

# Similarity of Industrial Structure and Sustainable Development of Regional Economy: The Perspective of Guangdong

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## Abstract

With the development of human society, the division of labor will not be weaker and weaker. On the contrary, the trend of division of labor will be stronger and stronger. No matter which field we study, the field of economic or that of social governance, the division of labor always has a process from spontaneity to filling to dispersion, and then to coupling. On this issue, Engels' Theory on Resultant Force in History is significant. The theory of resultant force suggests the general force of social development. Resultant force widely exists in all fields of society. Of course, the economic field is no exception. In the economic field, a prominent manifestation of resultant force is division of labor and its coordination. How can all parties in the economic field form a joint force as a favorable factor for social development? Obviously, the disorderly division of labor will only increase the chaos in the economic field. This paper analyzes the division of labor in social development, explains the important influence of urban division of labor in regional opening, and demonstrates the importance of urban division of labor in China's contemporary open economy. With the help of the coefficient of similarity of industrial structure in regional economic development, from the perspective of Guangdong, which is the forefront of China's reform and opening up, this paper studies the urban division of labor based on economic production as well as its contribution to the coordinated and sustainable development of regional economy, and then explores the role of core cities in this process.

## Keywords

Similarity, Industrial Structure, Regional Economy, Division of Labor, Development

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## 1. Introduction

Division of labor is the embodiment of the role of the subject in the field of practice. As a social subject, people first feel the existence of division of labor from their own body. Every part of an individual's limbs bears different functions, which cannot be replaced by other parts. The division of labor beyond a single person is manifested in the division of labor between people. The thought of division of labor has been running through the ideological development of political economy. It has been discussed as early as Plato. Plato wrote in his work, "The Republic that although men were born of same father and were brothers, when God shaped them, he added gold to some people, and these people are the most important, the rulers. Silver was added to the auxiliaries (soldiers). Iron and copper were added to the farmers and other technicians." Plato divided people into three categories: protector, helper and laborer. Different people have different talents, which means that there must be a division of labor in human society. Different people are engaged in what they are good at, which constitutes the labor of the whole society. This is the so-called "fatalism" about the division of labor. A city-state needs diversified products, but one person can only engage in one aspect of production, which requires social division of labor. (Plato, 1986)

The article is organized as follows: Firstly, the paper is focused on the division of labor in cities, including the topic: the factors affecting the division of labor, the relationship between urban division of labor and openness in contemporary China and the impact of urban division of labor on regional economic sustainability. Besides, the paper analyzes the industrial structure between cities in Guangdong Province from 2015 to 2019 through the similarity coefficient of industrial structure suggested by the United Nations Industrial Development Organization (UNIDO), which shows the current problem of Guangdong's regional development, and analyzes the conditions and chances for coordinated development. Last but not least, the paper suggested that regional economic cooperation could follow on the three stages of energy transformation, structure transformation and model development to realize Regional Sustainability.

## 2. Literature Review

With the development of economy, Productivity improvement leads to the specialization of the division of labor. The problems of insufficient and unbalanced development are increasingly manifested. Nowadays, China is shifting from high-speed economic development to high-quality development. Whether the division of the cities can bring structural sustainable improvement has become an important issue in China's construction of a modern economic system. Several scholars have explored the connotation and function of urban division of labor from social division of labor to regional collaboration. Mirela Cristiana NILĂ STRATONE believes that the division of labor is an objective historical and continuous process of the evolution of human society. Combining the analysis of

four waves of social change, she believes that each time productivity develops can further optimize the division of labor (Stratone, 2014). Candela agrees that the fundamental of economic development is to expand the scope of production specialization and exchange options (Candela, 2022).

Many scholars focus on the cooperation model of deepening regional division of labor. Some scholars believe that regional synergy is important, the optimization of industrial structure and the transformation of division of labor structure can promote sustainable economic development. Liang Lei, Liang Yawen, Gil-Lafuente Anna M. focus on the division of labor from the perspective of technological innovation and global value chain (Liang, Liang, & Gil-Lafuente, 2021). Zeyan Chen suggested that improving resource allocation and rationally standardizing the resource integration model among innovation entities could promote the development of Guangdong's industrial technology innovation system towards a highly coordinated development (Chen, 2021). Nawaz Saima discussed the importance of inter-regional coordinated development from the perspectives of infrastructure construction (Saima & Ullah, 2021).

However, other scholars believe that we should focus on the comparative advantages in core cities, and the development of regional advantages drives the development of the overall economy. Guoyong Ma believes that we should focus on the regional comparative advantages to promote investment development, following by strengthen regional investment and economic cooperation through policy encouragement (Ma et al., 2015). George C. S. Lin argues that rural industrialization leads to a process of spatial transformation, which large numbers of surplus rural laborers move into rural factories and cities, it is an inevitable by-product of industrialization in some way (Lin, 2001). Yulin Liu believes that in the process of regional innovation and development, actively cultivate industrial clusters based on their own advantages is priority (Liu & Yang, 2020). In addition, for regions that have the ability to build diversified industrial clusters, the cooperation between different industries is necessary. Given these, two research questions guide this study:

- 1) With the development of regional economy, what are the changes of industrial structure of the cities?
- 2) To achieve sustainable regional development, how to coordinate the development the Comparative Advantage of core cities and regional synergy with backward areas?

