



# A study on the correlation between the development of Shanghai's cruise economy and the construction of an international consumption center city

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**Abstract.** The roles of the cruise economy and the international center of consumption city are complementary. Cruise economy has a certain radiation effect on the regional economy, while the international center consumption city is the core function of the modern metropolis, with strong consumption guidance and driving effect, exploring the relationship between the two for the development of the urban economy has a further role in promoting. This paper takes Shanghai as an example, constructs cruise economy index and international central consumer city index, and combines the gray correlation model to empirically analyze the relationship between Shanghai's cruise economy and international central consumer city. The results can provide certain help for the decision-making of relevant departments.

**Keywords:** Cruise economy, international central consumer city, gray relative analysis method

## 1 Introduction

The cruise industry has become a new growth point to promote the development of coastal economy and the construction of international consumption center cities, and the state has put forward a number of policies to help the development of the cruise industry. At present, economic globalization, regional economic integration has become a major trend of development. Cruise as a major new industry in the tourism industry, more need to rely on the international consumption center city construction in-depth development of the industry, each other as an opportunity to promote. On this basis, this paper carries out an in-depth study on the relationship between the two, which helps us further understand the development between the two, and also provides theoretical and empirical evidence for the development of China's cruise economy.

In the study of the existing relevant literature, we find that the research on cruise economy is mostly based on the industrial chain as a perspective to study its impact on regional economic development, as well as to measure the contribution of cruise economy and evaluate the competitiveness of cruise ports; while the research on the international center of consumption city is mostly focused on the ways and methods of

building an international center of consumption city, as well as the competitiveness of the international center of consumption city and the evaluation. Existing literature has less research on the relationship between cruise economy and international center consumption city, so this paper takes Shanghai as the research object to explore the impact of the relationship between its cruise economy and international center consumption city.

The structure of this paper is as follows: the first part is the introduction; the second part is the related literature review; the third part introduces the selection of indicators of Shanghai's cruise economy and the international center of consumption city; the fourth part is the theory and methodology of the study; the fifth part is the empirical analysis; the sixth part is the analysis of the results; and the seventh part is the conclusion of this paper.

## **2 Literature Review**

### **2.1 Cruise Economy**

Many scholars have carried out some studies on the cruise economy. In foreign studies, Gulliksen V (2008) combed through the development history of cruise ships and studied the origin of cruise ships and the beginning of cruise tourism economy[1]. Zhang Z et al. (2015) explored the impact between cruise services on tourists' satisfaction[2]. Timothy MacNeill et al. (2018) and Jamie, M, Chen, et al. (2019) explored the positive economic impacts of cruise tourism from different perspectives, respectively[3,4]. Li Hua et al. (2015) analyzed the relationship between cruise economy and culture and resources to provide ideas for the soft environment construction of cruise economy[5]. Qiu Ling et al. (2015) explored the relationship and mechanism between cruise industries based on value chain related theories[6]. Sun Yan (2017), on the other hand, researched the correlation between cruise industries based on the theory of industrial association[7]. Jiang Hong et al. (2018) measured the output value and added value of cruise tourism by utilizing the theory of tourism satellite account[8]. Ding Jinxue et al. (2018) defined cruise economy as an industry that combines tourism, manufacturing and transportation[9]. Sun Ling et al. (2019) started from the perspective of cruise service supply chain to analyze the relationship between Shanghai's cruise industry and service providers[10]. Xu et al. (2021) explored the current situation of the cruise tourism industry in the South China Sea Rim region, and put forward a suggested path of cooperation[11]. Xu Jing (2021) analyzed and judged that the economic benefits of the cruise industry were obvious, could produce strong adsorption and pulling force, were the new economic power of the cities involved in the cruise industry, and could bring positive impact on the economic growth of the surrounding areas[12]. Xu Xiaotao (2022) believed that the cruise industry chain was still underdeveloped, and that the cruise industry, as an important part of the ocean economy, was a good medium to promote cultural exchanges, economic development, and cross-border cooperation among the countries around the South China Sea[13]. Ji Jiahui (2023) suggested that the cruise economy needed to focus on product specialization as well as combining the consumption preferences and personalized needs of tourists towards diversification and

