the differences in administrative systems[16]. It is important to formulate policies conducive to the scientific and technological innovation, encourage and support the reform of the scientific and technological innovation system in the

Guangdong–Hong Kong–Macao Greater Bay Area, and promote the efficient flows of scientific and technological innovation elements. Resolving the currency circulation problem among Guangdong, Hong Kong and Macao is a vital issue that needs to be considered. For example, to release the limitation conditions for investors in Guangdong, Hong Kong and Macao to a certain extent and promote capital circulation among the three regions are important issues. Regarding to the special issue of "three separate customs territories", to formulate appropriate policies to decrease the limitations of customs duties on materials in tax zone, provide special customs clearance treatments for scientific and technological innovation materials is very important in facilitating the flows of S&T innovation products and improving the efficiency of innovative product research. Furthermore, to build a global innovation network system that is more suitable for the further development of the Greater Bay Area and to create a healthy environment for technological innovation exchanges is very necessary.

5.2. Further Clarifying Industrial Division of Labor and Avoiding Homogenization of Industrial Development

The advantageous industries of each city in the Greater Bay Area are different, and there are serious homogenization problems in industrial development, which greatly hinder the overall economic development process of the Greater Bay Area[17][18]. Therefore, it is suggested to formulate a clear urban industrial division system to fundamentally solve the problems of resource duplication and adverse industrial competitions among cities. It is recommended to clarify and develop the advantageous industries of core cities, then transfer their capital, demand and other factors to other cities in order to promote the transformation and upgrading of core cities, drive economic development, shorten the economic strengths gap between cities and alleviate the uneven economic development[19]. For example, Hong Kong is an international financial center, while its influence on the nine cities in Guangdong is limited. Based on its international status, it could attract talents, encourage innovation in the technology industry, provide economic subsidies to technology researchers, create a sustainable environment for scientific and technological innovation, and continuously enhance its comprehensive strengths to drive the development of the economy[20]. It could amplify its development advantages to enhance its influence and promote economic progress in urban agglomeration. The gambling industry in Macao is world-renowned, but the development of its gambling industry is too single, and the industrial structure should not be too limited. It is important to diversify Macao's industrial structure, to improve the current situation of Macao's simple industrial mode and promote cultural exchanges between China and the outside world.

5.3. Improving the Degree of Openness to the Outside World and strengthening Institutional and Technological Innovation

It is suggested to increase the connections between the nine cities and the Hong Kong & Macao regions, and leverage the advantages of opening-up in Hong Kong and Macao regions in order to drive the economic development of the nine cities; at the same time, it is recommended to reduce the restrictions on the development of foreign trade in the nine cities, encourage the inflow of foreign investment and talents, and increase the autonomy of the nine cities[21]. With the updating and iteration of modern technological innovation, emerging industries such as artificial intelligence, autonomous driving, new energy, genetic technology and virtual reality have become hot topics nowadays. We should pay special attention to the development and cultivation of emerging technological innovation, increase investment in R&D of emerging products and encourage the development and innovation of emerging technologies[22]. At the same time, we need to help entrepreneurs share risks and encourage S&T talents to take part in the innovation of technologies. We also need to set up R&D subsidies to assist the start-up and development of emerging industries. The Guangdong–Hong Kong–Macao Greater Bay Area should seize the opportunity of explosive growth of scientific and technological innovation industry, pay attention to the quality of industrial innovation research and improve the quality of invention patents. We should also enhance industrial cooperation and development between cities and make more breakthroughs. And through the development model mentioned, there have been successful development cases, indicating that this mode is worthy of promoting and developing in depth. For example, DJI company takes advantage of the location advantage of the Greater Bay Area, combines Hong Kong's capital and technology with Shenzhen's manufacturing innovation, occupies the UAV market and drives the rise of an emerging field.

5.4. Leveraging Industrial Agglomeration Effect and Enhancing Overall Competitive strengths

It is suggested to utilize the industrial agglomeration advantages of four core cities to attract talents and capital inflows, promote industrial synergy among Guangdong, Hong Kong and Macao with agglomeration effect, continuously develop the influence of each core city’s agglomeration circle, promote complementary advantages, accelerate economic integration and enhance the overall competitive strengths of the Greater Bay Area[23]. Combining the general industrial situation of the Greater Bay Area, to drive a new economic development aspect and enhance the agglomeration effect of cities within the Greater Bay Area is of vital importance. In terms of talent aggregation factors, solving the issue of residents’ welfare benefits among Guangdong Province, Hong Kong and Macao, enabling residents in these regions to enjoy equal treatments is conducive to talent exchanges among these regions, and the talents from Hong Kong and Macao regions would be

willing to work and live in Guangdong Province. In summary, attracting talents and improving regional welfare benefits to promote overall competitiveness is beneficial and necessary[24].

6. Conclusion

In the era of rapid economic development, the Guangdong-Hong Kong-Macao Greater Bay Area needs to scientifically plan the industrial structure of the Greater Bay Area, enhance industrial innovation, strengthen institutional innovation and leverage industrial agglomeration energy, in order to enhance the overall competitive strengths of the Greater Bay Area and make contributions to the world economy.

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