### **3. Division of Labor and Regional Coordinated Development**

Hegel believed that the specialization brought by division of labor promoted the invention of production machines. In analyzing the changing process of society from workshop handicraft to machine production, Marx drew lessons from the predecessors' thought of division of labor to a certain extent. Marx believed that the basis of all developed division of labor mediated by commodity exchange is the separation of urban and rural areas. The whole economic history of society is

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summarized as this opposing movement (Marx & Engels, 2012: p. 215). Marx also believed that not only in the stage of capitalism, the development of any new productive forces is not only the expansion of itself, but also the evolution of the structure and specialization of division of labor.

### 3.1. Factors Affecting Division of Labor

Society is the union of every individual. The division of labor between people gradually became a collective division of labor within the process of social integration. If the successive emergence of the three industries in human history is the presentation of division of labor in the time dimension, the further development of collective division of labor into regional division of labor is the embodiment of division of labor in the space dimension. From Adam Smith to David Ricardo and then to Marx and Engels, looking at the views of famous political economists in history, we can find out in theory the factors affecting the division of labor.

First, as to the division of labor between areas, the degree of that depends on the factor endowment of local areas. The factor endowment contains all local natural conditions, such as natural resources, climatic conditions, production advantages brought by people's traditions, and so on. From this point of view, this condition has considerable objectivity and rigidity. In other words, endowment, which is mainly based on natural conditions and traditional heritage, is difficult to be replaced and eliminated under some certain conditions. From David Ricardo's Comparative Advantage Theory to Herschel Olin's Factor Endowment Theory, classical economists try to explain the division of labor from the perspective of production factors and resource allocation. As David Ricardo mentioned in his book *On the Principles of Political Economy and Taxation* that the value of a commodity, or, in other words, the quantity of any other commodity it can be exchanged with, depends on the relative amount of labor necessary to produce it (Ricardo, 1962). The purpose of division of labor is exchange. They believed that when there are differences in resources, or factor endowments between cities, efficiency can be improved through division of labor and exchange. Based on this, the government should take the lead in coordinating the development space, make use of the advantages of local productivity to match the industry, and allocate the productivity and means of production appropriately.

Second, the degree of division of labor depends on the improvement of production efficiency that can be achieved as local production. Let's take a look at Marx's point of view. Marx believed that the reason for the formation of cooperation is that workers get rid of individual limitations and give full play to collective advantages and abilities in planned cooperation. Marx also believed that workers changed from independent workers to local workers in large-scale industrial production was one of the result of focusing on one job which improved the process and reduced non production costs. It was conducive to the im-

provement of production efficiency. On the basis of individual cooperation, Marx discussed the conditions and significance of urban-rural separation (Marx & Engels, 2012: p. 683). From individual cooperation, collective division of labor to regional division of labor, Marx believed that division of labor is a special kind of cooperation, and many of its advantages are produced by the general nature of cooperation.

Third, the degree of division of labor depends on the depth of exchange, that is, the degree of market development. Each part in the social economy produces products with comparative advantages due to its endowment in economic activities. Whether this product can be popular and realized its value in exchange needs to be solved by the market. For example, Adam Smith believed that division of labor comes from exchange, and the degree of exchange will also affect the degree of division of labor (Smith, 1972). In other words, the degree of division of labor in a country depends on the development of the market. If the market is too small, it is difficult to form a fine division of labor, and the expansion of the market between cities depends on the transportation cost.

Based on the research of political economists on the development of division of labor, these preconditions affecting division of labor were obtained, and the relevant theories on the layout of productivity were further obtained.

### **3.2. Division of Labor in Urban and Opening up**

The emergence and development of urban division of labor stem from the diversification of material and cultural needs in the process of human development. Specialization brought by division of labor not only saves production costs in mass production, but also improves labor productivity, so as to promote the improvement of social productivity from the perspective of cost and efficiency. However, the specialized production under the division of labor will bring the problem of single product. The contradiction between the diversity of human material and cultural needs and the single product under specialized production always runs through the whole process of economic activities under the division of labor. The limitation of individual division of labor is solved by means of product exchange, which leads to the birth of “place” or “intermediary” of individual exchange, that is, the market. With the emergence of the market, people break the original “self-sufficiency” model and move towards the open state of product exchange. With the deepening of social division of labor, the society gradually moves from the original individual division of labor to regional division of labor and urban division of labor. At this time, the scope of social specialized production continues to expand, forming a model of orderly coordination within regions and rational division of labor among regions. Therefore, the diversification of human needs in daily life leads to the further development of exchange relations, and the need for exchange leads to the necessity of opening up.