releasing consumption potential[14]. Xu Juehui (2023) believed that Shanghai's cruise economy will usher in a new round of development opportunities, and can realize the resumption of growth in the cruise market and the high-quality development of the cruise economy through the construction of a new round of cruise hub ports[15]. Based on the FTZ context, Zhang, Wenjing et al. (2023) argued that the development of cruise economy deserved new exploration and innovation with new development opportunities[16]. Taking the official signing of RCEP as an entry point, Liu Gang et al. (2023) synthesized the significance of RCEP in advancing the integrated development of the cruise economy of the countries around the South China Sea[17]. Chen Haiyan (2024) believed that the global cruise market is still growing continuously, and the cruise economy had its unique charm and broad development space, attracting more and more investment and attention[18].

For the research on cruise economy, scholars unanimously agree on the entertainment attributes of cruise ships. Cruise has gradually become a new type of tourism, and the research on cruise industry has been increasingly emphasized by scholars. At present, scholars have tried different methods to measure the income of cruise economy, and most scholars believe that the cruise industry is a cluster industry, which needs to be combined with the local economy to actively expand the new tourism mode represented by the cruise economy.

## 2.2 International Center Consumer City

Wang Jia et al. (2013) argued that consumption city is the trend of future development of big cities, and explored how to build Shenzhen international center consumption city from multiple perspectives[19]. Wang Jing (2020) constructed an evaluation system of international consumption center city from multiple perspectives and empirically researched it by using entropy weighting method of empowerment and linear weighting method[20]. Liu Shejian (2021) took Shanghai as the research object, combined it with the actual background, and proposed that Shanghai should seize the opportunity to promote the construction of international center consumption city[21]. Zhou Jia (2021) analyzed the evolution process and related characteristics of the international central consumer city according to the problems encountered in the process of urban development[22]. Han Cheng (2021) evaluated the degree of coupling between the circulation industry and the consumption center city by using the coupling analysis method, starting from the advantages of constructing an international center consumption city[23]. Liu Sike et al. (2021) proposed the promotion points for building an international center consumption city from several different aspects[24]. Zhong Shimeng et al. (2021) measured China's consumption center city index and its pivot effect based on panel data from 10 domestic Chinese cities over a six-year period, and provided advice for improving the level of city development[25].

Most scholars believe that the construction of international center consumption city is the development trend of future big cities. The theoretical analysis mainly focuses on the path and experience of the construction of international central consumer cities, and the empirical analysis mostly focuses on the evaluation of the construction indexes of international central consumer cities.

### 2.3 Gray Correlation Model

Gong Xinshu et al. (2016) improved the gray correlation model and added TOPSIS method to evaluate the strategic emerging industries in Xinjiang[26]. Sun Yu et al. (2017) used the entropy weight method combined with gray correlation analysis to empirically analyze the factors influencing the price of commercial housing in Tianjin[27]. Li Guangming et al. (2017) used the gray correlation model to evaluate and comparatively analyze the sustainable development capacity of five provinces in Northwest China[28]. Zhang Rui et al. (2017) concluded that the land engineering evaluation system in Inner Mongolia contains economic, social and ecological aspects, and utilized the hierarchical analysis method to evaluate it[29]. Zhao Yan et al. (2017) proposed that there is a dynamic correlation between the gross domestic product and industrial structure changes in Inner Mongolia, and used the gray correlation model to carry out related research[30]. Wang Jun (2019) argued that there is a close correlation between economic development and financial support, and the empirical analysis used the gray correlation research method[31]. Peng Cong (2020) combined gray correlation and DEA research methods to conduct empirical research on five cross-border logistics corridors in China[32]. Zhao Li et al. (2021) used the gray correlation model to calculate the correlation between the distribution industry and industrial structure and propose optimization measures[33]. Wang Yifan et al. (2021) used data envelopment analysis (DEA) and gray correlation to evaluate and analyze the implementation efficiency of their clinical pathways[34]. Li Gang et al. (2021) constructed an evaluation index system of 38 specific indicators based on the dimension of “five revitalization” of the countryside, and measured the effectiveness of the implementation of rural revitalization in Qinghai Province by applying the improved entropy-value TOPSIS grey correlation model to find out the degree of fit between rural revitalization in Qinghai Province and the ideal state as a whole[35]. Chen Lei et al. (2022) used gray correlation analysis to quantitatively analyze the data of tourism industry in Sanya City, and found the gray correlation ordering of factors influencing tourism in Sanya City[36]. Lv Wei et al. (2022) used entropy value method and grey correlation method to calculate the data under the indicators of logistics development and agricultural industrialization, and concluded that the logistics indicators have a promotional effect on the development of agricultural industrialization, but there are differences in the size of the contributing role[37]. Sun Danning (2022) used the gray correlation model to analyze the degree of association between green finance and industrial structure upgrading, and concluded that green finance can promote industrial structure upgrading[38]. Zhang Guanghai et al. (2022) took Qingdao as an example and used the gray correlation method to explore the factors affecting its tourism development[39]. Xu Shan et al. (2023) used the International Property Rights Index (IPRI) published by the International Property Rights Alliance (IPRA) and its subdivided indicators to conduct a gray comprehensive correlation analysis of the property rights system and classified indicators of each economy and its value chain position in the service outsourcing industry[40]. Yang Yue (2023), with the help of gray correlation model, measured urbanization and regional logistics system indicators, and then judged the degree of coupling coordination of the degree of

