The Grey Correlation Analysis of the Three Major Industries and Shanghai's GDP

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Abstract: The 14th Five-Year Plan period is the first five years that my country has fully embarked on a new journey of building a modern socialist country. It is also a crucial period for Shanghai to deepen the functions of the "five centers". As the central city of China's economy, finance, and trade, Shanghai's GDP growth rate is basically the same as that of the whole country. This paper selects Shanghai's total GDP data from 2010 to 2019 and the GDP data of the primary, secondary, and tertiary industries as samples to establish a grey correlation analysis model to analyze the relationship between Shanghai's three major industries and Shanghai's economic growth. Grey correlation degree. The empirical results show that the tertiary industry has the greatest impact on the economic development of Shanghai, followed by the secondary industry and the primary industry. Finally, this article proposes corresponding countermeasures and suggestions for Shanghai's future economic development in terms of strengthening scientific and technological innovation and improving the quality and efficiency of opening to the outside world.

Keywords: Three major industries, Shanghai, GDP, grey relational analysis

1. Introduction

The "14th Five-Year Plan" period is the first five years after my country achieved its first centenary goal, and took advantage of the momentum to embark on a new journey of building a socialist modern country in an all-round way and March towards the second centenary goal. At the same time, this period is also an important period in which the functions of Shanghai's "five centers (international economic, financial, trade, shipping, and technological innovation centers)" are further enhanced and established. During this period, the scientific formulation and implementation of the 2030 goals and long-term plans to accelerate the adjustment of the industrial structure and economic structure is of great significance to the stable, high-speed, and high-quality development of the economy under the influence of the new crown epidemic and the violent Sino-US relations.

Shanghai is located on the front edge of the alluvial plain of the Yangtze River Delta, bordered by the East China Sea to the east, the Yangtze River to the north, Hangzhou Bay to the south, and Jiangsu and Zhejiang Provinces to the west. It is the center of China's coastline. The advantageous geographical location makes Shanghai the economic, financial, and trade center city of mainland China, and it has also achieved an important position in the world of finance, commerce and transportation. At the same time, Shanghai Port is the world's largest container port. As one of the two stock exchanges in Mainland China, the Shanghai Stock Exchange has laid the foundation for Shanghai's GDP to rank among the top in the country. Gross domestic product (GDP) is the market value of all the final results produced in a region's economic activities in a certain period of time. It is the core indicator of national economic accounting of a country or region, and it is also very important in measuring the economic status and development level of a country or region. Research on the relevant factors affecting GDP has become an important issue that needs to be explored and resolved for economic growth.

2. Literature Review

In recent years, many domestic scholars have conducted various research and analysis on economic development factors in various regions of our country. Wei Ming [1] analyzed the development and upgrading of Shanghai's service industry through gray correlation analysis of related industries, and the conclusion showed that social security and social welfare, public management and social organizations have the greatest impact on the total output value of the service industry; followed by wholesale and

retail trade. , Catering industry; once again for education, culture, sports, entertainment, and real estate, the development of Shanghai's service industry is in a new stage from scale expansion to energy level improvement. Liu Zhongguang [2] analyzed the relationship between the disposable income of urban residents in Henan Province and the consumption structure through the grey relational analysis method, and concluded that disposable income has a strong role in promoting consumption structure, and wage income and transfer income have a significant effect on consumption. Influence dominates. Sun Peilei [3] used the entropy method to measure the level of high-quality economic development and spatial differences in China's provinces, and the conclusion showed that the overall level of high-quality economic development in my country has risen steadily, but there is structural imbalance, and innovation and development are lagging behind. Wang Wei [4] established a gray correlation model through gray correlation analysis to study and analyze the relationship between Shanghai's financial industry and other industries. The conclusion shows that the financial industry has a relatively obvious correlation effect on various industries, of which the accommodation and catering industries have the highest correlation. . Yan Yujun [5] used the gray GM(1,1) model to predict the total number of elderly people in Shanghai in the future and the aging coefficient; at the same time, he studied the influencing factors of Shanghai's population aging with the gray correlation model, and the conclusion indicated that Shanghai will be aging in the future. The problem of globalization will become more serious, and the most critical factor in the aging of influence is the number of health technicians. Zhao Jingfeng [6] analyzed the impact of the synergy between investment, consumption, and exports on the high-quality economic development through multiple linear regression analysis. The results showed that exports and consumption are the driving force for high-quality economic development, and investment has a certain impact on economic development. Degree of inhibition. Liu Yinan [7] established a gray correlation model to analyze the relationship between Shanghai's information industry and economic growth through gray correlation analysis. The conclusion shows that the growth of the information service industry can promote the growth of Shanghai's economy. There is a strong correlation, among which the information service industry has the largest correlation with economic growth. Wang Jian [8] established a gray correlation model through the gray correlation analysis method to research and analyze the investment in science and technology and Shanghai's economic growth. The conclusion shows that R&D expenditure and investment in science and technology personnel have a high degree of correlation to the increase in Shanghai's economy, but it is clear that the role of Shanghai's scientific and technological personnel on Shanghai's economic growth is not obvious.