The opening of cities will inevitably lead to further division of labor and spe-

cialization. Opening to the outside world will inevitably deepen the division of labor while deepening inter-regional relations. Opening to the outside world has strengthened the flow of production resources and the cooperation between social commodity markets. The production advantages of a certain region in the original relatively closed state may be difficult to highlight or even maintain its original advantages in the open economic system. Therefore, opening to the outside world means the expansion of the regional scope of coordination and division of labor. All regions must reposition according to their comparative advantages in the new and broader economy and find their own role in the new division of labor system. In this process, the degree of division of labor and specialization has gradually deepened, resulting in the flow of production factors and the progress of specialized production technology, which promote the development of regional economy. Therefore, opening to the outside world is bound to be accompanied by the deepening of division of labor and specialization. In order to occupy the advantages in the opening-up system and take advantage of the opening-up opportunities to promote self-development, cities must clearly position themselves and find the role that urban advantages can play in the division of labor system. The further opening of society has brought about the deepening of urban division of labor, which is the complementarity of the advantages of productivity and production factors at multiple levels and in multiple fields. In addition to economic and trade ties brought about by comprehensive opening-up, close ties have been established in many aspects, such as science and technology, social culture and ecological construction. Local history and culture, geographical resources and scientific and technological advantages will deeply affect the status and role of the region in the cooperative body, so as to deepen the level and system of urban division of labor and change the pattern of urban division of labor.

### **3.3. Urban Division of Labor and Opening up in Contemporary China**

When examining the historical trend of Russian rural communes, Marx pointed out that Russia may not experience the stage of capitalist development under specific conditions and eventually move towards communism. This way is called "Crossing the Caudine Valley" (Marx & Engels, 2012: p. 825). This statement was named the Theory of Crossing the Caudine Valley. It was based on the fact that Russia had not experienced the full development of capitalism at that time, and the Russian commune still retained the basis of land public ownership. If Russia develops a public ownership society on the basis of this primitive organizational form, the Russian people can avoid experiencing this painful period of capitalist society. However, for the eastern countries that have not experienced the full development of capitalism, introducing and learning the economic elements that have been greatly developed in the capitalist society without changing their basic economic system is not only the inheritance and development of the

common cultural wealth of human society, but also a way of exchanging space for time.

In the process of the development of modern urban communities, there is both the possibility of cooperation and the trend of competition among cities. Only by giving full play to their advantages in regional development and forming a unique urban division of labor system, can cities achieve regional coordinated development. Facing the world, China should take a new path of Chinese development and advocate the concept of coordinated development through consultation, joint construction and sharing. To achieve win-win results in urban and national cooperation, we must carry out division of labor and cooperation according to the production advantages of each region. Today, globalization has closely linked the fate of all countries in the world. Global economic cooperation is bound to achieve coordinated development in regional division of labor and common progress in complementary advantages. Therefore, we must study and layout according to the factors such as science and technology, resources and industrial foundation in urban development, improve our core competitiveness in the global economy while forming a reasonable division of labor mechanism, and provide Chinese solutions and Chinese wisdom for global governance.

### **3.4. Urban Division of labor and Sustainability of Regional Economic Development**

The urban agglomeration in a region has gradually formed a stable division of labor system in a certain period of time. If the division of labor system and pattern of the region remain unchanged for a long time, can it achieve long-term sustainable economic growth? In fact, the objective conditions of regional development are dynamically adjusted with the interaction between external factors. The urban division of labor must change synchronously to meet the requirements of the development of productive forces. When we discuss the inevitability of the emergence of machinery and large industry, the workshop handicraft industry itself is developing continuously in the original division of labor system, which not only promotes the progress of productivity, but also affects the original division of labor structure. If the division of labor structure inside the workshop can no longer adapt to the advanced productivity at that time, that is, the machine mass production, this division of labor organization will gradually lag behind.

Therefore, in order to maintain the advantages of sustainable development, the urban division of labor system must constantly adapt to the requirements of advanced productive forces. Its essence is to constantly adjust and optimize the internal structure through the accumulation of knowledge and experience. How to make use of the urban division of labor to promote regional development? The key exist in the dialectical unity of contradictions between cities. No matter which aspect to see, the natural advantages or that of acquired, there are always

relative differences between cities. That is to say, the struggle of contradictions between cities always exists. The differences show different forms in different times. In the period of relying on natural production, the advantage of natural or geographical resources is the dominant factor in inter-city differences; Nowadays, science and technology is the primary productive force. What's more, science and technology and talent training have become the leading factors. Therefore, the basis of division of labor and coordination among cities has also changed. The reason why cities can divide labor and cooperate is that there is the basis for it, that is, the identity of contradictions. However, the existence of contradictory identity has a premise. If we can't grasp the respective characteristics of cities, there will not be a unity. Therefore, the sustainable development of urban division of labor lies in following the pace of the times, constantly grasping the new situation and characteristics, and constantly improving the self revolution within the region.

With the regional development, cities will gradually shape their unique position in the regional division of labor system. For example, the city of Shenzhen used to be just a small fishing village in Guangdong Province. Under the system of reform and opening up, Shenzhen seized the opportunity to realize self-innovation. Now it has become one of the important areas driving economic growth in Guangdong and even the whole country. In order to achieve sustainable development in today's globalization, Guangdong must learn and improve the ability in opening to the outside world, so as to continuously optimize its internal structure. Nowadays, the division of labor and coordination of Guangdong cities is essentially a process of absorption, sublation and reform in the open economy. The system and mechanism of division of labor have become the necessary basis for the development of the Great Bay Area. How to realize collaborative innovation under the premise of the differences between different systems and how to realize professional division of labor in today's scientific and technological revolution are the problems that must be solved for the sustainable development of Guangdong-Hong Kong-Macao Greater Bay Area under the modern division of labor structure.

