

# *Research on Urban Division of Labor in Guangdong-Hong Kong-Macao Greater Bay Area Based on Global Innovation Chain*

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**Keywords:** Guangdong-Hong Kong-Macao Greater Bay Area; Urban division of labor; Global innovation chain; Location quotient; Collaborative innovation

**Abstract:** For more than 40 years since the Reform and Opening Up, innovation has driven China's economy to grow steadily. In recent years, however, due to the overcapacity in some industries and the increase of factor costs, the comparative advantages of the value chain that relied on exports and low production factors have been rapidly reduced. To become an international first-class bay area, the Guangdong-Hong Kong-Macao Greater Bay Area is supposed to take the initiative to embed Global Innovation Chain (GIC) into Global Value Chain (GVC) and to promote industrial upgrading with innovative development. The main purpose of this paper is to study how Guangdong-Hong Kong-Macao Greater Bay Area integrates innovation elements through urban division of labor, with its focus on the advantages of the three core cities — Guangzhou, Shenzhen and Hong Kong, and how to take advantage of the three cities to promote the coordinated innovation of surrounding cities. Adopting the location quotient, this paper analyzed the industrial distribution of the Greater Bay Area in all aspects of the innovation chain, and defined the problems and causes of industrial division of the Greater Bay Area. Then, by fully considering the geospatial and resource elements of 11 cities in the Greater Bay Area, and learning from the successful experience of international first-class bay areas, we will optimize the allocation of the innovation elements, and promote the industrial upgrading and the industry's position in Global Value Chain with Global Innovation Chain.

## 1. Introduction

In 2019, the *Development Plan for Guangdong-Hong Kong-Macao Greater Bay Area* emphasized that it is necessary to promote the rational division of labor among large, medium and small cities in this bay area, to optimize the regional functional layout and to improve the regional development coordination. In 2017, the GDP of the bay area exceeded 10 trillion CNY, surpassing Russia and ranking the 11th in the world rankings. It is equal to South Korea and surpasses the New York Bay Area and the San Francisco Bay Area, becoming one of the most dynamic areas in the world.

As an emerging urban agglomeration, the economy of the Greater Bay Area has a strong

development potential. According to World Bank statistics, more than 60% of the global economy is concentrated in the Bay Area <sup>[1]</sup>. Guangdong-Hong Kong-Macao Greater Bay Area(GBA) is a manufacturing base which has great influence in the world. In the past 40 years, due to the manufacturing industry's low production factors and decreasing transaction costs, GBA has occupied a stable position in Global Value Chain(GVC).

However, with the increase of the labor costs and changes in international trade relations, the advantage of the area is facing severe challenges from the internal and external environment. Enterprises that are mainly based on international OEMs are squeezed by the main players of the GVC chain, and are also chased by lower production costs in Southeast Asia. Therefore, under the traditional GVC industrial growth model, the industrial development momentum of GBA has gradually weakened. At the same time, the urban development in the GBA is uneven and inefficient. The total GDP of the three cities — Guangzhou, Shenzhen and Hong Kong, is ten times that of the three cities — Jiangmen, Zhuhai and Zhaoqing. The coordination of internal labor in these cities is inefficient and unsustainable; the industries in each city are intersectional; and the resources are competitive.

To change this situation, we first divide the cities from the perspectives of the Global Innovation Chain(GIC), making full use of the strengths of each city. In accordance with GVC and GIC, we form a synergy between value creation and innovation in the cities and closely integrate the industrial clusters to break the administrative boundaries and to achieve the optimal allocation of production factors and innovation elements.

Based on this, the main purpose of this paper is to study the current urban division of labor in GBA. Drawing on the experience of building an international first-class bay area, we explore how to leverage the advantages of the cities, and how to integrate the innovation elements, with the intention of enhancing the status of GBA in the GVC, and building GBA into an international first-class bay area.

## 2. Overview of related literatures

### 2.1 The meaning and method of urban division of labor

With the expansion of the city scale, modern cities have gradually formed a cluster of cities consisting of central cities and surrounding cities. GBA is a form of urban cluster. This concept was first derived from the San Francisco Bay Area. Urban division of labor refers to the division of labor in a city cluster based on geographic area, industrial chain and value chain. Economic growth and the rise of the knowledge-based economy have also changed the system of urban division of labor.

In the theory of urban division of labor, the regional division of labor was first put forward. Hao Shouyi (1999) believes that regional division of labor is an organic combination of social and economic activities in accordance with certain rules in the geographical space. This division of labor is first manifested in the regional division of labor, and at the same time it must be implemented in space. Zhang Dunfu (1999) believes that geographical division refers to the implementation of regional specialized production on the basis of full use of regional advantages in all regions of a country. It can also realize the product value through interregional exchange and satisfy a region's own demand for products that are not suitable for production in the region, thereby can expand regional production capacity and enhance regional interests. In short, regional division of labor enables each region to obtain higher benefits from resource allocation, promote the development of the region's own economy, and get realized through developing the specialized sectors in the region <sup>[2]</sup>.