correlation, to explore the important factors affecting the coupling and coordinated development of the two[41]. Zhang Xiaoling et al. (2023) used gray correlation analysis to calculate the correlation between tourism development and economic development factors in Tibet by selecting 11 indicators as a comparison sequence and taking total tourism revenue as a reference sequence[42].

For the research on the empirical method of gray correlation, scholars study the degree of coordination between two industries or sectors based on the gray correlation model, analyze the changes in the degree of coordination between the two and put forward the corresponding recommendations based on the results, which involves most of the research objects for the regional economy of a certain area or the primary, secondary and tertiary industries of a certain region. After that, scholars used the entropy value method to calculate the weights and proposed the entropy weight gray correlation model, which improved the previous research method. In addition, the gray correlation model is often used in the evaluation of competitiveness, which is a very common research method in the evaluation model.

### **3 Model Construction**

The interaction between the cruise economy and the international consumption center city is a dynamic relationship, and there are certain difficulties in trying to make a very precise quantitative analysis, mainly reflected in the fact that there are fewer cruise-related data. Regarding the interactive development of cruise economy and international consumption center city, there are too many influencing factors to be fully recognized, which belongs to the category of gray system. This paper adopts gray correlation analysis to study the correlation between the two and analyze whether there is a consistency of trend between the two. Cruise economy and international consumption center city influence each other in the process of development, and this mutual influence does not develop according to a stable trend, in addition to this, the indicators in the two systems have different degrees of influence, and it is necessary to study the degree of influence of the indicators in the two systems on the system as well as the interactions between the systems, and therefore the analysis of the indicators is also essential. China's cruise economy has been developed since 2006, more than ten years ago, and the process of cruise economy and regional economic development is often not in a stable trend of change. When analyzing the interaction between cruise economy and international consumption center city, the grey correlation analysis method can solve the problems of small amount of data and few samples of cruise industry, and also can analyze the indicators between systems, so that it can better improve the development of the two systems.

#### **3.1 Cruise Economy**

The number of cruise ships and the number of cruise passengers are more direct indicators to reflect the potential of cruise tourism. As the number of cruise ships and cruise passengers exist in both home ports and visiting ports, this paper takes the number of

home ports/visiting ports receiving cruise ships in Shanghai and the number of tourists in home ports/visiting ports in Shanghai as positive indicators to be included in the system of cruise economy indicators.

China's cruise market economy has experienced more than ten years of rapid development, in which cruise companies have made great contributions, while the development of China's cruise economy is also inseparable from the strong support of the relevant government departments, which have launched a number of cruise-related policies to promote the vigorous development of the cruise economy. The research on cruise companies and related policies belongs to the research category of cruise support services, which is conducive to the growth of the cruise economy, and at the same time, the use of policy innovation and industrial evolution to promote the high-quality development of the cruise industry, thus promoting the prosperity of Shanghai's cruise tourism industry, so this paper will be the number of cruise companies, the number of cruise-related policies in Shanghai, and the cruise-related research as a positive indicator to be included in the indicator system of the cruise economy.