#### **4. The Current Situation of Urban Division of Labor in Guangdong**

According to the latest economic data released by Guangdong Province in January 2022, the province has been ranking first in China for 33 consecutive years. Despite its strong economic development, Guangdong's regional development is not balanced. Guangdong governs 21 cities. Although the GDP ranks among the top in the country on the whole, the per capita GDP of 2/3 cities in the province is lower than the national average (Kai, 2022). The reasons for this situation include both natural conditions and historical traditions. For objective difficulties, economic planning is needed to intervene. It should be pointed out that for the needs of economic development, the political status of the city is the planning of

political resources. In addition, it is also necessary to plan the division of labor of cities in the region to form a situation of coordinated development.

#### 4.1. Methodology and Methods

The industrial structure is the most basic structure in the regional economy, which reflects the internal connection between various industries in the regional economy. Therefore, comparing the changes of the industrial structure between regions, the development status and coordination of different regions and industrial developing situation can be analyzed. This paper applies the industrial structure similarity coefficient to quantify the industrial structure of the cities. The coefficient aims to measure the similarity of the industrial structure between the two cities. Based on the ratio of the three major department in the total output value, drawing conclusion through the inter-city relationship conjoint analysis of industry values. The industrial structure similarity coefficient provides data to support the further research on the industrial distribution and cooperation in the region, and show up a feasible plan based on the specific actual situation in the region.

In order to study the possibility and changes of the urban agglomeration of Guangdong in economic coordinated development, this paper selects the structural similarity coefficient proposed by the International Industrial Research Center of the United Nations Industrial Development Organization (UNIDO). (Qin & Pan, 2018) This index aims to study the degree of similarity or differentiation of the industrial structure in different regions. The higher the similarity coefficient, the more similar the industrial structures between the cities. The specific formula is as follows:

$$S_{ij} = \frac{\sum_m X_{im}X_{jm}}{\sqrt{\sum_m X_{im}^2 \sum_m X_{jm}^2}} \quad (1)$$

The letter  $i$  and  $j$  represent two different regions, and  $m$  represents a certain industry,  $X_{im}$  is the proportion of the industry  $m$  in the industrial structure of region  $i$ . The index  $S_{ij}$  is between  $[0, 1]$ . If it is 0, the industrial structure of the two regions is the same, and if it is 1, the industrial structure of the two regions is completely different at all.

#### 4.2. The Explanatory Power of the Similarity Coefficient of Industrial Structure

For urban division of labor, the structural similarity coefficient itself only reflects the similarity of industrial distribution. The degree of similarity of industrial structure itself does not reflect the advantages and disadvantages of urban collaborative division of labor, but the distribution of different industries.

On the one hand, without understanding the structural similarity between cities, it is easy to cause the repeated waste of urban resources, vicious competition

and monopoly, like those in some western society. In the free competitive market, capital expansion is carried out in the form of capital concentration and production concentration. Fierce competition leads to excessive resource concentration and investment in the same direction, and finally a monopoly situation is gradually formed through capital annexation. It makes the information mastered by a few people, and the use of resources is further limited. The repeated investment of resources will gradually reduce the social production efficiency. For the industrial structure between cities, there are many reasons for the high similarity of structural coefficient, one of which is the excessive concentration of resources in competition. Only by studying the similarity of industrial structure between cities can we have the possibility to know how the disorderly competition of cities causes the duplication of resources and then make timely adjustment at the macro level.

On the other hand, if we blindly pursue the similarity or difference of industrial structure, it is easy to be divorced from the actual social situation, resulting in the failure to achieve the expected economic and social effects of the government. The overall layout of urban division of labor should be an organic integration and should be based on following objective laws. It must be clear that the similarity coefficient of urban industrial structure is a number and the internal reasons for its formation are diverse. The higher similarity coefficient of industrial structure does not mean that the possibility of industrial development synergy between cities is low. Similarly, if regional industries are complementary and can develop together, it may also show that the similarity coefficient of industrial structure tends to be lower. Take the second industry as an example. If the structural similarity coefficient tends to be higher, it may suggest that the regional urban agglomeration is suitable for the development of the secondary industry especially manufacturing industry, while industries in different cities form complementary and coordinated development among the subdivided industries. The same is true when it comes to the low coefficient of structural similarity. For example, the low structural similarity coefficient of an urban agglomeration may be due to the different conditions and backgrounds of each city, which can get complementary development in modern agriculture, service industry and other fields.

Therefore, the similarity coefficient of industrial structure is only an entrance to the analysis in the construction and planning of urban division of labor system. The simple number itself cannot be used as the direct judgment basis for the layout of urban collaborative division of labor. Jumping out of the number itself and finding the reason behind the coefficient is the fundamental method for the construction and development of urban division of labor system. All social development should follow objective truth, and the so-called objective truth is the unity of regularity and purpose. Following the objective figures to find the reasons for the development status of industrial structure among cities, and fully understanding the history and objective conditions of urban development have

become the basic clue to investigate and obtain more information.