Second, with the rise of major industrial sectors, the division of value chain and industrial chain has drawn the attention of many scholars. The division of value chain is composed of numerous

value links. Enterprises in the value chain carry out various value-added activities from design, product development, intermediate products and final product manufacturing, to marketing, sales, consumption, after-sales service, and final recycling<sup>[3]</sup>. The division of industry chain is mainly based on the comparative advantages of each region, and, with the help of regional markets, coordinates the contradiction of the division of specialization and multi-dimensional needs between regions, and considers the division of value chain is a regional cooperation carrier and the industrial cooperation is the realizing forms and contents. There are many “value links” in the value chain. When a series of economic activities in competition carried out by enterprises in industrial chain are defined only from the perspective of value, the industrial chain will be the industrial value chain. The industrial value chain is the structural form of value organization and creation behind the industrial chain. It represents and reflects the deeper value of the industrial chain, and determines the business strategy and competitive advantages of the industrial chain.

In recent years, innovation has promoted the steady development of China’s economy, and the GVC is becoming a new situation of innovation and development. The GIC aims to make full use of global innovation resources to carry out open innovation and realize knowledge-based economy. Larson and Brahmakulam (2002)<sup>[4]</sup> argue that the innovation chain is a process that links knowledge, innovation and wealth to promote economic development and national prosperity. Ma Lin and Wu Jinxi (2011) believe that the so-called GIC refers to enterprises searching for available knowledge resources, paying attention to the use of resources on a global scale, and having a highly open value network innovation model<sup>[5]</sup>. Zheng Wenfan (2018) believes that the innovation chain can be divided into five branches: scientific innovation chain, technology innovation chain, engineering innovation chain, industrial innovation chain, institutional innovation chain, which involves multiple subjects, multiple elements, and multiple steps. The innovation chain is the whole process of value creation, spanning multiple time and space until the final result is achieved<sup>[6]</sup>. Fang Peng (2016) believes that China’s industrial innovation pays more attention to technological innovation and neglects other aspects, lacks synergy between industries, and fails to form a mature GIC<sup>[7]</sup>.

GBA is a national-level strategy with the goal of building an international first-class bay area. Therefore, we must study the construction of the GBA with a global strategy, study the status of the GBA in the GVC, and study how to enhance the status of the international division with GIC. Based on this, GBA will be placed in the global environment to explore how the 11 cities will build a GIC and form a coordinated industrial system with division of labor. Among them, the GIC division refers to an innovative development model in which each city exerts its own advantages through division of labor, absorbs global innovation elements, and shares innovation results with surrounding cities. GIC is divided into five links for research in this paper — education, finance, emerging industries, manufacturing, and commerce. At the same time, they correspond to five innovative factors — talent, capital, technology, production and market.

## 2.2 The significance of urban division of labor

First of all, the urban division of labor is conducive to the city’s full use of talent, capital, technology, location and other advantages for innovation and development. In Tokyo Bay Area, Tokyo is the largest economic, financial, and transportation center. In Japan, there are more than one-fifth of the universities, three-tenths of university faculty, one-fourth of private research institutions, and one-half of top technology companies gathering in Tokyo. They provide talent, capital and technology support for the economic development of the Bay Area. Yokohama is the second largest city in Japan which is dominated by heavy chemical industry. The industrial output value of refining, electrical appliances, food, machinery and metal products accounts for 80% of the

total industrial output value, which is very competitive in the market. At the same time, with the superior geographical location, the bay area has formed a horseshoe-shaped port group connected by the six ports of Yokohama Port, Tokyo Port, Chiba Port, Kawasaki Port, Kisarazu Port and Yokosuka Port, with an annual throughput of more than 500 million tons. Driven by the huge port group, the Tokyo Bay Area has formed two industrial zones — Keihin and Jingye. They are well developed in equipment manufacturing, steel, chemical, modern logistics and high-tech industries, and have exerted the greatest advantages of each city in the zones. <sup>[8]</sup>.

Secondly, urban division of labor is conducive to the accumulation of production factors and innovative resources. Fujita and Tabuchi (1997) discovered that the Tokyo-based manufacturing sector gradually shifted to the Pacific industry belt by studying the spatial and temporal evolution of the urban division of Tokyo Bay Area after the Second World War. Instead, the Tokyo Bay Area gathered more productive services and Japan's large enterprise headquarters, which has demonstrated increasingly strong production service functions such as headquarters management, R&D design, and financial business <sup>[9]</sup>. Kolko (1999) examined the impact of information technology on urban development in the United States, and found that advances in information technology have concentrated manufacturing in small and medium-sized cities, while service industries, especially producer services, have concentrated mainly in large cities <sup>[10]</sup>. In addition, the radiation effect of the growth pole after division of labor will agglomerate resource elements, making the core city become the talent gathering center, information exchange processing center, value-adding center and economic growth center <sup>[11]</sup>, thus enhancing the city's professionalism.

Thirdly, the division of labor can promote the diffusion of factors and enable the core cities to drive the economic development of the surrounding cities. As the scale of the city expands and the level of development increases, the spillover of economic activities in core cities will continue to increase <sup>[12]</sup>. Innovative elements such as capital, technology and talents are continuously diverted to surrounding cities through a series of transmission mechanisms, which forms the sharing of resources, environment and infrastructure. At the same time, the close connection of industrial activities will gradually promote the process of building urban functional areas with integration tendency and achieving optimal market-selective planning, which allows the surrounding cities to complete the different industrial positioning with different central points, thereby reducing decision-making costs and risks.

