

# Study on Problems and Countermeasures of Collaborative Development of Industrial Innovation in Guangdong, Hong Kong and Macao Greater Bay Area

Ziqian Chen, Lingyun Song<sup>a,\*</sup>, Shiyun Hu

Guangxi Normal University, Guilin, China

<sup>a</sup>cassie8888@163.com

\*Corresponding author

**Abstract:** The construction of the city cluster of Guangdong, Hong Kong and Macao Bay Area is not only the intrinsic demand for the development of the Bay Area's economy and culture, but also an important strategic initiative to realize China's construction of a world-class innovation and economic zone. The strategy is aiming to implement the "one country, two systems", and the establishment of a new system of an open economy that is on a par with the international standards. Therefore, how to promote the synergistic and mutual assistance among cities in the Bay Area, build a multi-body linkage, enhance the level of resource factor allocation in the Bay Area, and finally coordinate the industrial links among the three places are important to realize the development of industries in the Bay Area. However, the coordinated development of industrial innovation in the Guangdong-Hong Kong-Macao Greater Bay Area faces the problems of increasing factor flow costs due to the institutional differences, insufficient independent innovation capacity of small and medium-sized enterprises (SMEs), the shortage of technological innovators reservations as well as the urgent need to upgrade industrial cooperation and division of labor. Accordingly, the article proposes the following countermeasures to promote the coordinated development of industrial innovation in the Guangdong-Hong Kong-Macao Greater Bay Area: (1) Improve the foundation and capacity of research and development. (2) Promote the rate of transformation of innovation results and knowledge, and to fully integrate the Bay Area's innovation resources and platforms. (3) Build the innovation ecosystem of the Guangdong-Hong Kong-Macao Greater Bay Area.

**Keywords:** Guangdong-Hong Kong-Macao Greater Bay Area; Pearl River Delta (PRD) City Agglomeration; Industrial Synergistic Development; Industrial Innovation; Deep Integration of Industry, Academia and Research

## 1. Introduction

The Guangdong-Hong Kong-Macao Greater Bay Area is one of the most open and economically vibrant regions in China, comprising nine cities, including Guangzhou, Shenzhen, Zhuhai, Foshan, Dongguan, Zhongshan, Jiangmen, Zhaoqing and Huizhou, as well as the two Special Administrative Regions of Hong Kong and Macao, which constitutes the "9 + 2" Bay Area City Cluster, and the first national-level Bay Area in China. The construction of the Guangdong-Hong Kong-Macao Greater Bay Area creates a natural innovation system for the flow of innovation subjects and factors among the three places, and is another new model for regional integration in China. According to data from the China Statistical Yearbook, as of 2022, the 11 cities in the Guangdong-Hong Kong-Macao Greater Bay Area will have an economic total of more than RMB 13 trillion, accounting for 10.7% of the country's total GDP. Through innovative division of labor and collaboration, the cities in the Bay Area can realize inter-regional complementarities by giving full play to their respective geographic and industrial advantages, forming a unique innovation network and innovation system in the Bay Area, driving the city subgroups to realize the synergistic development of regional industrial innovation with the central city of the innovation network, providing a strong economic pillar for the development of the Bay Area, and gradually becoming an important spatial carrier and an advanced demonstration area for the high-quality development of China's economy.<sup>[1]</sup>

Existing studies on the industrial development of the Guangdong-Hong Kong-Macao Greater Bay

Area mainly focus on the overall planning and development of the Bay Area, and there is not enough literature on industrial innovation and synergy development. As a regional integration strategy under the background of "one country, two systems", the Guangdong-Hong Kong-Macao Greater Bay Area will not only help promote cross-strait economic development, but also help solve the friction and structural challenges brought by "one country, two systems". It also helps to resolve the friction and structural challenges brought by "one country, two systems". This paper first analyzes the reality foundation and development mode of industrial innovation synergy development in Guangdong, Hong Kong and Macao Greater Bay Area, and further explores the main problems in the process of industrial synergy development, and finally puts forward countermeasures and suggestions for industrial innovation synergy development in Guangdong, Hong Kong and Macao Greater Bay Area based on the analysis and summary.