### 4.3. A Series of Similarity Coefficients of Industrial Structure between Cities Obtained by Analyzing Statistical Data

Because the COVID-19 began in December 2019, the year 2019 is the last year for the world economy to operate under normal conditions before the epidemic. Based on the statistical yearbook of Guangdong Province, this paper selects the data of the proportion of three industries in various cities of Guangdong Province from 2015 to 2019 for statistical analysis, and studies the change trend of the similarity coefficient of industrial structure in the 5 years. The similarity coefficients of industrial structure between cities are as follows<sup>1</sup>:

The above chart shows that the change of industrial structure similarity coefficient of cities in Guangdong Province is relatively stable. For example, taking the industrial structure of Guangzhou as a reference, the similarity of industrial structure between Shenzhen and Guangzhou is high. The similarity coefficient of industrial institutions remains between 0.96 and 0.99. And, the similarity of industrial structure between Foshan and Guangzhou is relatively low, always lower than 0.85. The industrial structure of Shenzhen has changed significantly in the past five years, which should be related to the construction of Guangdong-Hong Kong-Macao Great Bay Area (GBA).

## 5. Results

### 5.1. The Difference of Similarity Coefficient of Industrial Structure of Cities in Guangdong

Taking five years as a research period, this paper compares the industrial structure similarity coefficients between cities in Guangdong Province at both ends of this time period, that is, 2015 and 2019, as shown in **Graph 1** and **Graph 2** below. **Graph 1** and **Graph 2** show the coefficients between Guangzhou and Shenzhen and other Guangdong cities in 2015 and 2019 respectively; **Graph 3** shows the change of structural similarity coefficient between Guangzhou, Shenzhen and other cities in Guangdong Province in the 5 years<sup>2</sup>:

### 5.2. Two Levels of Coordinated Development of Industrial Division of Labor among Cities

#### 5.2.1. Division and Coordination among Industries

When the structural similarity coefficient is relatively low, there is the possibility of division of labor and coordination among industries among cities. From the charts of inter-city industry structural similarity coefficient from 2015 to 2019, it can be seen that the industry structural similarity coefficient between Maoming and Shenzhen is stable at about 95% to 96%, which is lower than that between Shenzhen and Zhuhai, and that between Shenzhen and Guangzhou. Maoming,

<sup>1</sup>**Tables 1-5**: The resource of original data: Guangdong Statistical Yearbook (2015-2019), Guangdong Bureau of Statistics.

<sup>2</sup>**Graphs 1-3** is based on the data from **Tables 1-5**.