To sum up, there are many domestic studies on China's economic development and influencing factors, but most of them are studying the impact of individual industries, industries or factors on economic development, such as the information industry, financial industry, technology investment, etc., from a holistic perspective there is less research on economic development. Therefore, this paper selects Shanghai as the research object, and uses the method of gray correlation analysis to analyze the correlation degree of Shanghai's GDP from the perspective of the primary, secondary, and tertiary industries, and analyzes the future industrial structure and economic structure of Shanghai. Adjustments and suggestions are made to provide a theoretical perspective for the country to issue relevant economic policies and formulate economic development plans.

3. Grey relational analysis

Grey system theory can be used to quantitatively analyze the dynamic development process of the system, and analyze the closeness of the relationship between the factors based on the quantitative data obtained, so as to obtain the primary and secondary importance of the factors that affect the dynamic changes. Different system colors reflect different amounts of information. The white system represents a system whose information is completely known, and its amount of information is also very sufficient; the black system represents a system whose information is completely unknown, and it contains extremely large amounts of information. Less; The gray system is a transitional system between black and white systems, it represents part of the information is known and part of the information is unknown. Gray correlation analysis is a multi-factor statistical analysis method, which is based on the sample data of each factor and uses the gray correlation degree to describe the strength of the relationship between the factors. It analyzes and determines the degree of influence between factors or the degree of contribution of factors to the main behavior based on the microscopic or macroscopic geometric proximity of the behavior factor sequence.

The steps of grey relational analysis:

(1) Determine the analysis sequence

To analyze an abstract complex system, it is necessary to construct a sequence of behaviors that can reflect the characteristics of systemic behavior and a sequence of related factors that affect the behavior of the system, and to judge the degree of system relevance based on the comparison between the two.

Selected reference sequence:

$$X_0 = \big(x_0(1), x_0(2), x_0(3), \ldots\ldots, x_0(n)\big) \tag{1}$$

Selected comparison sequence:

$$X_i = \big(x_i(1), x_i(2), x_i(3), \ldots\ldots, x_i(n)\big) \tag{2}$$

Among them, X_0 is the reference sequence of the system; $X_i(1,2,\ldots\ldots,r)$ is the sequence of r related factors; n is the number of data samples.

(2) Dimensionlessness of variables

Since the selected analysis data comes from different indicators, it may affect the rationality and correctness of the final conclusion due to the different dimensions. Therefore, we need to eliminate the influence of the dimensions during analysis. At this time, we need to carry out infinite data. In this way, the interference caused by the different magnitude of the data can be eliminated. The method used in this article is the initial value processing method to obtain the initial value image of the reference sequence and the comparison sequence:

$$X_0^* = \frac{X_0}{x_0(1)} = \big(1, x_0^*(2), x_0^*(3), \ldots\ldots, x_0^*(n)\big) \tag{3}$$

$$X_i^* = \frac{X_i}{x_i(1)} = \big(1, x_i^*(2), x_i^*(3), \ldots\ldots, x_i^*(n)\big) \tag{4}$$