## **2. Current Situation of Collaborative Development of Industrial Innovation in Guangdong, Hong Kong and Macao Greater Bay Area**

### ***2.1 Conditions for collaborative development of industrial innovation***

The synergistic development of industrial innovation in Guangdong, Hong Kong and Macao Greater Bay Area cannot be separated from the three central elements of science and technology innovation, namely innovation research and development (R&D), innovation transformation and product application, which are interdependent and form a mutually reinforcing cycle.<sup>[2]</sup> Innovation R&D is the process of creating knowledge, which includes basic research, applied research, and ultimately scientific papers, publications or patents as the display results. Innovation transformation is the transformation of knowledge through testing, development, application, promotion and other channels, transforming scientific research results into new products with practical value and commercial prospects. Product application is the application of new products, new processes, new business models, etc. by enterprises to successfully put the results of knowledge transformation into the market in order to meet the needs of customers.

In the knowledge production process, the Guangdong-Hong Kong-Macao Greater Bay Area has been promoting the construction of "double first-class" universities, building high-quality teaching resources and scientific research talents in Guangzhou, Hong Kong and Macao, and cooperating with domestic and international higher education institutions to run schools, so as to attract more first-class scientific and technological talents and institutions from home and abroad to gather. In the knowledge transformation process, the Greater Bay Area utilizes the economic advantages of the Special Administrative Region and the relaxed institutional environment to reduce the institutional barriers to the transformation of scientific research and knowledge achievements, and improve the success rate of knowledge transformation. In the product application segment, it will give full play to the advantages of intelligent manufacturing in the central cities of the PRD and neighboring cities, and make use of the science and innovation foundation of high-tech industrial development zones and science and technology parks to promote the smooth transformation of scientific and technological achievements into quality products.

### ***2.2 Realistic basis for synergistic development of industrial innovation***

#### ***2.2.1 Policy Basis***

The Greater Bay Area city cluster is a frontier station of reform and opening-up. Since the establishment of the Shenzhen Special Administrative Region (SAR) in 1980, there have been a series of demonstration results of reform and opening-up and major national strategies, such as the Hengqin New Area and the Nansha New Area, which have laid a solid political foundation for the construction of the Guangdong-Hong Kong-Macao Greater Bay Area. Based on the principle of "one country" and making good use of "two systems", giving full play to the advantages of the three independent customs zones of Guangdong, Hong Kong and Macao, the flexible system of the Greater Bay Area of Guangdong, Hong Kong and Macao provides a convenient way to cooperate with countries with similar systems along the route, and provides valuable opportunities for the cities in the Bay Area to learn from each other and to promote each other's development. This provides valuable opportunities for cities in the Bay Area to learn from and promote each other.

### 2.2.2 Economic Base

Table 1 shows the comparison of the world's four largest bay areas. The Greater Bay Area covers an area of approximately 56,000 square kilometers, accounting for less than 1% of the country, but attracts 20% of the country's foreign direct investment and contributes more than 1/10th of the country's economic development. The total GDP of the Guangdong-Hong Kong-Macao Greater Bay Area will be approximately US\$1.85 trillion in 2022, an increase of 4.8% compared to that in 2021, and it has already surpassed the Tokyo Bay and ranked the first among the four major Bay Areas in the world. Compared to the world's other three Bay Areas, the Guangdong-Hong Kong-Macao Greater Bay Area has the largest resident population of about 68 million people, and it has also become the Bay Area with the largest airport passenger throughput.

Table 1 Comparison of the world's four largest bay areas

	Guangdong-Hong Kong-Macao Greater Bay Area	Tokyo Bay Area	New York Bay Area	San Francisco Bay Area
Area (million square kilometers)	5.6	3.7	2.1	0.8
Population (million)	8600	4300	2340	770
GDP (Trillions of dollars)	1.85	1.8	1.7	0.8
Per GDP (dollars)	21511	41407	80000	105203

Note: Data as of 2022, source: <http://baijiahao.baidu.com/s?id=1766156693281781458&wfr=spider&for=p>

The unique economic and spatial structure of the Greater Bay Area brings together factors of production such as manpower, capital and land, and its large total economic scale and strong development potential provide a strong guarantee for the development of small and medium-sized enterprises (SMEs), progress in science and technology innovation, and the promotion of innovative products. From the perspective of city clusters, the Guangdong-Hong Kong-Macao Greater Bay Area is home to the core cities of the Pearl River Delta (PRD) city cluster, such as Shenzhen and Guangzhou, as well as a science and technology innovation center and an advanced manufacturing service base, and at the same time, Hong Kong, an international financial and trade center, and Macao, an international tourism and leisure center. The complementary economic advantages of the three places make the Guangdong-Hong Kong-Macao Greater Bay Area bound to become a new growth point for China's economic development in the future.