Such being the case, it is necessary for cities in GBA to carry out a rational division of labor and strengthen the cooperation between cities. Making full use of the advantages of each city, absorbing global talents, technologies and other innovative resources will provide a continuous source of power for the economic development of GBA and even the world.

### **3. Analysis of the current situation of urban division of gba**

#### **3.1 Research methods and data sources**

The current research on urban division of labor is based on two types of methods. The first one is the cluster analysis and principal component analysis. Although both of them can divide the functional division of cities, they cannot make quantitative analysis, and it is also impossible to compare different cities horizontally. The second one is the statistical methods of indexing, such as the Nelson standard deviation method, the specialization index method, etc., but the results obtained cannot reflect the intensity of urban functions. The improved location commercial method adopted in this paper can directly calculate the degree of specialization of the industries in each city, and reflect the current status of urban division of labor by comparing cities <sup>[13]</sup>. In addition, the method has nothing to do with the division of industry and region, and has the characteristics of stability and symmetry in time and space.

$$NLQ_j^i = \frac{E_j^i}{E} - \frac{E^i E_j}{E^2}$$

Among them,  $NLQ_j^i$  indicates the location business (specialization index) of the industry  $j$  in  $i$  city, which is measured by the number of employed people.  $E_j^i$  stands for the number of employed people in the industry  $j$  in  $i$  city.  $E^i$  stands for the total number of employed people in  $i$  city.  $E_j$  is the total employment of the  $j$  industry in GBA.  $E$  is the number of employed persons in all industries in GBA. The improved location quotient index is (-0.25, 0.25).

①  $NLQ_j^i > 0$  indicates that  $j$  industry has a comparative advantage in  $i$  city, and the larger the value indicates the higher the degree of specialization.

②  $NLQ_j^i < 0$  indicates that  $j$  industry has a comparative disadvantage in  $i$  city.

③  $NLQ_j^i = 0$  indicates that  $j$  industry is at a balance of power in  $i$  city.

This paper will study the nine cities of Guangdong, as well as two special administrative regions, Hong Kong and Macao. The data of the nine cities of GBA are from the “employed population by industry” table of the China City Statistical Yearbook. The data of Hong Kong and Macao are from the “total employment by industry” table of the China Population and Employment Statistics Yearbook.

### 3.2 Calculation results and analysis

By solving the collected data with the improved location quotient, it is found that Guangzhou has a highest trade index among the cities of GBA; Shenzhen has the highest manufacturing index and new industries index is also outstanding; Hong Kong’s financial industry has significant advantages, and the commerce and trade industry scores are also high; Macao’s entertainment and gaming industry is the most prominent, while the commerce and trade industry has certain advantages. The dominant industries in Dongguan, Foshan, Zhongshan and Zhuhai are manufacturing industries, and the phenomenon of industrial homogeneity is serious. It can be seen that GBA failed to fully subdivide the cities according to GIC. The division of labor between cities failed to maximize the advantages of each region, and the links were not close enough to form a joint force.

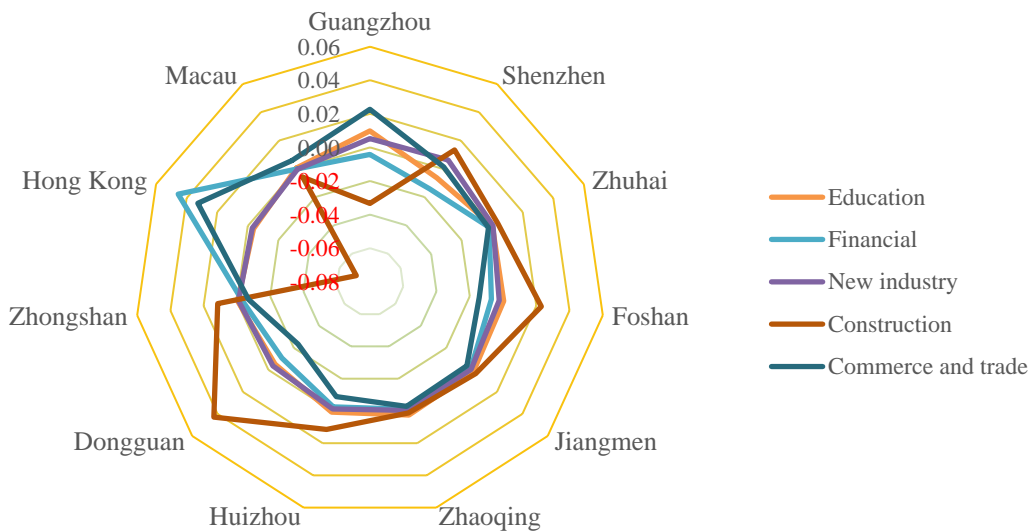


Figure 1 City Advantages of GBA

### 3.2.1 Current status of division of labor in education industry

Education is the starting point of GIC, and it is the basis for innovation to accumulate and cultivate talents for innovative activities. Institutions of higher learning and R&D institutions, as gathering places for talents, often promote the creation of new knowledge and new theories. Colleges and universities are not only the cradle of talents, but also play the role of the basic and theoretical innovation in the innovation chain. It is necessary to explore the theoretical innovation achievements of colleges and universities, and lay a solid theoretical foundation for the completion of the output of the subsequent research and the development of the innovation chain.