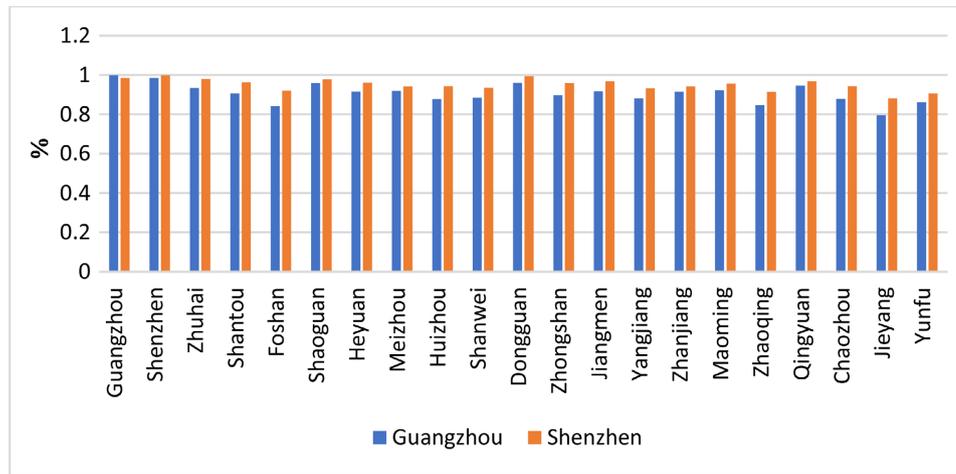




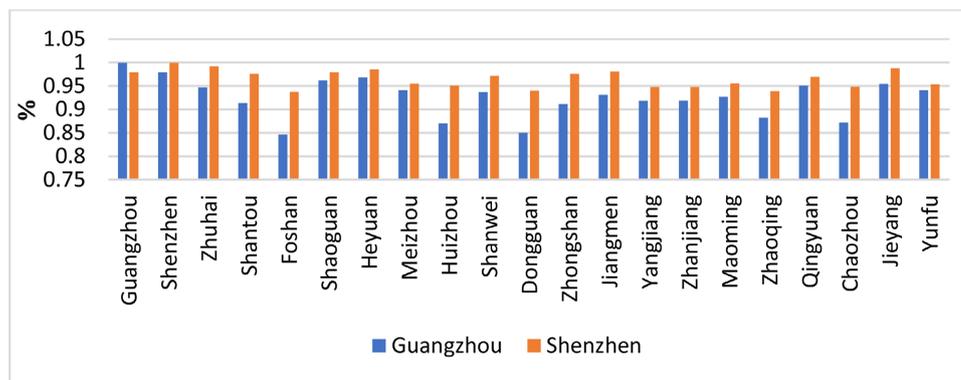




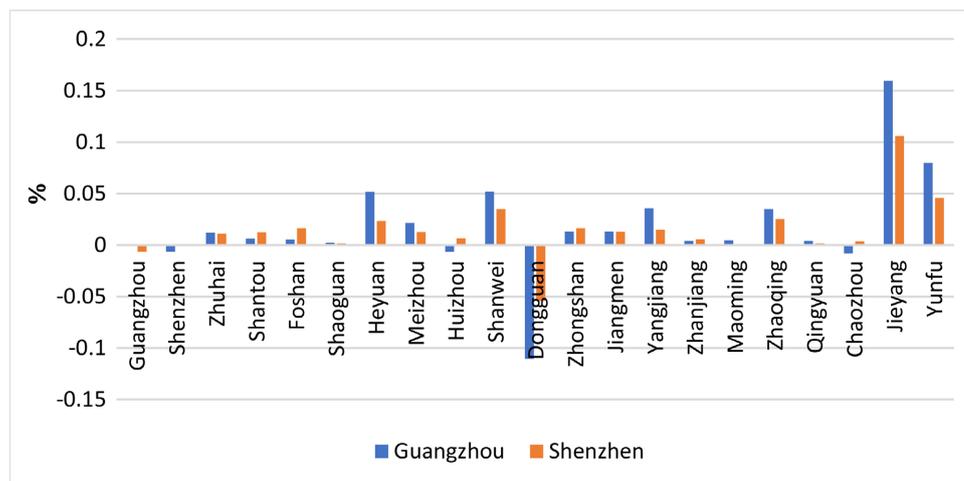




**Graph 1.** The comparison of industrial structure similarity coefficients in 2015.



**Graph 2.** The comparison of industrial structure similarity coefficients in 2019.



**Graph 3.** The changes of industrial structure similarity coefficients between Guangzhou, Shenzhen and other cities in Guangdong Province (2015-2019).

located in the southwest of Guangdong, is one of the cities with relatively developed agricultural economy. The reason for the relatively low structural similarity coefficient between Maoming and Shenzhen lies in the different industries that

the two cities focus on. Maoming takes the primary industry as the urban development advantage, while Shenzhen promotes the rapid development of the city with the high-tech industry in the secondary industry and the rising service industry.

Maoming has built ten agricultural pillar industries. As a major agricultural city in Guangdong, Maoming ranks in the forefront of the province in terms of the total output of grain, vegetables and meat. Meanwhile, Maoming is also a city with a large national fruit production base, fish production base and southern medicinal plants production base. As early as the 13<sup>th</sup>-*Five-Year-Plan for the Development of Modern Agriculture in Maoming* released in 2018, it was mentioned that the comprehensive agricultural development level of Maoming has been improved and the agricultural structure has been optimized. Agricultural science and technology and infrastructure construction were further developed, and agricultural branding was gradually formed. At the same time, the document also pointed out that the task of Rural Revitalization in Maoming City is arduous, the agricultural infrastructure and operation mode are still not advanced, and the ability of sustainable income growth of residents is weak. In fact, the difficulties and challenges encountered by Maoming in developing modern agriculture equal to the opportunity for Maoming to realize transformation and upgrading. According to the above analysis, Maoming has rich resources in forestry, aquatic products, fruits and vegetables and other industries, laying a solid foundation for the development of modern agriculture in Maoming.

The question now is how to find a city that can form coordinated development with such a large agricultural city. Cities with a relatively solid agricultural foundation should choose the easiest opportunity to start and realize industrial upgrading as the breakthrough for development. In this way of thinking, what Maoming needs is a city with strong innovation ability and comparative advantages in the secondary industry. Shenzhen has made outstanding achievements in the development of modern industries. Moreover, they are in the same province. In a sense, the cross regional cost in order to realize the coordinated development of industries will be reduced. Taking the added value of high-tech manufacturing in modern industries in 2019 as an example, the data obtained from the 2019 Guangdong Statistical Yearbook shows that Shenzhen accounts for more than 60% of the industry in high-tech manufacturing, much higher than other cities. However, the proportion of Maoming in this aspect is less than 10%. The gap between the two is very wide. The proportion of high-tech manufacturing industry in industry shows the scientific and technological content and technological advancement of the city's industry to a certain extent.

The development of advanced technology in Shenzhen's secondary industry can be combined with the rich agricultural resources of Maoming's primary industry to form the coordinated development of industries in the two cities. On the one hand, Shenzhen provides support for the development of modern agriculture with advanced scientific and technological advantages. From drone

seeding to mechanized harvesting, the development of modern agriculture can take advantage of the R & D advantages of Shenzhen universities, scientific research institutions and enterprises to further improve the production tools of modern agriculture and improve labor productivity. In addition to the progress of large machinery, Shenzhen can also use the advantages of scientific and technological development to realize agricultural fine management in intelligent agriculture and intelligent fish ponds. For example, monitoring the planting environment (such as humidity, temperature and sunshine) and adjusting the irrigation time in real time through monitoring will help to improve the efficiency and quality of agricultural production. On the other hand, Maoming's advantages in agricultural resources not only provide favorable conditions for scientific research fields such as agricultural breeding, gene improvement and soil research. Whether it is the quality of agricultural products or brand marketing, Maoming can provide good coordination conditions for the development of modern agriculture in Guangdong. Shenzhen's high and new technology helps to improve labor productivity. Maoming's advantages in agricultural resources provide a basis for cooperation to optimize the quality of agricultural products. The advantages of Shenzhen's secondary industry and Maoming's main industries can lay a cooperative foundation for the development of modern agriculture in Guangdong.