### 2.2.3 Basis of Innovation Body Clustering

Diversified city clusters provide a good industrial base, scientific and technological capital, market opportunities and enterprise subjects for global scientific and technological changes.<sup>[3]</sup> Specifically, Guangzhou as has the three traditional pillar industries of automobile, petrochemical and electronic information. At present, Guangzhou has turned its attention to information technology, artificial intelligence, biomedicine, new energy materials and other strategic emerging industries and the development of future industries, and gradually formed a modernized industrial system of "dual-axis drive" of emerging industries and advanced manufacturing services. According to the Guangzhou Bureau of Statistics data disclosure, in 2022, Guangzhou "3 + 5" strategic emerging industries to achieve added value of 887.9 billion yuan, accounting for about 30.8% of the proportion of GDP. Data from the Ministry of Commerce of the People's Republic of China disclosed that Shenzhen's PCT international patent applications amounted to 15,900 in 2022, accounting for about 22.99% of the national total, and has ranked first in the country for 18 consecutive years. The financial intensity of science and technology R&D investment (R&D expenditure as a percentage of GDP) was 5.49%, ranking steadily in the second place in the country. The computer communications and other electronic equipment manufacturing industry is the two industries with the highest number of patent applications in Shenzhen, and is also the main funding area of the government's innovation subsidies. R&D investment in the field of computer communication and other electronic equipment manufacturing has led to the integration of the industrial chain in the neighboring cities of Shenzhen (Dongguan, Huizhou, etc.), and the coupling degree of urban innovation has been gradually improved under the influence of the siphon effect. Unlike Guangzhou's "3+5" strategic emerging industries, the Shenzhen Municipal Government focuses its innovation efforts on strategic emerging industries such as brain science and brain-like intelligence, visible optical communication, quantum information, etc., and coordinates the layout of the future industry to create a "6+5" core bearing area.

Excluding the two core cities of Guangzhou and Shenzhen, the remaining seven cities in the Guangdong-Hong Kong-Macao Greater Bay Area have a comprehensive coverage of industries,

including communications equipment, biomedicine, shipping and marine engineering, health and pharmaceutical equipment, etc. For example, The Chinese University of Hong Kong and The Hong Kong University of Science and Technology have set up new campuses in Shenzhen and Guangzhou, which have played an important role in creating the "Guangdong, Hong Kong, Macao and International" industry-university-research model of innovation. Macau is the third largest gambling city in the world and likewise one of the international tourist destinations. Macau is dominated by the service industry, with its tourism and entertainment revenues taking up more than half of the city's economy. The importance Macau attaches to tourism, hotel management, and health care is also evident. The construction of the Guangdong-Hong Kong-Macao Greater Bay Area further solidifies Macau's position as the center of the world's tourism and leisure industry.

#### **2.2.4 Socio-environmental base**

Hong Kong and Macao are affected by special historical reasons and have both English and Portuguese cultures. Combined with the overseas Chinese culture in the Pearl River Delta region, the three cultures converge in the Greater Bay Area, and the Greater Bay Area has become an important link for exchanges between the countries along the 21st Century Maritime Silk Road and China, which provides an open and inclusive cultural condition for the introduction of international innovation forces into the Greater Bay Area. The highly tolerant and open social environment of the Guangdong-Hong Kong-Macao Greater Bay Area will help generate more scientific research and innovation results and provide a favorable social environment for the development of high-tech enterprises. As one of the earliest open ports in China, Macao has established close ties with many EU countries since the reform and opening up, and has acceded to 106 international conventions and multilateral clauses, which makes it an important channel for introducing advanced technological talents to the outside world, and also an important platform for promoting the innovative enterprises and innovation achievements of the Greater Bay Area to go global. The high level of openness has brought together domestic and foreign innovation factors and innovation subjects, and created a unique "immigrant city" and "immigrant culture" such as Shenzhen. Shenzhen's foreign population has always accounted for more than half of the resident population, because of the mutual friction between different cultures, pioneering and innovation, fair competition and other immigrant cultures have taken root in Shenzhen, and nurtured the pursuit of success, tolerance for failure and other innovation spirit unique to Shenzhen.<sup>[4]</sup>