The data shows that in 2013-2017, the average number of college students in Guangdong Province reached 2.46 million; the number of graduates exceeded 700,000; and there were nearly 150,000 faculty members. In 2016, two of the 173 colleges and universities in GBA ranked among the top 100 in the world. Compared with the three major Bay Areas, there are 3 in the San Francisco Bay Area, 2 in the New York Bay Area, and 2 in the Tokyo Bay Area, which is comparable to GBA. In addition, GBA also possesses 43 national key laboratories. There are 201 provincial key laboratories and 64 key enterprise laboratories in the Pearl River Delta. The number of talents is quite rich<sup>[14]</sup>, indicating that GBA has the basic conditions and sufficient talent reserves for building a GIC.

Compared with the international first-class bay area, there is still a certain gap in the basic and theoretical innovations in GBA. On the one hand, there is insufficient reserve for cutting-edge talent. At present, GBA has only one of the top 100 innovation institutions in the world, but there are 20 in the international first-class bay area in the Tokyo Bay Area and 8 in the San Francisco Bay Area, which indicates that GBA has a certain foundation of research, but cutting-edge talent is still very scarce. On the other hand, the level of specialization of education division among cities in GBA is not high. The two existing top 100 universities in the world are located in Hong Kong, and the universities in the inland nine cities are mainly located in Guangzhou. In 2016, there were 1,057,300 students in Guangzhou, accounting for 43.0% of the GBA. While Hong Kong and Guangzhou are stocking a great number of talents, it is possible to run on the educational output of the surrounding cities, which shows that GBA has not yet formed a suitable university cluster development model. How to cultivate and attract cutting-edge talents, increase the reserve of cutting-edge talents, and balance the distribution of educational resources in GBA is an important issue in the development of a collaborative and innovative GBA.

### 3.2.2 Current status of division of labor in financial industry

The financial industry provides funds for each link of GIC, perfecting the financial market system and providing stable financing sources for innovative enterprises. It is an important part of making the theory go to reality and a necessary condition for the formation of the innovation chain. The developed financial industry in the three major Bay Areas of the world provides financing channels for enterprises to achieve “production and prosperity”, and the company has obtained sufficient space for innovation and development. In 2016, Manhattan, the financial and economic center of the New York Bay Area, created an output value of around 70% of New York City in an area of 8%. At the same time, Wall Street has more than 2,900 world finance, securities, futures and other institutions to provide convenient and diversified financing channels for enterprises. Tokyo, as the fifth largest GFCI index in the Tokyo Bay Area, is the financial core, and spreads to the surrounding areas and helps to economize the entire Tokyo Bay. This shows that a sound financial market plays an important supporting role in gathering capital elements and promoting industrial innovation.

Table 1 Global Financial Center Index

City	GFCI23		GFCI22		Compared with the previous period	
	rank	score	rank	score	rank	score
Hong Kong	3	781	3	744	0	+37
Shenzhen	18	710	20	689	+2	+21
Guangzhou	28	678	32	668	+4	+10
New York	2	793	2	756	0	+37
San Francisco	8	726	17	693	+9	+33
Tokyo	5	749	5	725	0	+24

Source: No.23 Global Financial Center Index

Compared with the global financial center data, Hong Kong and Shenzhen have the most obvious financial advantages in GBA. Currently, Hong Kong's GFCI index ranks third only to New York; Shenzhen ranks 18th, with a strong upward trend. As a financial center, Hong Kong's financial sector accounts for nearly 85% of its GDP, and its level of development is high. Shenzhen has a Shenzhen Stock Exchange, and the number of companies listed in Shenzhen is large, and the proportion of GDP in the financial industry is also on the rise. The Shenzhen Stock Exchange and the Hong Kong Stock Exchange are two world-class stock exchanges. The total market capitalization and number of listed companies are among the highest in the world. They provide funding sources for nearly 20,000 high-tech SMEs in the Pearl River Delta, and provide important financing channels for building the GIC of the GBA.

The existing financial system has not yet reached the international first-class level, and has not fully utilized capital power to promote the accumulation of innovation factors. The listed companies in the Hong Kong Stock Exchange and the Shenzhen Stock Exchange account for only 3% and 12% of the new economic sectors, far lower than the 60% and 47% of the NASDAQ exchanges and the New York Stock Exchange. With the diversification of listed companies' industry distribution and demand, it needs further discussion and thinking that how to promote Hong Kong and Shenzhen financial intercommunication, provide effective financial support and risk diversification functions, meet their investment and financing needs, and accelerate the construction of the GIC.

### 3.2.3 Current status of division of labor in new industries

Emerging industries are located in the middle reaches of the innovation chain and play a central role in the innovation chain of GBA. The strategic emerging industries mainly developed in GBA are information technology, big data industry; electronic information industry; biomedical industry; electric power industry and new energy new materials industry [15]. Research and technology is the backbone of developing emerging industries.