From the analysis based on those tables (**Tables 1-5**) and graphs (**Graphs 1-3**) above, Shenzhen has similar industrial structure with Guangzhou. If Shenzhen can form coordinated development with Maoming, other cities like this will also have the possibility of forming coordinated development of industrial structure with Maoming. Moreover, Yangjiang, Zhanjiang and other cities with similar industrial structure to Maoming also have the possibility of coordinated development with the big cities like Shenzhen and Guangzhou. Shenzhen is also one of the core cities in the GBA. Shenzhen has the similar industrial structure with other core cities of the GBA. It means that the linkage between the Mainland and Hong Kong as well as Macao based on coordinated development will be further strengthened.

### **5.2.2. Intra Industry Division and Coordination**

By comparing the industrial structure similarity coefficients of cities in Guangdong Province, it can be found that from 2015 to 2019, the industrial structure similarity coefficients of Dongguan and Huizhou were also very high, ranging from 97% to 99%, and showed a gradual upward trend. The main reason for this similarity is that in recent years, Dongguan and Huizhou have planned and arranged the advanced manufacturing industry, and there is a possibility of coordination or synergy between them in the secondary industry. Dongguan was originally known as the "world factory". Dongguan factory has carried out a large number of equipment assembly and product processing. Although most of the production processes of products are carried out in Dongguan, due to the

lack of core technology, most of the profits are often obtained by the original manufacturers with patents, and Dongguan factories can only share a small part of the profits. If Dongguan wants to really obtain the main benefits of products, it is facing the test of industrial transformation and upgrading. Only by truly mastering the technology and transforming the low-end simple assembly and processing labor force into advanced technology can Dongguan usher in new development opportunities. Dongguan and Huizhou are geographically adjacent, and they are also very similar in the development of manufacturing technology.

According to statistics, Dongguan and Huizhou each have more than 50% of the advanced manufacturing industry. The two cities plan and distribute advanced manufacturing industries at the same time. Although the development speed of Dongguan is higher than that of Huizhou in terms of urban GDP and industrial output value, the proportion of advanced manufacturing industry in Huizhou is higher than that of Dongguan. The possible reason is that Huizhou has relatively perfect infrastructure and resources. Huizhou has 11 industrial parks with perfect digital industry infrastructure. Among them, electronic information industry is a major advantage of Huizhou science and technology. Dongguan should change from traditional labor-intensive industry to technology intensive industry. Solving the problem of workers' employment is a factor that must be considered in the process of industrial transformation. As a historic city, Huizhou can accommodate a considerable number of jobs in terms of regional area, number of industrial parks and industrial growth rate.

In addition, Dongguan and Huizhou are both planning and developing in the electronic information industry, and are adjacent to each other at the same time. As a famous "world factory", Dongguan can make full use of Huizhou's Industrial Park and other infrastructure and potential development space for coordinated development, which is not only conducive to Dongguan's own transformation and upgrading, but also drives the economic development of Huizhou. In the layout of electronic information related industries, Dongguan and Huizhou can make complementary planning according to their own industrial advantages. For example, the cell phone and communication industry in Dongguan has certain basic advantages, while Huizhou is more prominent in Intelligent Connected Vehicle (ICV) and Ultra High-Definition TV (UHDTV). The industrial development of the two cities can form a complementary pattern and coordinated development in the subdivided track.

## 6. Discussion

On the issue of regional economic development, we need to examine it from a philosophical perspective. Among them, "region" is a hierarchical and relative word. The word "region" can be either a whole or a part of the whole. It can refer to a continent from the perspective of the earth, such as Asia, Europe and America, or a country, a province, city and county within a country. Then, how

to realize the sustainable development of the regional economy we study is closely related to its territory, administrative division, social system, history and culture as well as natural endowment. To study the sustainable development of regional economy based on China, we must take the coordinated development of various places in the region as an important topic. Because of China's vast territory, the problem of unbalanced regional development has always existed. In China, urban agglomeration is the region with relatively large scale and relatively stable zoning. Therefore, this paper selects urban agglomeration as the research sample.

For economic research, data is indispensable. As to analyzing and processing the collected data, we can't do without the help of mathematical tools. It is found that the similarity coefficient of industrial structure is a general tool. It indicates that it is widely recognized by researchers. However, the industrial similarity coefficient also has its inevitable defect, what is, the meaning of "similarity" for industrial development. Similarity not only means that there is the possibility of coupling, like the principle of "similar solubility" in Chemistry, but also means that there is the possibility of competition and exclusion. Coupling or exclusion exactly represents the two extremes of the possibility of coordinated economic development among cities. Therefore, the similarity coefficient of industrial structure can not be used as the only basis to judge the possibility of coordinated economic development between cities.