### **2.3 Collaborative development model for industrial innovation**

To realize the collaborative development of industrial innovation in the Greater Bay Area of Guangdong, Hong Kong and Macao, it is necessary to make full use of the prerequisites of the Pearl River Delta (PRD) city cluster, Hong Kong and Macao, give full play to the advantages of the resources of each city, make full use of the main body of innovation and the conditions of the policies of each city, realize the division of labor and complement each other's strengths, and establish a model for collaborative development of industrial innovation in the Greater Bay Area, which is: "Hong Kong, Macao, and Guangzhou innovate in research and development - Shenzhen innovate in transformation - and Pearl River Delta products are applied".

#### **2.3.1 Innovative R&D in Hong Kong, Macau and Guangzhou**

Hong Kong, Macao and Guangzhou are cities with a concentration of high-level universities at home and abroad, with a good research and academic environment and internationalized talent training conditions. Table 2 shows the major university institutions and research priorities. Hong Kong occupies five of the world's top 100 schools and has achieved high level academic achievements and international recognition in the fields of medicine, financial science and technology, biology, artificial intelligence and big data. The level of higher education in Macau has also developed significantly since the handover. The University of Macau, established in Hengqin, has seen a more comprehensive improvement in its operating conditions, and tourism and hotel management education, which is unique to Macau's higher education, has thus gained wider recognition. Gathering nearly 80% of the tertiary institutions and 97% of the national key disciplines in Guangdong Province, as well as 18 national engineering and technology research centers, 25 national enterprise technology centers, 19 national key laboratories, and 6 national and provincial universities, Guangzhou has become a veritable leading city in the Pearl River Delta as a nationally-funded innovation demonstration zone.<sup>[5]</sup>

Universities and scientific research laboratories are important origins of innovative research and development, but it is difficult to truly transform knowledge into products and thus put them on the market by relying solely on the scientific research strength of universities and laboratories. Despite the

fact that Hong Kong and Macao have a large number of colleges and universities and their reputation, the overall industrial pattern of the society is slightly solidified, the social development is deconstructed and lacks the support of the real economy, and it is difficult for the achievements of science and technology innovation, such as bio-engineering, electronic information, etc., to be put into practice locally, and the vitality of innovation of the enterprises is insufficient; Guangzhou has a better manufacturing and service industry foundation, but the R&D achievements and popularity of universities are not as good as those of Hong Kong. Therefore, the integration of teaching resources and scientific research achievements of universities in Hong Kong, Macao and Guangzhou and the sharing of high-quality teaching resources and scientific research conditions are the prerequisites for the realization of high-quality innovation and R&D.

*Table 2 Major University Institutions and Research Priorities*

City	University	Research area
Hongkong	University of Hongkong	Biomedicine, neuroscience, chemistry, new energy, smart grid, new materials, computational science and information technology, pharmaceuticals, etc.
	Chinese University of Hongkong	Smart Cities, Environment and Sustainability, Biomedicine, Journalism and Communication, etc.
	Hongkong University of Science and Technology	Nanotechnology, neuroscience, artificial intelligence, robotics and automation technology, new energy, etc.
Macao	University of Macau	Civil and Environmental Engineering, Electrical and Mechanical Engineering, Biomedical Sciences, Chinese Medicine, etc.
	Macau University of Science and Technology	Quality of Traditional Chinese Medicine and Innovative Drugs, Smart City, Architecture and Urban Planning, Systems Engineering, etc.
Guangzhou	Sun Yat-sen University	Mathematics, chemistry, biology, materials science and engineering, electronic science and technology, basic medicine, clinical medicine, etc.
	South China University of Technology	Chemistry, Materials Science and Engineering, Information and Communication Engineering, Mechanical Engineering, Architecture, Control Science and Engineering
	Jinan University	Pharmacy, Mechanics, Biomedical Engineering