Table 2 Comparison of the Transformation Rate of Scientific and Technological Achievements in the Four Great Bay Areas in 2016

	Guangdong, Hong Kong and Macao Bay Area	New York Bay Area	San Francisco Bay Area	Tokyo Bay Area
Invention patent(10,000 pieces)	19.37	4.11	5.55	13.96
Patent growth rate(%)	24.92	-3.73	-1.86	-0.38
PCT Patent(10,000 pieces)	1.61	0.82	0.68	2.85
Patent application (10,000 times)	0.42	2.83	1.86	5.44

Source: Guangdong Statistical Yearbook, GDI Think Tank

At present, the total number of invention patents in GBA is much higher than that of the other three major Bay Areas, and it is growing rapidly. However, the number of Patent citation was only

0.42 million times, only 1/8 of the average level of the three major Bay Areas. The patented results have no obvious guiding effect on the social economy, and the quality is far lower than other Bay Areas. There is only one of the top 100 innovation institutions in the world, which is far from the 20 and 8 in the Tokyo Bay Area and the San Francisco Bay Area. Insufficient technological innovation capability is not conducive to the innovative development of emerging industries.

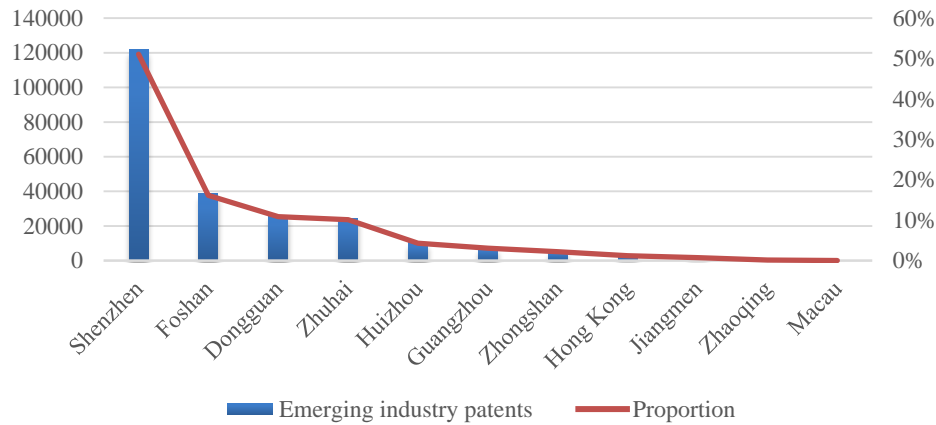


Figure 2 Number and proportion of patents in emerging industries in 11 cities from 2015 to 2017

In addition, among the emerging industry patents in 2015-2017, Shenzhen accounted for more than half of the total volume of GBA with 121.69 million pieces. There are only 44 in Macao, accounting for only 0.16%. It can be seen that Shenzhen has a dominant position in emerging industries, and the innovative capacity of emerging industries in the cities of GBA is extremely unbalanced, which is not conducive to the formation of the industrial innovative chain in GBA. Therefore, how to play the leading role of Shenzhen in the field of innovation, synergistically drive the development of emerging industries in surrounding cities; how to form innovative industrial regions to attract talents and technology from all over the world, and develop GBA into an international first-class bay area, which will be Strategic issues.

### 3.2.4 Current status of division of labor in manufacturing industry

The manufacturing sector is the link to convert results of theoretical innovation into reality, which is the actual productivity in the innovation chain. Being an influential manufacturing base in the world, GBA is a manufacturing link in GIC, whose manufacturing employment provides sufficient labor for the production of R&D products. Manufacturing sector in GBA is densely distributed in the core and surrounding cities, among whom the top three are Dongguan, Shenzhen and Guangzhou, accounting for 23%, 22% and 15% respectively. The total employment of manufacturing in Dongguan, Foshan, Huizhou and Zhongshan reached 98.18 million, accounting for 51%, higher than the international first-class GBA, providing sufficient human resources for R&D.

As can be seen from the Figure 3, the total number of manufacturing in Guangzhou and Shenzhen is 7,065,400, accounting for 37% in GBA, which is equivalent to the number of manufacturing in the last nine cities. With the increase of labor costs and the change of international trade relations, OEMs are subject to orders causing a large number of manufacturers have been unable to continue because of the failure to turn around. At the same time, the existing empirical research shows that GBA has many types of industry, among which service industry and manufacturing industry have high coupling, but urban division of labor lacks of coordination, leading to overlap, competition and other conflicts.

Therefore, how to strengthen the professional functions of the core cities of GBA under the high



value-added original functions of R&D, design and trade so as to make full use of the superiority of the labor force in the surrounding cities transforming the research and development results into products and improving the level of division of labor in each city is a question worth exploring.