(3) Calculate the correlation coefficient

The correlation coefficient calculation formula is:

$$\xi_i(k) = \frac{\min_s \min_t |x_0(t)-x_s(t)| + \rho \max_s \max_t |x_0(t)-x_s(t)|}{|x_0(k)-x_i(k)| + \rho \max_s \max_t |x_0(t)-x_s(t)|} \tag{5}$$

Where $\min_s \min_t |x_0(t) - x_s(t)|$ and $\max_s \max_t |x_0(t) - x_s(t)|$ Maximum difference between levels. Among them, $\rho \in [0,1]$ is the resolution coefficient. Generally speaking, the larger the resolution coefficient ρ, the greater the resolution; the smaller the ρ, the smaller the resolution.

(4) Calculating the degree of grey correlation

The correlation coefficient calculated by the above formula is an indicator that describes the degree of correlation between the comparison series and the reference series at a certain time. Since each time has a correlation number, the information is too scattered and inconvenient for comparison. Therefore, the following formula is defined as the series x_0 the degree of relevance to the reference sequence x_i

$$r_i = \frac{1}{n}\sum_{k=1}^{n} \xi_i(k) \tag{6}$$

4. Grey correlation analysis of Shanghai's three major industries' GDP and Shanghai's economic development

(1) Data selection

Based on the "Shanghai Statistical Yearbook", this paper selects Shanghai's GDP and the GDP of the primary, secondary and tertiary industries from 2010 to 2019 as economic development indicators for grey correlation analysis.

Table 1: Shanghai GDP and GDP of the three major industries

Unit: 100 million yuan

Years	Shanghai GDP	By industry		
		Primary Industry	Secondary Industry	Tertiary Industry
2010	17 915.41	114.45	7 434.89	10 366.07
2011	20 009.68	126.44	8 169.34	11 713.90
2012	21 305.59	129.33	8 174.13	13 002.13
2013	23 204.12	131.63	8 286.53	14 785.96
2014	25 269.75	131.96	8 633.25	16 504.54
2015	26 887.02	125.53	8 408.65	18 352.84
2016	29 887.02	114.34	8 570.24	21 202.44
2017	32 925.01	110.78	9 525.89	23 288.34
2018	36 011.82	104.78	10 360.78	25 546.26
2019	38 155.32	103.88	10 299.16	27 52.28

(2) Numeral Calculations

After finishing the data, in the grey correlation analysis of Shanghai's GDP and the GDP of the three major industries, Shanghai's GDP was selected as the reference sequence, and the GDP of the three major industries was the comparison sequence, using equations (3), (4) and (5) Take the value of the resolution coefficient ρ as 0.5, and calculate the gray correlation coefficients of Shanghai GDP and the GDP of the three major industries. The results are shown in Table 2.

Table 2: The gray correlation coefficients of Shanghai's GDP and the GDP of the three major industries

Data sample	GDP of the primary industry	GDP of the secondary industry	GDP of the tertiary industry
$\xi_1(k)$	0.4988	0.6231	0.7876
$\xi_2(k)$	0.4790	0.6143	0.7805
$\xi_3(k)$	0.4989	0.6845	0.8331
$\xi_4(k)$	0.5478	0.7943	0.9075
$\xi_5(k)$	0.6385	0.8854	0.9635
$\xi_6(k)$	0.8586	0.9416	1.0000
$\xi_7(k)$	0.6905	0.7206	0.8609
$\xi_8(k)$	0.5129	0.7149	0.8546
$\xi_9(k)$	0.3953	0.6827	0.8294
$\xi_{10}(k)$	0.3527	0.5654	0.7385

According to the gray correlation coefficient, the gray correlation degree is obtained, and the results are shown in Table 3.