### **2.3.2 Innovation transformation in Shenzhen**

Shenzhen is the most dynamic city in China in terms of innovation, and also ranks second in the world among the innovative and active cities, thanks to the relaxed entrepreneurial environment and the healthy competition among science and innovation-oriented SMEs. Shenzhen has established a favorable industrial ecological environment and institutional mechanism for the transformation of scientific research results through continuous reform and development in the past few years. In order to better promote the transformation of scientific and technological achievements, the government has established a platform for resource sharing, provided services such as trading and transferring, consulting and incubation, and improved the mechanism for sharing scientific and technological achievements.<sup>[6]</sup> In new technology fields such as artificial intelligence, meta-universe, bioprinting and drones, Shenzhen enterprises have 264,200 valid invention patents, accounting for about 7.33 percent of the national total. By the end of 2022, Huawei will hold more than 120,000 valid patents licensed globally, with patent licensing revenue of about \$560 million. However, Shenzhen's deficiency lies in the lack of innovation and R&D, the number of institutions of higher learning and scientific research laboratories is far less than that of Guangzhou and Hong Kong, and only innovation and transformation activities and motivation, the lack of the source of transformation can not realize the smooth landing of scientific research results. Therefore, give full play to the transformation ability of Shenzhen's innovation results, so as to achieve the synergistic development of the industrial innovation of the Guangdong-Hong Kong-Macao Greater Bay Area.

### **2.3.3 Product Application in PRD Cities**

At the beginning of the reform and opening-up period, the demographic dividend and low-cost labor advantage of the PRD region attracted Hong Kong's manufacturing industries to relocate to the Mainland, and a cross-border division of labor system was formed, with Hong Kong as the window to the external international market, and the PRD region as the back-up production force, with the "store

in front and factory at the back". Driven by the policies of industrial transformation and upgrading, the manufacturing industry in the PRD has continued to develop towards high-end and intelligitization, and the technological innovation content of products has been continuously improved. A knowledge-intensive industrial belt has been formed on the east bank of the Pearl River Estuary, a technology-intensive industrial belt on the west bank of the Pearl River Estuary, and a health industrial belt in the central part of the Pearl River. The three industrial belts cover a complete range of industries and have led to a number of new industries and new forms of "Internet Plus" such as online medical care, online education, digital entertainment and cross-border e-commerce, and have driven the transformation and upgrading of traditional industries, which have become the new highlights of economic growth in the PRD. After four decades of reform and opening up, the PRD region already has a fairly complete industrial system and strong manufacturing capacity.

#### ***2.3.4 Constructing a three-in-one model of coordinated development of industrial innovation***

The coordinated development of industrial innovation in the Guangdong-Hong Kong-Macao Greater Bay Area cannot be separated from the organic integration of the three processes of innovation research, innovation transformation and product application. By utilizing the resource advantages of each enterprise in each process to achieve the division of labor, the coordinated development of industrial innovation in the entire Bay Area can be promoted. Specifically, efforts will be made to promote the establishment of the Hong Kong-Shenzhen Science and Technology Creation Circle and the Guangdong-Hong Kong Technology Corridor, to form the "Hong Kong-Macao-Guangzhou Innovation and Research and Development-Shenzhen Innovation and Transformation-Pearl River Delta Product Application" model of cooperation and development in industrial technological innovation in the Greater Bay Area.

"Innovation and R&D in Hong Kong, Macao and Guangzhou", that is, to capitalize on the resource advantages in higher education teaching resources, talents, basic R&D and applied research of the two places, to provide intellectual support for the synergistic development of industrial innovation in the Guangdong, Hong Kong and Macao Greater Bay Area, as well as to contribute to the capacity of innovative basic research. Local finances will increase investment in R&D and technology, and improve the technology support system such as personnel attraction and research funding, while Hong Kong may, through the development of tertiary education institutions and R&D practice platforms, cultivate new points of economic growth, and change the more homogeneous industrial structure, so as to solve the economic and social development problems caused by real estate and the financial industry, and so on.