To summarize, this paper constructs the Shanghai cruise economy index system, as shown in Table 1.

**Table 1.** Shanghai Cruise Economy Indicator System

	<b>Dimension</b>	<b>Secondary Indicator</b>	<b>Serial Number</b>	<b>Unit</b>	<b>Nature of the Indicator</b>
<b>Shanghai Cruise Economy</b>	Tourism Potential	Shanghai hosts homeport cruise ships	X1	ship number	forward
		Shanghai Hosts Visiting Port Cruise Ships	X2	ship number	forward
		Shanghai Homeport Visitor Volume	X3	ten thousand people	forward
		Visitor arrivals at the Port of Shanghai	X4	ten thousand people	forward
	Service Support	Number of cruise lines	X5	one	forward
		Number of cruise-related policies in Shanghai	X6	one	forward
		Cruise-related research	X7	one	forward

This table provides an indicator system of Shanghai's cruise economy, which measures the development of Shanghai's cruise economy from two dimensions: tourism potential and service support. Each dimension is subdivided into several secondary indicators, as follows: Shanghai Receiving Home Port Cruise (X1), Shanghai Receiving Visiting Port Cruise (X2), Shanghai Home Port Tourists (X3), Shanghai Visiting Port Tourists (X4), Number of Cruise Companies (X5), Shanghai Cruise Related Policies (X6), Cruise Related Research (X7). All are positive indicators.

### 3.2 International Center Consumer City

The Ministry of Commerce has given an assessment index system for international center consumption cities in the Overall Plan for Cultivating International Center Consumption Cities (2019), as shown in Table 2.

**Table 2.** Ministry of Commerce-International Center Consumer City Indicator System

Number	Dimension	Specific Indicators
1	International Reputation	Global city competitiveness ranking
2		Visitor arrivals/country
3		Number of international organizations or number of Fortune 500 companies in the country
4		Number of major international and domestic events and exhibitions
5		Number of World Heritage Sites
6		Number of 4A5A scenic spots
7	Consumer Prosperity	Total retail sales of consumer goods
8		Consumption expenditure per inhabitant
9		Domestic and international travel expenses
10		Value added of services
11		Imports of consumer goods
12	Business Activity	Number of iconic commercial districts
13		Number of internationally renowned brands of goods and services moving in/number of Chinese long-established brands
14		Number of duty-free stores and departure tax refund stores
15		Number of beds in three-star and above tourist hotels
16		Tertiary fixed asset investment
17		Consumer satisfaction
18	Reaching Convenience	Number of cities and routes served by international and domestic flights
19		Number of cities and trains directly served by high-speed rail/motorized train
20		Total metro mileage
21		Number of highway passages
22		Number of online vehicles
23	Policy Leadership	Leading organizations and sectoral coordination mechanisms
24		Planning, objectives, implementation programs
25		Policy innovations and supporting measures

Source: Ministry of Commerce's Overall Program for Cultivating International Center Consumption Cities.

This paper constructs this paper's international center consumption city indicators based on the relationship between the indicators included in the international center

consumption city given by the Ministry of Commerce and the cruise economy, as shown in Table 3.

**Table 3.** Indicators of international center consumer city

	Dimension	Secondary Indicator	Number	Unit	Nature of the Indicator
International Center Consumer City	International Reputation	Number of inbound tourists received in Shanghai	Y1	people	forward
		Number of outbound trips organized by Shanghai travel agencies	Y2	people	forward
		Number of international conventions and exhibitions organized	Y3	one	forward
	Consumer Prosperity	Shanghai GDP (primary sector)	Y4	billions	forward
		Shanghai GDP (secondary sector)	Y5	billions	forward
		Shanghai GDP (tertiary sector)	Y6	billions	forward
		Total retail sales of consumer goods (wholesale and retail trade)	Y7	billions	forward
		Total retail sales of consumer goods (accommodation and food services)	Y8	billions	forward
		Per capita disposable income	Y9	yuan/people	forward
		Shanghai's foreign exchange earnings from inbound tourism	Y10	billions of dollars	forward
		Shanghai Domestic Tourism Revenue	Y11	billions	forward
		Value Added of Shanghai Tourism Industry	Y12	billions	forward
		Shanghai's total imports	Y13	billions of dollars	forward
		Shanghai's total exports	Y14	billions of dollars	forward
	Traffic Activity	Miles of road routes	Y15	kilometer	forward
		Miles of highway routes	Y16	kilometer	forward
		Inland waterway mileage	Y17	kilometer	forward
		Number of vehicles operating in urban rental cars	Y18	one	forward
		Total urban bus and tram passenger traffic	Y19	ten thousand people	forward
		Number of vehicles operated by urban public buses and trams	Y20	one	forward