The similarity coefficient of industrial structure indicates the structural similarity. The similarity of industrial structure among different regional subjects may contain the possibility of cooperation at different levels. For example, the basis of inter industry cooperation lies in the low similarity coefficient of industrial structure, so as to achieve the rational allocation of resources. The intra industry cooperation just needs the high similarity coefficient of industrial structure, so as to realize the effective cooperation among enterprises. It is precisely because the similarity coefficient of industrial structure represents a structural index. When discussing specific practice, the situation of different regional subjects should be discussed seriously. This paper has also tried to learn from the works of other researchers. In addition to the similarity coefficient of industrial structure, some other mathematical tools should be introduced, such as the location entropy, coefficient of variation, and so on. However, it is found that location entropy itself is also a fuzzy meaning, and its value is uncertain. Coefficient of variation analysis is an index widely used to measure the difference of per capita national income between regions. The coefficient of variation is committed to continuing to explore the changes of the per capita national income difference between regions, so as to demonstrate the relationship between the formation of the inter regional national income difference and the inter regional economic structure factors. As far as the situation of Guangdong is concerned, the development in the province is very unbalanced, and the gap between cities and regions is very large. Therefore, to explore the industrial structure between regions

based on the gap of national income can not provide a better explanation within the framework of this paper. Therefore, we select several representative cities in this paper, deeply excavate their specific conditions, and make a tentative discussion and assumption on the possibility of coordinated development.

## 7. Conclusion

Specifically, the regional adjustment made by Guangdong for high-quality development can be divided into three stages, which can be described as kinetic energy transformation, structure transformation and model development. The degree of development of a social productive force marks its stage of development (Zhang, 2021). In order to realize the transformation of China's economy from high-speed growth to high-quality development, the most important things to do are promoting industrial upgrading through the progress of science and technology, and realizing the purpose of kinetic energy transformation. At present, Guangdong is gradually moving from processing and manufacturing industry with low traditional technology content to R & D-based basic industry. Guangdong has gradually formed its own advantages in many fields such as digital economy, new energy and bio-medicine, and promoted industrial development and progress through innovation. To achieve high-quality economic growth, this province must continue to strengthen the R & D and application of core technologies to inject new momentum into social production and development. Therefore, the role of colleges and universities should be given full play in scientific and technological R & D and innovation. Strengthening university cooperation between cities, realizing the landing and transformation of innovative achievements improve the achievement transformation rate and gradually realize the transformation of kinetic energy through school enterprise cooperation.

Taking the transformation of kinetic energy as the basis and premise, the structural transformation of economy becomes more natural. The transformation direction of economic structure should be considered from multiple levels. The major conflict of the Chinese society has changed in the New Era. How to solve the problem of unbalanced and insufficient development and what kind of material and cultural products the people need are the primary issues to be considered in the transformation of economic structure. Only by carrying out supply side structural reform from the source can we optimize the market structure and maintain the healthy and stable development of the market. The innovation of economic model is based on the long-term development of this area. After kinetic energy transformation and structural transformation, a stable coordination and division of labor system will come into being, and cities will cooperate with each other in an appropriate way to form a stable and free coordinated development model.

To form a deep-seated and multi-field self reform mechanism, we need to give full play to the convenience and advantages in contacting the world economy. In economic cooperation and practice, we should constantly absorb world advanced

technology and form an innovative and open mechanism by mobilizing the vitality of the urban agglomeration. Industrial enterprises can widely cooperate with universities to conduct research on core technologies. The capital should be used reasonably to facilitate innovative technology research and development, so as to form its own industrial advantages.

## 8. Deficiency and Prospect

On the basis of empirical research, this paper discusses the role of inter city division of labor in regional economic development. Urban division of labor is not only a problem based on natural conditions, but also a huge project with many human traces. In the empirical research, based on statistical data and field investigation, this paper studies the possibility of coordinated development between cities from the perspective of division of labor. Therefore, the discussion on the political arrangement of urban division of labor is not enough. In this paper, the hypothesis related to this problem is that the established pattern of division of labor between cities is formed in history, which must include the results of political arrangements. On the other hand, this study takes those policy documents directly related to the coordinated development of regional economy as the premise, which is the implicit explanation of the role of urban division of labor in the coordinated development of regional economy under the influence of policy factors in a certain period of time. Of course, it also provides a new research topic for the members of this research group to carry out the next stage of research, that is, the influence of political arrangement in urban division of labor and its relationship with the coordinated development of regional economy.

## Authors' Contributions

Conceptualization, W. F.; methodology, W. F.; software, J. H.; validation, W. F. and J.H.; formal analysis, W. F. and J. H.; investigation, J. H.; resources, W. F.; data curation, J. H.; writing-original draft preparation, W. F. and J. H.; writing-review and editing, W. F. and J. H.; visualization, W. F. and J. H.; supervision, W. F.; project administration, W. F.; funding acquisition, W. F.. All authors have read and agreed to the published version of the manuscript.

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## Institutional Review Board Statement

Not applicable.

## Informed Consent Statement

Not applicable.

## Data Availability Statement

All the data are obtained from Guangdong Statistic Bureau (Available online) <http://stats.gd.gov.cn/> (accessed on 1 March 2022).

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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