"Shenzhen Innovation Transformation" means giving full play to the advantages of the Shenzhen Special Administrative Region in the transformation of scientific research and innovation R&D results, and improving the system construction for the smooth transformation of innovation R&D results. Relying on the Shenzhen-Hong Kong Science and Technology Innovation Cooperation Zone in the Loop and the Shenzhen-Hong Kong International Science and Technology Innovation Center, the development of the science and technology service industry will be fostered, Shenzhen will be built into a core force for the transformation of innovation R&D results in the Greater Bay Area, and the transformation of R&D results will be driven by Shenzhen's science and innovation enterprises, which will develop high-quality and high-technology science and innovation products and realize the deep integration of industry, academia and research.

"Product Application in Pearl River Delta Cities" is to make full use of the manufacturing base and advantages in intelligent manufacturing accumulated by the Pearl River Delta cities after the reform and opening up, relying on the high-tech industrial development zones, high-tech industrial cooperation bases and special industrial parks in Zhuhai, Huizhou and Dongguan, etc. The east bank of the Pearl River estuary relies on innovation platforms such as Guangzhou Science City, Sino-Singapore (Guangzhou) Knowledge City and Shenzhen-Hong Kong Innovation Circle to build a science and technology innovation corridor and implement the innovation-driven development strategy. The west bank of the Pearl River Estuary is situated in the Pearl River - Xijiang River Economic Belt, which has a long history of strength in the development of machinery and equipment manufacturing industries. The cities on the west bank of the Pearl River make full use of the manufacturing advantages of the Pearl River - West River Economic Belt, promoting the development of advanced equipment manufacturing industry in Guangdong, Hong Kong and Macao in the Greater Bay Area, integrate and optimize the new ecological zones in the western cities of the Pearl River Delta, laying a major industrial foundation for the construction of a national science and technology innovation center in the Greater Bay Area.

### **3. Constraints on the synergistic development of industrial innovation**

#### ***3.1 Social system differences***

The institutional arrangement for innovation cooperation is an important guarantee for the free flow of innovation factors among the city clusters in the Greater Bay Area and the realization of collaborative development in industrial innovation. Influenced by historical factors, there are obvious differences in the internal legal systems and regional administrative systems of Guangdong, Hong Kong and Macao, which push up the cost of economic factors such as the flow of people, capital and information among the three regions. Secondly, the significant difference in the level of urban development among Guangdong, Hong Kong and Macao is the synergistic development of industrial innovation among the three places. Furthermore, the legal systems of the three places are quite different, and there is the problem of inconsistent legal protection for innovation cooperation among Guangdong, Hong Kong and Macao. Hong Kong's intellectual property legal system is well developed and detailed, covering a wide range of aspects from the declaration and recognition of property rights to the handling of property disputes, but there is still a lot of room for improvement in the area of intellectual property protection in other cities in the Pearl River Delta, except for Shenzhen and Guangzhou in the Mainland.

#### ***3.2 Insufficient independent innovation capacity of SMEs***

There is often a "dilemma" in the development of innovation in SMEs: overcompetition and technopoly competition. For SMEs, limited technological capital and relatively fragile technological infrastructure prevent them from realizing technological transformation and new product application within a reasonable range of large enterprises, while the rigid structure of large enterprises' technological monopolies also squeezes SMEs' innovative development. On the one hand, some large enterprises are already in the high-speed growth period, and have formed a more stable development mode, SMEs have strong momentum of innovation but face the objective factors brought about by the lack of technical capital and other difficult issues.<sup>[7]</sup> However, most SMEs' scientific and technological progress still mainly relies on foreign technology introduction, and the scientific and technological infrastructure of independent intellectual property rights is relatively thin. Statistics from the Special Research Report show that less than 15% of the industries represented by the manufacturing and service sectors have their own core technologies, and about 80% of the manufacturing core technology products and parts are imported.

On the other hand, the independent innovation ability of SMEs is constrained by many conditions. The number of small and medium-sized enterprises in Shenzhen has been close to 1.8 million, but by the flow of capital, technology, talent and other innovation factors and accumulation of limitations, independent innovation capability compared to large enterprises have obvious shortcomings. Although the production quantity of innovative products is remarkable, the quality has not yet followed the pace of quantitative improvement, making it difficult to establish a strong brand capacity. This results in a lack of momentum in the synergistic development of industrial innovation.

