

Study on the Factors Affecting the Economic Development of Guangdong-Hong Kong-Macao Greater Bay Area Based on the Characteristics of Time and Space Evolution

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Abstract: Based on the economic data of the regional units of Guangdong-Hong Kong-Macao Greater Bay Area from 1997 to 2016, the paper builds an indicator system and uses intelligent algorithms to analyze the spatial economic network structure and temporal and spatial evolution characteristics of urban agglomerations. The results of the study found that: Firstly, from the perspective of dynamic economic comparison, the spatial network of urban agglomerations is relatively strong, and Guangzhou, Hong Kong, Shenzhen, Foshan, etc. have always been at the center of the space economic network. Secondly, location characteristics, regional development policies, and external environmental factors, are the main factors affecting the spatial and temporal differences in regional economic development.

1. Introduction

Big party nineteenth report to Guangdong-Hong Kong-Macao Greater Bay Area construction, Guangdong-Hong Kong-Macao Greater Bay Area cooperation, regional cooperation in the Pan-Pearl River Delta as the focus, and comprehensively promote mutually beneficial cooperation with Hong Kong, Macao, Mainland. On July 1, 2017, witnessed by President Xi Jinping, Hong Kong SAR, Macao SAR, the National Development and Reform Commission of Guangdong Province signed a "deepening Guangdong-Hong Kong-Macao Greater Bay Area to promote cooperation in the framework of a large Bay Area ". Current research on Guangdong-Hong Kong-Macao Greater Bay Area around the main functional orientation, aspects of internal relations and regional development strategies to explore such areas. Based on regional advantages on the Eurasian continent geographically and economically important node and its own development base, Guangdong-Hong Kong-Macao development orientation Greater Bay Area in the international economic landscape for the third Asia-Europe Continental Bridge bridgehead. Based on this research, Thesis uses intelligent algorithm to establish the index factor of economic evaluation model, analyzes the economic network structure and the special evolution of time and space, and measures the comprehensive level of economic development. It is expected to further develop Guangdong-Hong Kong in the context of "one country, two systems". The planning of the Guangdong-Hong Kong-Macao Greater Bay Area provides development advice.

2. Model Construction

2.1 Social Network Analysis

Under the background of certain development between cities and cities, towns and towns, regions and regions, and between cities and regions, there are extensive and profound flows of materials, capital, technology, information and other factors, resulting in extensive links between various

regions. Under this connection, there is a complementary or mutually exclusive phenomenon between the various spatial categories, the so-called cooperative division of labor and competition. The interaction effect of space is to enable each space to guarantee the input and output of production and consumption, and promote each the function transformation and flow between the class spaces makes the basic focus of the interaction between cities and spaces lies in the elements [1]. On this basis, the functional transformation of the elements is realized, and the formation of the urban-regional system structure is promoted on the basis of transformation. The mobility of space makes the spatial interaction have dynamic effects. The flow and function complementation of spatial elements occur under the effect of “flow”. The arrival of the fast circulation era and the Internet era makes the spatial interaction more characteristic of the times, and the traditional local model has significant differences [2]. The traditional model is based on the central theory, which relies on the radiation and attraction of local fixed points to form the structure and mode of interaction. Therefore, for the measurement of the economic network of the Guangdong-Hong Kong-Macao Greater Bay Area, this paper will select the following indicators for quantitative analysis.

(1) Network density. The degree of density of nodes in a network is defined as the ratio of the number of edges actually present in the network to the upper limit of the number of edges that can be accommodated. Online social networks are often used to measure the intensity and evolution of social relationships. A network with N nodes and L actual edges, the urban group network density is expressed as the ratio of the actual number of connections between the nodes of the city to the maximum number of theoretical connections. The calculation formula is:

$$D_N = \frac{L}{N(N-1)} \quad (1)$$

(2) Relevance. The two variables are positively correlated, negatively correlated, and uncorrelated. If the value of one city variable is higher than the value of another city variable, similarly, the low value corresponds to a low impact value, indicating that each city in the network is less affected by other cities. The correlation calculation formula is:

$$C_N = 1 - \frac{2V}{N(N-1)} \quad (2)$$

(3) Centrality. The centrality measures the degree to which other cities depend on the city. The degree of degree reflects the extent to which a node in the network is at the core. The degree of centrality in a directed network can be divided into a point-in degree center degree and a point-out degree center degree, respectively indicating the ability of the node to receive and issue a relationship [3]. Suppose that $C_{i,i}$ is used to indicate the degree of point-in, $C_{o,i}$ is the degree of point-out, l_{ij} and l_{ji} are the strengths of the two nodes i(j) and j(i), respectively, and N is the number of cities in the network. For:

$$C_{o,i} = \sum_{j=1, j \neq i}^N l_{ij} / (N-1) \quad C_{i,i} = \sum_{j=1, j \neq i}^N l_{ji} / (N-1) \quad (3)$$

2.2 Entropy determination method to determine the comprehensive level of economic development

(1)The indicator system is determined. On the basis of reference to related literatures, the comprehensive evaluation index system of economic development is constructed from six aspects: economic aggregate, economic structure, economic benefit, economic capacity, economic openness and economic speed to measure the comprehensive level of regional economic development [2].

Tab. 1 Comprehensive evaluation index system for regional economic development

Feature layer	Indicator layer
Economic Aggregate (A)	A1 Gross Domestic Product
	A2 Per Capita Gross Domestic Product
Economic Structure (B)	B1 The Proportion of Secondary Industry in GDP
	B2 The Proportion of Tertiary Industry in GDP
Economic Benefit (C)	C1 Share of the Contribution of the Secondary Industry
	C2 Share of the Contribution of the Tertiary Industry
	C3 Total Retail Sales of Consumer Goods
Economic Capacity (D)	D1 Investment in Fixed Assets
	D2 Local Public Budgetary Revenue
	D3 Local Public Budgetary Expenditure
Economic Openness (E)	E1 Total Imports and Exports
	E2 Foreign Direct Investment Actually Utilized
Economic Speed (F)	F1 Gross Domestic Product Growth Rate
	F2 Growth Rate of Total Fixed Asset Investment

(2) The entropy value reflects the degree of disorder of information and can measure the amount of information. The entropy method is an objective method of weighting. It is a method of determining the weight of an index by using the amount of information provided by the entropy of each indicator. This method uses the relationship between the original data to determine the weight, effectively avoids the subjective bias caused by human factors, and makes the evaluation results more in line with the actual situation.

Firstly, raw data standardization processing. Converted as follows:

$$x_{ij} = \frac{\max_i \{a_{ij}\} - a_{ij}}{\max_i \{a_{ij}\} - \min_i \{a_{ij}\}} \quad (i = 1, 2, 3, \dots, n) \quad (4)$$

In the formula, $\max_i \{a_{ij}\}$ and $\min_i \{a_{ij}\}$ respectively represent the maximum value and the minimum value among all the evaluation objects under the same indicator.

Secondly, calculate the characteristic weight of the i-th evaluated object under the j-th index.

$$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^n x_{ij}} \quad (i = 1, 2, 3, \dots, n) \quad (5)$$

Thirdly, calculate the entropy value A of the j-th index, with the expression:

$$e_j = -(\ln n)^{-1} \sum_{i=1}^m p_{ij} \ln p_{ij} \quad (6)$$

If $p_{ij}=0$, define $\lim_{p \rightarrow 0} p \ln p = 0$. If x_{ij} is equal for a given j, then $p_{ij}=1/n$, then $e_j=1$. Where n is the number of objects to be evaluated and m is the number of indicators.

Fourthly, calculate the difference coefficient of index x_j . The greater the difference coefficient $q_j = 1 - e_j$, q_j more attention should be paid to the role of this indicator.