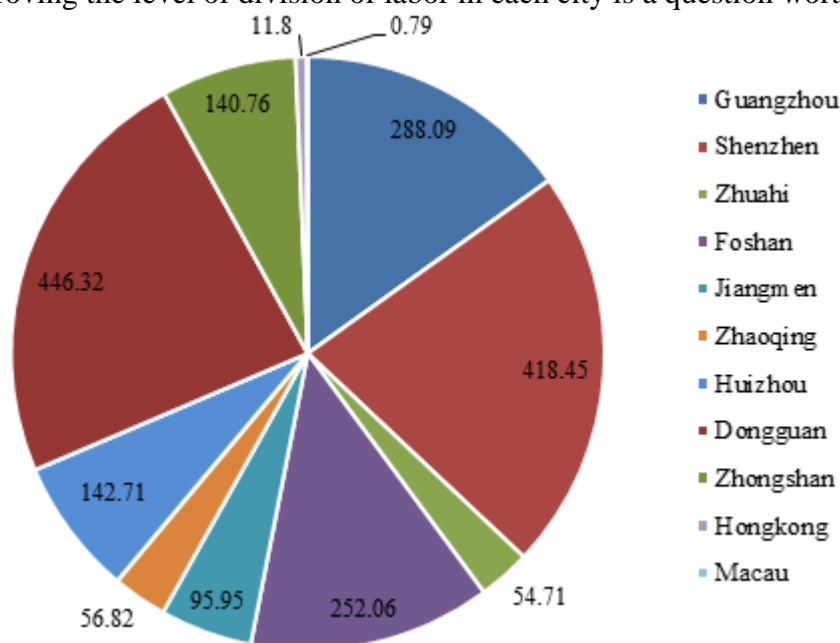


Figure 3 Employment and proportion of cities and towns in GBA in 2016 (Unit: 10,000)

### 3.2.5 Current status of division of labor in commerce and trade

As the terminal of the GIC, the commerce and trade industry is linked to bring the high-tech products to the market, and also the driving force for transforming scientific innovation into productivity and economic growth. The study finds that, closely related to the trade and economic growth of the entire GBA, the port economic development is highly fitted to the regional GDP, which is also an important node for international trade.

With the geographical advantage, GBA has the largest population of the world's seaport and airport group, surrounded by mountains on three sides. Port throughput of GBA ranks first in the world and the container throughput is 4.5 times total of the three major bays. It has three world-class ports such as Guangzhou, Hong Kong and Shenzhen. Meanwhile, Zhuhai Port and Dongguan Port are also developing strongly.

Table 3 Port throughput of Guangdong-Hong Kong-Macao GBA in 2016 (Unit: 10,000 tons)

City	Port cargo throughput	Port container throughput
Guangzhou	54356.12	1884.97
Hong Kong	25670.00	1981.00
Shenzhen	21400.00	2397.93
Dongguan	14583.72	—
Zhuhai	11778.00	165.00
Jiangmen	7923.00	—
Zhongshan	6731.00	—
Foshan	5996.08	261.75
Huizhou	5413.90	16.20
Zhaoqing	3236.90	71.31
Macao	—	14.97

As can be seen from the above table, the port economy of GBA is mainly dominated by Guangzhou Port, Hong Kong Port and Shenzhen Port, occupying 92% of entire GBA. Dongguan Port, Zhuhai Port and Jiangmen Port are closely following, providing a trading route for commercial trade in GBA. At the same time, as a business center in GBA, Guangzhou's development of port trade is conducive to promoting the coordinated development of the port city. Ports drive the city's economy through foreign trade, which will generate more freight demand, increase port throughput and expand the port size, thus forming a virtuous circle between cities and ports.

However, compared with the international first-class bay area, the three world-class ports in Guangdong, Hong Kong and Macao are very close to each other, and there is a clear overlap with the industries in hinterland cities. The urban division of labor is not clear enough, so the competition in commercial trade is fierce and difficult to form a joint force. Therefore, how to plan the major ports and make rational use of the status of the Guangzhou Business Center in order to drive the growth of the commerce and trade industry in the surrounding areas. Improving the efficiency of resource utilization will directly affect the circulation of all links in the innovation chain.

#### **4. Improvement of urban division of labor in gba by gic**

The particularity of GBA lies in its multi-faceted pattern of “one country, two systems, three legal domains, and four core cities”, which is both characteristics and the biggest difficulty of GBA. How to realize the organic integration of economic models in Hong Kong, Macao and the Chinese mainland cities under “One Country, Two Systems” so that the free flow of resource elements and the parallelism of action management can give full play to the innovation factors of various regions for collaborative innovation is a major challenge for GBA. It is the breakthrough of creating a GIC of GBA to promote the formation of industrial integration and enhance the competitiveness as well as capability of independent innovation of GBA.

##### **4.1 To break down institutional barriers and establish university clusters**

Basic research is indispensable for building GIC and talents are the basis of innovation activities. Hong Kong has two of the world's top 100 universities, while Guangzhou has nearly half of the university resources in nine cities in the hinterland. The two cities have absolute advantages in quality and quantity. GBA should make full use of the basic innovation and theoretical innovation ability of institutions of research institutions, promoting the flow of innovation theory through close scientific research exchanges between universities in order to maximize the use of innovative resources and improve the efficiency of innovation. Subject to different institutional mechanisms in GBA, there are still obstacles in carrying out scientific innovation activities among researchers across the region. Talents flow and research funding have largely hindered cross-regional scientific research cooperation. GBA should break down institutional barriers and maximize the synergy in the innovation process of the three regions.

First of all, GBA build a “band-shaped radiation” university group, learning from the “multi-center + axis” university group model in New York, the “multi-center complementary” university group model in San Francisco; the “center + periphery” university group model in Tokyo <sup>[15]</sup>. In this way, GBA can better explore mutual recognition of specific course credits, implement more flexible exchange arrangements and simplify the talents settlement system to ensure the social welfare of cutting-edge talents so as to reduce the loss of talents.