#### ***3.3 Insufficient reserve of technological innovators***

The Guangdong-Hong Kong-Macao Greater Bay Area is home to a number of renowned universities of national and international repute, attracting innovative talents from all over the country. However, it still faces a shortage of composite talents, senior technicians and technological researchers and developers in terms of industrial innovation synergy. One of the root causes of this problem is the mutual constraints that exist between the two mechanisms, which impede the cross-border mobility of innovative, skilled and knowledge-based personnel. The inability to utilize scientific research funding across the border has restricted the freedom of scientists to conduct scientific and technological acts in different fields. In addition, there are problems with mutual recognition of vocational and technical qualifications between Hong Kong and Macao and the cities in the PRD region. Meanwhile, migrant workers from Hong Kong pay tax in both places at the same time, which increases their tax burden and discourages Hong Kong and Macao talents from coming to the Mainland to work and receive education. Furthermore, although the Bay Area has been improving its policy on the admission of talents by raising housing subsidies, living allowances, education subsidies and other entitlements, there are still major differences between the mainland corporate culture, education system and medical services and those of Hong Kong, Macao and overseas countries.

### ***3.4 Industrial cooperation and division of labor still needs to be upgraded.***

Although the modern industrial systems necessary for research, translation and manufacturing have been developed in the Hong Kong-Guangdong Greater Bay Area, the distribution of technological collaboration among firms is not sufficiently scientific and rational, thus weakening the effectiveness of firms' innovation. Although Guangzhou is very rich in scientific and technological resources, the development speed of high-tech industries is generally small, and there are no large-scale high-tech leading enterprises, which makes the scientific and technological innovation of enterprises doubly limited. Shenzhen, on the other hand, has a large number of innovative companies, including Huawei, Tencent and other leading companies, and its scientific and technological achievements are also very strong. However, there is a relative lack of science and technology innovation in Shenzhen, as the city has not been able to build high-quality research universities and world-class platforms for basic and cutting-edge research.

## **4. Responses and reflections**

### ***4.1 Effectively improving the basis and capacity for innovative R&D***

In order to crack the lack of scientific and technological innovation and the shortage of innovative talents in our country from the root, it is necessary to actively explore the improvement of the R&D management system. First of all, we should refer to the successful experience of foreign countries in the supervision of scientific research funds, and build a project financial management system led by the subject director in the Greater Bay Area. Also, we should take the lead in the Greater Bay Area to try to change the salary distribution system for researchers, and increase the profit-sharing ratio of scientists' technology transformation through the distribution of researchers' equity options. At the same time, the credit system of researchers should be improved in R&D management, performance appraisal should be strengthened, and the budget of R&D funds should be based on the conclusions of the assessment of scientific and technological research results, so that the mode of utilizing R&D funds can be combined with the scientific research results of the subject.

In terms of research funding, there is a mismatch between Hong Kong's research funding and the needs of tertiary institutions and research institutes, which has seriously inhibited the conduct of scientific research. Therefore, government departments should continue to increase research-related support and increase funding support for tertiary institutions and research institutes; relevant policies should be introduced to guide private enterprises to increase their investment in research and absorb social capital into research. Finally, basic research in science and innovation in the Greater Bay Area must be demand-driven, and according to the major national development strategies such as "Made in China 2025" and the reality of the needs of regional industrial development, to clarify and adjust the priority areas for research, in order to prospectively build the theoretical basis for research with significant development needs.

The theoretical foundation of research is needed for development. To leverage the research and educational resources across the Bay Area, it is imperative to establish policies and systems facilitating the involvement of higher education institutions from Hong Kong, Macao, and Taiwan in the development of the Pearl River Delta. Additionally, frameworks for collaborative talent development between these institutions and those in the Pearl River Delta should be devised. These initiatives aim to elevate the technological capabilities and talent pool of regional universities and research and development organizations.

### ***4.2 Actively promote the rate of innovation and knowledge transformation***

In order to more efficiently solve the problem of "two skins" between science and technology and the social economy, the Guangdong-Hong Kong-Macao Greater Bay Area should also introduce corresponding policies to unleash the development potentials of universities and scientific research institutes, and to promote in-depth tripartite cooperation among the industry, academia and research institutes. In addition, according to the differences in society and legal systems, the Greater Bay Area needs to further improve the patent management system and establish a patent transaction and service center for the Guangdong-Hong Kong-Macao Greater Bay Area, so as to maximize the incentives for the protection and transaction of patent rights.