Lastly, determine the weight. Using the entropy value to calculate the objective weighting expression of each indicator is:

$$w_j = q_j / \sum_{j=0}^m q_j \quad (j=0, 1, 2, \dots, m) \quad (7)$$

2.3 Data source

The data mainly comes from the Guangdong Statistical Yearbook (1997-2017), the Hong Kong Statistical Yearbook (1997-2017), the Macao Statistical Yearbook (1997-2017), the website of the Hong Kong Census and Statistics Department, the Macao Statistics and Census Bureau and the People's Republic of China. The National Bureau of Statistics, etc., the data loss in some years is treated by the adjacent interpolation method [4].

3. Time-space evolution characteristics of Guangdong-Hong Kong-Macao Greater Bay Area

3.1 Urban network overall network characteristics

Since the publication of the Guangdong-Hong Kong-Macao Greater Bay Area planning and construction, the development of urban agglomerations has been particularly prominent. Established between cities. New layout. It can be the maximization of the overall urban development and construction. Observed by substituting economic data of the urban agglomeration of the Guangdong-Hong Kong-Macao Greater Bay Area into the model. Since 1997, the economic operation has achieved good results. It also laid a solid foundation for cooperation and development in various cities [5].

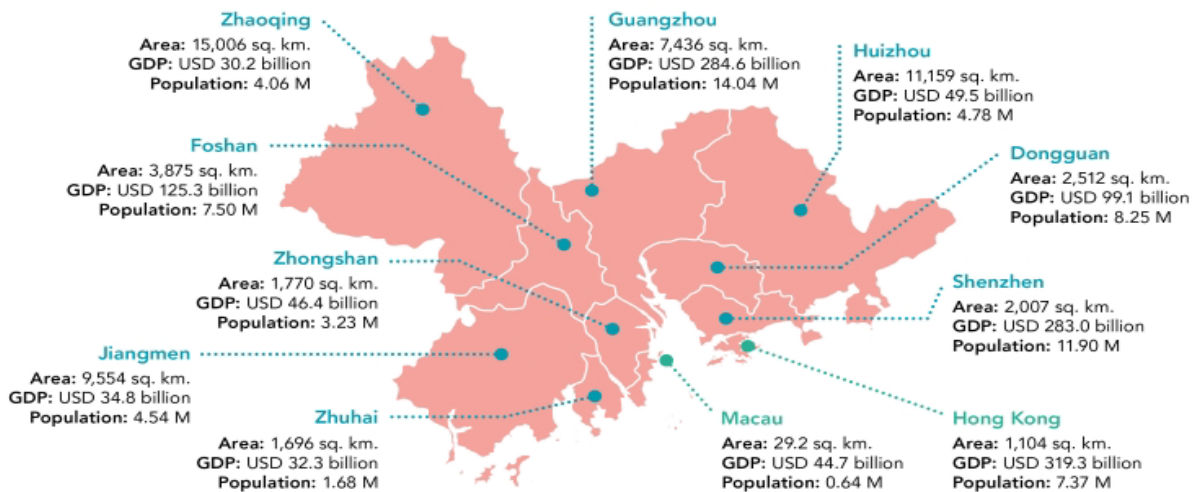


Fig. 1 Guangdong-Hong Kong-Macao Greater Bay Area layout

3.2 Urban Group Network Centrality Analysis

We have made a comprehensive assessment of all aspects of the city through previous network densities and correlations. And statistics, the top eight cities in the region in 2010-2016, through the assessment of relevant economic data, to find out the link and development. Explain the role of the region in promoting the economy. First, the summarized data are statistically summarized. The results are shown in Table 2.

Tab.2 The central center of the Guangdong-Hong Kong-Macao Greater Bay Area

Sort	2010		2012		2014		2016	
1	Hong Kong	32.254	Hong Kong	17.024	Hong Kong	16.312	Hong Kong	15.936
2	Guangzhou	25.832	Guangzhou	16.412	Guangzhou	11.378	Guangzhou	11.253
3	Foshan	8.013	Foshan	12.037	Shenzhen	11.297	Shenzhen	10.897
4	Dongguan	2.536	Shenzhen	9.346	Foshan	8.837	Foshan	8.267
5	Shenzhen	1.404	Dongguan	2.058	Zhongshan	1.739	Zhaoqing	2.355
6	Zhongshan	0.381	Jiangmen	0.796	Dongguan	1.236	Dongguan	1.791
7	Macao	0.053	Huizhou	0.704	Huizhou	1.027	Zhongshan	1.653
8	Zhuhai	0.012	Zhongshan	0.573	Zhaoqing	0.825	Huizhou	1.251

3.3 The overall level of overall economic development is volatility and rapid growth

The entropy method was used to determine the weight, and the regional economic index of the Guangdong-Hong Kong-Macao Greater Bay Area for 20 years was calculated. It was found that the region's economy showed a rapid fluctuation in overall growth and could be divided into four stages.