Table 3: The gray correlation degree of Shanghai's GDP and the GDP of the three major industries

Correlation	Numerical value
GDP of the primary industry(r_1)	0.5493
GDP of the secondary industry(r_2)	0.7227
GDP of the tertiary industry(r_3)	0.8556

(1) Analysis of results

The gray correlation degree between Shanghai Economic Exhibition and the GDP of the three major industries can reflect to a certain extent the degree of influence of each major industry on the economic development of Shanghai. The greater the gray correlation coefficient and the gray correlation degree, the greater the correlation between the two. Powerful. Based on this, we get that the sequence of the GDP of the three major industries to the GDP of Shanghai's economy is r_3>r_2 〖>r〗_1, so the degree of influence is the tertiary industry's GDP> the secondary industry's GDP> the primary industry gross product. Among them, the correlation degree of the tertiary industry's GDP is above 0.8, indicating that the tertiary industry has a greater impact on the development of Shanghai, and the development of the tertiary industry will greatly affect the economic development of Shanghai. The correlation degree of the GDP of the secondary industry is above 0.7, which shows that the economic development of Shanghai is based on the industry, not entirely determined by the tertiary industry such as the financial industry. The correlation degree of the GDP of the primary industry is less than 0.6, which is about 0.55. It can be seen that the primary industries such as agriculture have little influence on the economic development of

Shanghai. The current mode of operation and production is difficult to promote the economic development of Shanghai. It is necessary to change the production model, improve the technological innovation of the primary industry, and accelerate the industrial upgrading.

At the same time, it can be seen from Table 2 that the gray correlation coefficients of the GDP of the three major industries in 2010-2019 and the GDP of Shanghai have shown a trend of first increasing and then decreasing, reaching the maximum in 2014 and 2015. This shows that the industrial structure and development model of the three major industries are consistent with the current development situation of Shanghai. The subsequent decline indicates that the development of the three major industries is gradually inconsistent with the economic development of Shanghai. The three major industries have simultaneously entered the process of industrial restructuring and industrial transformation and upgrading.

5. Thoughts and suggestions on Shanghai's economic development

Grey relational analysis is to find out the main factors that affect the change of the reference sequence. This is to find out the industry that contributes the most to Shanghai's economic development in the process of Shanghai's economic development, so that the industry can be accelerated to promote economic development. . At the same time, for industries with a low degree of relevance, corresponding incentives or supporting policies can be used to promote their compliance with the development status quo. Through the gray correlation analysis of the GDP of Shanghai's three major industries and Shanghai's economic development, in order to promote the better development of Shanghai's economy, the following aspects can be carried out:

(1) Innovation drives the upgrading of the three major industrial structures

The government must strengthen scientific and technological innovation, build a national strategic scientific and technological force, build a national laboratory, and strive for the establishment of more major scientific and technological infrastructures. At the same time, it is necessary to actively give play to the main role of enterprises and strengthen the connection between the innovation chain and the industrial chain. Promote mass entrepreneurship and innovation, build a number of university science parks with unique characteristics, and promote the quality and upgrading of various crowd-creation spaces.

(2) Vigorously develop the digital economy and promote the construction of high-end industries

Actively promote economic digitization. Persist in the deep integration of the digital economy and the real economy, and promote digital industrialization and industrial digitization. Accelerate the development of a new online economy and focus on key areas such as smart factories. Promote the development of high-end industries, enhance the independent controllability of the industrial supply chain, build a growth engine for strategic emerging industries, vigorously implement industrial infrastructure reengineering projects, encourage technological transformation and technological upgrading of key industries and enterprises, and actively eliminate outdated production capacity.

(3) Deepen reform and opening up and play a leading role

Deepen reform and opening up in key areas. Promote the reform, development, transformation and upgrading of private enterprises, and actively implement the innovation plan for small and medium-sized enterprises and the "enabling" action of enterprises. Promote the landing of an international financial asset trading platform in Shanghai, gather a number of landmark, representative, and functional major projects to create a world-class frontier industrial cluster. Actively cultivate a group of world-class enterprises, deepen the reform of state-owned enterprise mixed ownership and the establishment of equity incentive system, unswervingly strengthen and improve state-owned enterprises, and promote more private enterprises to grow into leading enterprises and unicorn enterprises.

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