The people's governments in the Greater Bay Area will also break the traditional territorial blockade



by establishing within their borders the China Foreign Exchange Trading Center for international intellectual property rights and the Taiyuan Coal Exchange Center to serve domestic financial and interbank lending, in order to further enhance the international transfer of China's scientific and technological achievements. At the same time, diversified technology dispute resolution organizations such as the Greater Bay Regional Legal Service Station will be established to provide the necessary legal protection for technology enterprises in the Greater Bay region to carry out international cooperation and competition. At the same time, it is also necessary to actively develop the high-tech service industry in the Greater Bay region and establish a full-chain technology service system, including R&D and design, venture capital incubation and technology transfer.

### 4.3 Fully integrate Bay Area innovation resources and innovation platforms

In response to the challenge of the level of industrial cooperation and division of labor among the cities in the Greater Bay Area and the inherent gaps in the social system, the Guangdong, Hong Kong and Macao Greater Bay Area will form a framework for the high-tech industrial chain in the Greater Bay Area based on the National High-Tech Industrial Park and the Hong Kong Science and Technology Park.<sup>[8]</sup> The national high-tech industrial park becomes a platform for organically integrating various elements of innovation technology and maximizing the industrialization of high-tech achievements, and the corresponding national high-tech industrial park and the Great Bay region have different industry R&D focuses. The above resources can be synergistically integrated to create a specific platform for the technology application link of the Pearl River Delta Economic Zone, thus forming the basis of the high-tech industrial chain of the Greater Bay Area, especially the Shenzhen-Hong Kong Lok Ma Chau Loop Regional Cooperation Center. We will take the lead in promoting the cross-border flow of important science and technology factors, including personnel and capital, between the Mainland, Hong Kong and Macao. At the same time, we will actively absorb important international-level laboratories and engineering technology research and development centers set up by renowned domestic universities in the Loop region, so as to build it into an important hub for global scientific research and collaboration. It can become an important pilot demonstration of the "Hong Kong and Guangzhou Innovation R&D - Shenzhen Innovation Transformation - Pearl River Delta City Product Application" trinity technological innovation system, building and forming an innovation belt with shared resources, complementary functions and industry interaction.

### Acknowledgement

Project Fund: Research on The Influence of Local Fiscal Science and Technology Expenditures on Enterprise Innovation - Based on The Perspective of Quantitative and Qualitative Effects (JG2023011)

### References

- [1] Yumei Lin, Shanlang Lin. *Research on Coordinated Development of Cross Regional Industries in the Context of Regional Integration—Take the Yangtze River Delta as An Example*[J]. *Academic Journal of Zhongzhou*,2022(11):34-40.
- [2] Guanghan Chen, Ying Ta. *Join Hands to Build a Global Technology and Innovation Hub in the Guangdong-Hongkong-Macao Greater Bay Area*[J]. *Asia-pacific Economic Review*, 2018(6): 127-134+149.
- [3] *The Research Group of China Development Institute. Leading the Development of Guangdong-Hongkong-Macao Greater Bay Area by “Two Transforms”* [J]. *China Opening Journal*, 2017(4):7-12.
- [4] XianzuGu, Mei Yang, Qinqin Zhuang. *Strategic Thinking on Developing Innovative City to Implement the Strategy of Innovation-Driven Development—Based on the Model of Shenzhen Innovative Development*[J]. *Forum of Science and Technology in China*, 2016(9):31-37.
- [5] Chenglin Qin, Longjie Huang. *Innovation Cooperation and Guangzhou's Construction of Innovation Growth Pole in the Guangdong-Hongkong- Macao Bay Area*[J]. *Urban Insight*, 2019(1):7-18.
- [6] Chenglin Qin. *The Research on the Development of Guangdong-Hongkong- Macao Bay Area* [J]. *Urban Insight*,2019(1):5-6.
- [7] Binbin Liu, Xiaoyong Huang. *Cross-ownership M&As, Institutional Environment and Technology Innovation of Private Enterprise*[J]. *Macroeconomics*,2021(11):164-175.
- [8] Xiaomei Xiang, Juan Yang. *The Paths of the Industrial Synergy Development in Guangdong-Hongkong-Macao Bay Area*[J]. *Journal of South China Normal University (Social Science Edition)*, 2018(2):17-20.