In the development of integration with international talents, GBA should develop the green channels for science and technology talents and set up an international talent zone relying on Shenzhen Qianhai, Hong Nansha, Zhuhai Hengqin Free Trade Zone. GBA should give full play to

the advantages of university resources attracting well-known scholars at home and abroad. To promote innovation in talents, technology and management experience, GBA should make full use of Hong Kong's industrial and geographical advantages, attracting global high-tech enterprises to invest and build factories with the freedom of entry and exit, efficient capital and information circulation, and less language barriers. Local enterprises enhance cooperation with multinational corporations to promote the process of joint research and development and cultivate their own professional talents.

Furthermore, the corresponding featured institutions should also be established. In the course of the development of universities in GBA, the diversification of university types within university groups is the basic condition for the formation of a good ecosystem of higher education in GBA<sup>[16]</sup>. Diversified colleges and universities cultivate talents in different fields, forming a social environment in which competition, struggle, and innovation can survive. GBA should adapt to the surrounding cities of the three core cities and explore diversified types of higher education institutions with diverse levels and distinctive features to provide high-end talents.

#### **4.2 To deepen financial linkage and build an international financial hub**

Small and micro enterprises are the majority of 20,000 high-tech enterprises in GBA, including many early-stage innovative companies. There gather 449 companies of Guangdong's Top Five Hundred Enterprises with huge capital demand. Therefore, PE and VC-based institutional investors accounted for 80% of the investment institutions in GBA. However, the current financial market mechanism in the three places is not perfect and there is a shortage of high-quality financial assets with single financial products. Focusing on the innovation chain, we must provide financial risk diversification for enterprises to better cultivate high-end manufacturing industry and realize innovation-driven development. GBA should also pay more attention on the investment and financing needs of technology enterprises of different scales, tailoring their financial investment and cash flow management.

Therefore, GBA must give full play to the advantages of Hong Kong's world financial center and provide effective financial support for industrial innovation and technology-based micro-enterprises. We should expand the space and channels for cross-border investment between the Chinese mainland and Hong Kong as well as Macao, so that the financial products of the two places will be more compatible. Meanwhile, we should strengthen the cooperation between the Chinese mainland and the Hong Kong Monetary Authority, further improve the policy of Chinese mainland enterprises to go public in Hong Kong with improved process efficiency and reduction of financing costs.

In addition, we must grasp the development direction of cross-border RMB business and promote the development and upgrading of the real economy in GBA with financial innovation. As an important pillar of financial cooperation in GBA, the cross-border two-way RMB loans in the GBA have accumulated more than 80 billion Yuan in 2018, but it still cannot fully meet the cross-border capital needs of the GBA. The Financial Interconnection of GBA serves the economic and industrial upgrading of the GBA. There should be policy encouragement given priority to relevant financial needs. In the diversified system of "one country, two systems and three tax zones", GBA should grasp the dividend of institutional advantages, improve the flow of funds, optimize the cross-border payment environment, and facilitate the flow of various innovative elements in GBA. Electronic check clearing facility should be continued to implement, the foreign exchange management system reform aspects of the implementation of pilot cross-border exchange of funds, and constantly improve trade finance compliance review mechanism, to create "financial opening test area" in order to promote the development of creative industries GBA.

### **4.3 To push enterprise innovation and cultivate emerging industrial clusters**

To cultivate new industrial clusters and improve the quality of urban division of labor, the government should encourage enterprises to carry out research and development activities around industrial needs, guiding enterprises as the mainstay of technological innovation. The three international first-class bay area are all of the Science and Technology Innovation with a densely populated area of universities, research institutes and R&D institutions. Besides, acceleration of the transformation of knowledge into technology and the industrialization of scientific and technological achievements. The government should guide the financial funds to improve the technological innovation capability of enterprises as a reform direction, including tax reduction and exemption policies. Risks come with investment in technology research, so the government should plan to strengthen the construction of a co-research platform to gradually improve the risk sharing mechanism. With the reduction of risks brought by technical and market uncertainties, enterprises are encouraged to further enhance technology innovation quality, especially in industrial application research. At the same time, enhance the technical testing and market inspection services of R&D products for industrial promotion.

Strengthening scientific and technological cooperation in GBA and building the innovation circle based on new industrial clusters can thereby further promote the integration of high-tech results. With the supports of universities and enterprises, new industrial clusters form large urban agglomerations, radiating the development of surrounding areas [16]. The innovative resources from universities and the new industry in Shenzhen can bring out the utilization the manufacturing advantages of Dongguan, Zhongshan and Foshan, guiding the core cities to intervene in R&D and form supporting clusters for promotion of advanced technologies. With the complementary industry chain, development, transformation and application from a new industrial cluster will gradually guide GBA's transformation from industrial clusters to innovative clusters and drive the innovation development through effective links in the innovation chain.

### **4.4 To improve the quality of the workforce and optimize the internal division of labor in manufacturing industry**

In the GIC, manufacturing is an important part of putting innovation theory into actual production. The specific performance of GBA's construction of GIC is that, with implementing the strategy of expanding domestic demand, GBA upgrades traditional manufacturing to promote the development of modern service industry, gradually embedding into GIC based on the foundation of GVC<sup>[17]</sup>.