This table provides a series of indicators to measure a city as an international center of consumption, divided into three main dimensions: international visibility, consumption prosperity, and transportation activity. Each dimension is subdivided into different secondary metrics.

## 4 Theoretical Foundation

### 4.1 Gray Correlation Model

At present, the development of gray system theory is more active, and most of the domestic research on gray correlation analysis revolves around the gray correlation analysis model proposed by Deng Julong scholars to carry out research and put forward innovative research theories and methods on its basis. Gray system theory is characterized by information with uncertainty and incompleteness, focusing on problems such as small samples and less information, and using less data for modeling. Gray correlation analysis method examines the strength and order of the relationship between different factors, this method reflects the trend of development between the factors, if the trend of change between the two show consistency, there is a correlation, the higher the consistency, the greater the correlation. The gray correlation model is often used to solve evaluation problems, and is a relatively simple and reliable analysis method.

### 4.2 Gray Correlation Calculation Process

In the process of selecting the indicators, the content, meaning and value criteria are different. In order to make the comparability between the indicators, before the calculation, the data need to be dimensionless, so as to facilitate the comparison between the indicators, usually using the initial value of the method and the averaging method.

In this paper, we use the averaging method to normalize the data.

$$x'_i(k) = \frac{x_i(k)}{\bar{x}_i} \quad (1)$$

(1) Calculate the absolute difference between the reference and comparison series:

$$\Delta_i(k) = |x'_0(k) - x'_i(k)| \quad (2)$$

Among them, the comparison sequence is a data sequence consisting of factors affecting the behavior of the system, and consists of the values of the evaluation indicators for each evaluated object.

(2) Calculate the gray coefficient of the indicator system:

The gray correlation coefficient reflects the correlation in gray theory. Essentially, it is the degree of difference in the geometric structure between curves. The magnitude of the difference can be used as a measure of the degree of correlation. The gray correlation coefficient is the geometric distance between the comparison series and the reference series at any given time. The greater the distance, the higher the degree of correlation. The formula for calculating it is as follows:

$$\gamma(x_0(k), x_i(k)) = \frac{\min_k \min_j \Delta_i(k) + \xi \max_j \max_k \Delta_i(k)}{\Delta_i(k) + \xi \max_j \max_k \Delta_i(k)}, 0 < \xi < 1 \tag{3}$$

where  $\xi$  is the separate rate coefficient, usually  $\xi$  takes 0.5, in this paper  $\xi$  is equal to 0.5.

(3) Calculate the gray correlation and rank the correlation order:

The value of the gray correlation coefficient is the result under different time nodes, so there is more than one result, which cannot be compared uniformly. The gray correlation method is to gather the correlation coefficients to find out the relevant values through mathematical methods, and to reflect the degree of correlation between the reference series and other indicators in general.

The integrated gray correlation is calculated as:

$$\gamma(x_0, x_i) = \frac{1}{n} \sum_{k=1}^n \gamma(x_0(k), x_i(k)) \tag{4}$$

## 5 Empirical Analysis

This paper takes the international center consumption city-Shanghai and Shanghai cruise economy as the research object to explore the degree of correlation between the two. Due to the impact of the previous COVID-19, resulting in the missing data during the period of 2022-2023, this paper selects the data from 2011-2019 for the study, and the data of specific indicators are shown in Table 4 and Table 5.