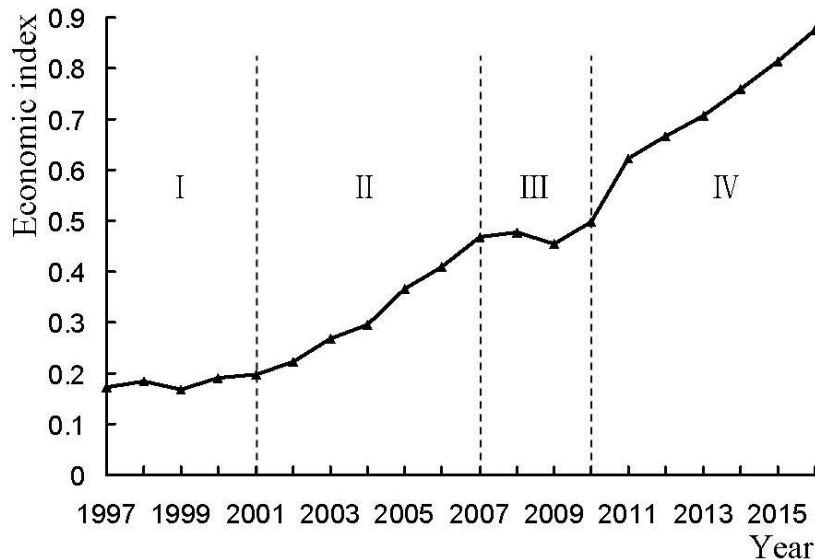


Fig.2 Changes in the economic development level of the Guangdong-Hong Kong-Macao Greater Bay Area

1) Slow economic growth stage (1997-2001). The economic index at this stage rose from 0.173 to 0.198, with an average annual growth rate of 0.006. In the 1980s and 1990s, the establishment of the Shenzhen Special Economic Zone opened the industrial cooperation and geographical division model of Guangdong-Hong Kong-Macao "front store and back factory". Hong Kong and Macao provided technology and platform to utilize natural resources such as cheap labor flowing into Guangdong. The production of the products, the final products with the export of Hong Kong and Macao exports, Guangdong-Hong Kong-Macao formed an inseparable processing trade chain in the global production network.

2) Accelerated economic growth stage (2001-2007). The economic index at this stage rose from 0.198 to 0.468, with an average annual growth of 0.058. After the Asian financial crisis, the economy began to recover, while a series of favorable policies stimulated economic growth. During this period, with the gradual integration of China into the WTO, the economic ties between Hong Kong and Macao and the Pearl River Delta region have become increasingly close, and the economic development of Guangdong, Hong Kong and Macao has been relatively stable. In addition, the national policy has increased support for coastal areas, especially the Pearl River Delta region and Hong Kong and Macao SAR. The external environment of the country is relatively stable, and it also provides favorable conditions for the overall development of the economy.

3) The period of severe economic shock (2007-2010). The economic index at this stage fell from 0.468 to 0.454 and then rose to 0.497. Since the outbreak of the financial crisis in 2008, the mainland, Hong Kong and Macao have been hit hard, and the development of various industries has undergone major changes. In addition, the shortcomings brought about by the ultra-high-speed development of China's economy since the reform and opening up have become more prominent, and the industrial structure has undergone major adjustments, resulting in industrial structure. The level of rationalization has slowly declined. Since then, with the government's efforts to guide the optimization and upgrading of the industrial structure, emerging businesses have gradually emerged, leading the economy to gradually pick up.