With the development of economic globalization, the increasing China's labor costs drive international OEMs to gradually shift to other countries. The era of demographic dividends has gradually passed. The traditional manufacturing industry which relies on low labor costs and extensive economic growth methods needs to be upgraded. The introduction and absorption of technology is essential for promoting transformation of traditional manufacturing and embedding GIC into industries. High-quality labor can promote the introduction and absorption of technology and enhance the upgrading of industrial structure, thereby providing impetus for developing advanced manufacturing industry<sup>[18]</sup>. To improve the quality of the workforce, the government needs to increase public education investment and increase vocational and technical training for the labor force in the leading industries. At the same time, enterprises and schools should collaborate to encourage the further study of the workforce.

In the process of developing advanced manufacturing industry, it is necessary to improve internal division of labor and coordinate development. Guangzhou and Shenzhen should form supporting facilities with Dongguan, Foshan, Huizhou and Zhongshan. Guangzhou, Shenzhen and

other major Academy dense core of the city should be committed to high-end industries, and the development of the core components, the Internet, big data, cloud computing, chain blocks and artificial intelligence and other emerging technologies. Dongguan, Foshan, Huizhou and Zhongshan make use of the accumulation of manufacturing industry and proximity to Guangzhou and Shenzhen, to focus on the electronic information industry and intelligent manufacturing, transferring the scientific and technological achievements of patent technology, genetic testing and AI image recognition from Guangzhou and Shenzhen. Industrialization<sup>[19]</sup>. Cities with relatively low labor costs, such as Zhaoqing and Jiangmen, can undertake the industrial and capital transfer of other cities, and make the traditional manufacturing industry better. Zhuhai can make electronic information, petrochemical industry, home appliance electrical, precision machinery manufacturing, biomedicine and electric power industry become the leading industries, focusing on the advanced manufacturing with core techniques. The urban division of labor can accelerate application of advanced technologies with the help of the coordination and collaboration between industries, helping Guangdong-Hong Kong-Macao Greater Bay Area develop the GIC.

#### **4.5 To improve port layout and facilitate the innovation in commerce and trade industry**

With the advantages of the port group, GBA should develop the commerce and trade industry in the GBA.

First of all, the government should strengthen planning and clarify the major and minor relationship between Guangzhou Port, Shenzhen Port and Hong Kong Port. The business scope of different ports will reduce vicious competition and repeated investment between each other. Guangzhou is China's largest distribution center for business flow, passenger and logistics. Therefore, Guangzhou Port can be regarded as the core of the GBA commercial and trade city group. Shenzhen and Hong Kong being the sub-core port cities, the government should make full use of Hong Kong's international status and influence to play an important role in the transit shipment, and make Shenzhen Port the port hub of the GBA. As the "leaders" in the port, Guangzhou, Shenzhen and Hong Kong should strengthen cooperation in container transportation, shipping finance, shipping legal arbitration, etc., so as to achieve a win-win situation and promote the development of hinterland cities and build the world-class commercial industry cluster.

Secondly, GBA should also enhance the communication within the city group to form a joint force. With the advantages of Hong Kong's financial industry, Guangzhou can provide settlement and financing services for commerce and trade. By utilizing the advantages of Shenzhen's high-end information technology, it can create a high-end service industry and establish a professional market with brand influence. At the same time, Dongguan and Foshan can provide a production base for commercial manufacturing with advantages of its adjacent geographical location. This can form a development pattern of Guangzhou- Zhuhai- Foshan and Shenzhen- Hong Kong- Dongguan.

### **5. Conclusion**

GBA shoulders the task of open innovation for the construction of China's GIC. With 0.6 % of the country's land area, Guangdong contributes 12.57 % of Chin's GDP. The international financial market of Hong Kong and the prosperous foreign trade of Macao have brought more and more development opportunities to GBA. However, with the increase of the human resources cost and the overcapacity of urban division of labor caused by homogenization competition, the traditional GVC industrial model of GBA is faced with the weakening development momentum, which needs industrial upgrading by building a GIC.

In the backdrop of GBA being a national strategy, Guangdong-Hong Kong-Macao Greater Bay Area has to adhere to innovation-driven economic growth to become Chinese economic growth

pole, radiating South China. To reshape the momentum of sustained economic growth, the government must shift from embedding the GVC to building the GIC. With the integration of the geospatial and resource elements of 11 cities by specialized division of labor, GBA should focus on the growth of the three core cities, Guangzhou, Shenzhen and Hong Kong, and absorb global innovation elements for promoting collaborative innovation in surrounding cities. Change the current division of labor in the GBA and help build Guangdong-Hong Kong-Macao Greater Bay Area into an international first-class bay area.

## Acknowledgements

This paper was supported by the *National Social Science Fund Project “From Global Value Chain to Global Innovation Chain: a Strategic Study of Enhancing China’s Status in International Division of Labor* and Guangzhou Social Science 13th Five-Year Plan Project “*Research on the Status of Growing Guangzhou Industry in Global Division of Labor Based on Double Spiral Model of Global Innovation Chain and Global Value Chain* (Project No.: 2017GZYB41).

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