**Table 4.** Indicator Data Sheet for Shanghai's Cruise Economy

Time	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019
Shanghai hosts homeport cruise ships (X1)	ship number	75	80	167	240	317	482	482	378	226
Shanghai Hosts Visiting Port Cruise Ships (X2)	ship number	30	41	31	29	24	28	31	29	33
Shanghai Homeport Visitor Volume (X3)	ten thousand people	14.54	26.4	69.79	115.11	159.53	282.9	290.82	268.96	181.08
Visitor arrivals at the Port of Shanghai (X4)	ten thousand people	6.89	9.34	5.87	6.45	4.72	8.56	6.58	6.69	8.27
Number of cruise lines (X5)	one	43	49	54	70	79	100	118	137	152
Number of cruise-related policies in Shanghai (X6)	one	2	3	5	9	11	14	10	24	11
Cruise-related research (X7)	one	242	184	298	337	379	417	607	542	629

Source: Shanghai Statistical Yearbook, China Statistical Yearbook, Cruise Green Book.

**Table 5.** Indicator Data Sheet for International Center of Consumption – Shanghai

Time	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of inbound tourists received in Shanghai (Y1)	people	8175756	8003983	7574007	7912996	8001609	8543661	8730111	8937075	8972292
Number of outbound trips organized by Shanghai travel agencies (Y2)	people	1324445	1728163	2294146	2340833	3828451	5654692	5449911	4936589	4591760

Number of international conventions and exhibitions organized (Y3)	one	227	265	247	258	292	287	293	300	310
Shanghai GDP (primary sector) (Y4)	billions	126.44	129.33	131.63	131.96	125.53	114.34	110.78	104.78	103.88
Shanghai GDP (secondary sector) (Y5)	billions	8169.34	8174.13	8286.53	8633.25	8408.65	8570.24	9525.89	10360.78	10299.16
Shanghai GDP (tertiary sector) (Y6)	billions	11713.9	13002.13	14785.96	16504.54	18352.84	21202.44	23288.34	25546.26	27752.28
Total retail sales of consumer goods (wholesale and retail trade) (Y7)	billions	7223.86	7930.50	8739.35	9580.86	10443.51	11354.96	12359.08	13469.24	14381.34
Total retail sales of consumer goods (accommodation and food services) (Y8)	billions	828.35	902.70	953.80	1011.82	1162.19	1233.25	1340.44	1405.52	1466.21
Per capita disposable income (Y9)	yuan/people	36230.00	40188.00	42173.64	45965.83	49867.17	54305.35	58987.96	64182.65	69441.56
Shanghai's foreign exchange earnings from inbound tourism (Y10)	billions of dollars	58.35	55.82	53.37	57.05	59.60	65.30	68.10	73.71	83.76
Shanghai Domestic Tourism Revenue (Y11)	billions	2786.54	3224.39	2968.00	2950.13	3004.73	3443.93	4025.13	4477.15	4789.30
Value Added of Shanghai Tourism Industry (Y12)	billions	1411.26	1497.68	1400.80	1449.33	1535.64	1689.70	1888.24	2078.64	2309.43
Shanghai's total imports (Y13)	billions of dollars	2276.47	2299.51	2371.54	2563.45	2547.64	2503.38	2824.42	3084.79	2948.64
Shanghai's total exports (Y14)	billions of dollars	2097.89	2068.07	2042.44	2102.77	1969.69	1834.67	1936.81	2071.7	1989.39
Miles of road routes (Y15)	kilometer	12084	12541	12633	12945	13195	13292	13322	13106	13045
Miles of highway routes (Y16)	kilometer	806	806	815	825	825	825	829	836	845
Inland waterway mileage (Y17)	kilometer	2037	2074	2074	2073	2058	2058	2023	1973	1910
Number of vehicles operating in urban rental cars (Y18)	one	50438	50683	50612	50738	49586	47271	46397	41881	39962
Total urban bus and tram passenger traffic (Y19)	ten thousand people	281100	280360	271048	266530	254852	239112	220072	210103	208500
Number of vehicles operated by urban public buses and trams (20)	one	16589	16695	16717	16155	16531	16693	17461	17513	17899

Source: Shanghai Statistical Yearbook, China Statistical Yearbook, Cruise Green Book.