4) Rapid economic development stage (2010-2016). The economic index at this stage rose from 0.497 to 0.876, with an average annual growth rate of 0.063. After the global financial crisis, the country introduced a series of strategies and policies. At the same time, after the establishment of the Guangdong Free Trade Zone in 2014, institutional innovation provided more convenient conditions for the Guangdong-Hong Kong-Macao production service industry and service trade. The "The Belt and Road" strategy promoted Guangdong-Hong Kong-Macao in cross-border finance. In the far-reaching cooperation in shipping logistics, service trade and other fields, Guangdong-Hong Kong-Macao has played a more important strategic role in opening up [6].

4. Factors affecting the economy of Guangdong-Hong Kong-Macao Greater Bay Area

4.1 Geographic location

Guangdong-Hong Kong-Macao Greater Bay Area has different geographical locations. Hong Kong, Shenzhen and Guangzhou are all mega-cities in Greater Bay Area. They have entered the ranks of international first-class cities in terms of economic aggregate, industrial development level, and urban development level, while the economic and social development levels in Zhaoqing and Jiangmen. It is still low and still in the ranks of domestic third- and fourth-tier cities. The east and west sides of the Pearl River Estuary have great gaps in terms of economic strength, industrial development stage, and the number of permanent residents. There are two international metropolises in Hong Kong and Shenzhen on the east coast, while the West Bank lacks development to lead cities.

4.2 Regional Development Policy

Regional development policies play a decisive role in the evolution of the economic structure of the Greater Bay Area. The development of the Guangdong-Hong Kong-Macao Greater Bay Area is a cooperation between the three independent customs zones under the "one country, two systems" principle. During the "Seventh Five-Year Plan" period, the national land space was divided into three major economic zones: the eastern, central, and western regions. The state gave priority to the development of the eastern region, and established a series of special policy zones on the eastern coast. The Pearl River Delta was closely followed by Hong Kong and Macao. The country has been positioned as a "first step" for reform and opening up, and has gained a first-mover advantage in opening up to the outside world. And in 1980, the Pearl River Delta carried out reform and opening up, vigorously developed the manufacturing industry, and attracted foreign investment, making it one of the most developed regions in mainland China. Then, under the leadership of President Xi Jinping, "The Belt and Road" was launched, which strengthened the cooperation between Hong Kong, Macao and Taiwan and formed a new economic development situation.

4.3 Changes in external environment

Among the various factors that determine the regional development pattern, institutions are the most fundamental factor. To promote regional coordinated development, the most fundamental thing is to establish and improve the institutional mechanisms that are compatible with it through comprehensive deepening of reforms. The 1997 Asian financial crisis has had a major impact on the economic development of the Guangdong-Hong Kong-Macao Greater Bay Area, especially Hong Kong and Macao. After China joined the "WTO" in 2001, economic development was in line with international standards, and the economic relationship between the mainland and Hong Kong was closer. The GDP growth rate of Hong Kong and Macao was lower than that of cities in the Pearl River Delta. Under the policy guidance of "The Belt and Road", along with the opening of the Hong Kong-Zhuhai-Macao Bridge, Guangdong-Hong Kong-Macao has made a big step in the connection of hardware such as transportation infrastructure. Next, we must give full play to the role of Hong Kong's "super contacts" and effectively promote the soft docking of Guangdong-Hong Kong-Macao in terms of mechanisms, rules, information, people's hearts and culture.

5. Conclusion

The paper analyzes the economic development of Guangdong-Hong Kong-Macao Greater Bay Area from 1997 to 2016 as a timeline, and analyzes the impact of Guangdong-Hong Kong-Macao Greater from political, environmental and geographical perspectives. The specific reasons for the Bay Area economy. The paper found that in order to achieve the goal of the Guangdong-Hong Kong-Macao Greater Bay Area towards the world-class urban agglomeration, it is necessary to follow the development of the times and follow the "The Belt and Road " initiative to deepen cooperation and exchanges with countries along the line and innovate. Only then can they occupy a large market share in the overseas trade market.

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