Substituting the data in Table 4 and Table 5 above into Equations 4.1-4.4, the correlation with the indicators of Shanghai's cruise economy as the reference series and the correlation with the indicators of the international center of consumption city-Shanghai as the reference series are obtained respectively, as shown in Tables 6 and 7.

**Table 6.** Correlation with indicators of Shanghai's cruise economy as a reference series

	X1	X2	X3	X4	X5	X6	X7	Mean
Y1	0.582706	0.889267	0.583914	0.849397	0.623953	0.717144	0.712034	0.708345
Y2	0.779543	0.627268	0.74735	0.65792	0.736562	0.764735	0.793995	0.729625
Y3	0.603985	0.848538	0.603304	0.831842	0.629764	0.739269	0.717813	0.710645
Y4	0.561849	0.849236	0.52287	0.79909	0.530549	0.657846	0.608105	0.647078

Y5	0.580984	0.867852	0.59667	0.828919	0.632647	0.711603	0.722391	0.705866
Y6	0.658497	0.728607	0.629651	0.751028	0.801936	0.722178	0.881061	0.738994
Y7	0.63609	0.764138	0.619184	0.782718	0.733494	0.725929	0.820979	0.726076
Y8	0.636943	0.773392	0.629313	0.795889	0.713952	0.727032	0.793618	0.724305
Y9	0.628878	0.772022	0.613223	0.78784	0.723567	0.720868	0.815422	0.723117
Y10	0.594578	0.828142	0.589974	0.834948	0.675988	0.710391	0.770636	0.714951
Y11	0.596897	0.802575	0.591234	0.796206	0.709916	0.686198	0.793263	0.710898
Y12	0.598915	0.803415	0.592989	0.80379	0.705601	0.69659	0.793128	0.71349
Y13	0.592014	0.850278	0.602872	0.811973	0.633178	0.717949	0.723402	0.704524
Y14	0.558017	0.891691	0.548377	0.818608	0.564226	0.678247	0.646572	0.672248
Y15	0.580302	0.881086	0.573439	0.827741	0.59664	0.707949	0.681384	0.692649
Y16	0.571368	0.898677	0.569001	0.836781	0.589802	0.705561	0.674064	0.692179
Y17	0.573499	0.889063	0.554388	0.830281	0.575166	0.690074	0.657297	0.681395
Y18	0.575613	0.855465	0.528585	0.80163	0.545705	0.669112	0.623475	0.657083
Y19	0.560987	0.838738	0.521371	0.789746	0.526896	0.648059	0.604604	0.641486
Y20	0.573704	0.908737	0.57436	0.84155	0.601595	0.70928	0.686037	0.699323
Mean	0.602268	0.828409	0.589603	0.803895	0.642557	0.705301	0.725964	

**Table 7.** Correlation with the indicators of the international center of consumption city-Shanghai as a reference series

	X1	X2	X3	X4	X5	X6	X7	Mean
Y1	0.637584	0.881089	0.610718	0.838938	0.699015	0.691852	0.746751	0.729421
Y2	0.785524	0.551245	0.729037	0.587401	0.758425	0.699525	0.792024	0.700454
Y3	0.65465	0.836062	0.626716	0.81893	0.704125	0.714248	0.751665	0.729485
Y4	0.645432	0.858593	0.584114	0.810118	0.650082	0.657345	0.683546	0.698461
Y5	0.622587	0.850579	0.609517	0.808097	0.695561	0.67372	0.746451	0.715216
Y6	0.669108	0.670957	0.614309	0.699436	0.821987	0.653243	0.881662	0.715815
Y7	0.65675	0.720646	0.614528	0.74446	0.76913	0.669781	0.827032	0.714618
Y8	0.664108	0.736627	0.631515	0.764609	0.757184	0.678033	0.805604	0.719669
Y9	0.652651	0.732044	0.611749	0.752234	0.762963	0.66709	0.823566	0.714614
Y10	0.635036	0.807016	0.604925	0.815642	0.73342	0.672058	0.790989	0.722727
Y11	0.618146	0.763648	0.586168	0.757242	0.746581	0.623822	0.799809	0.699345
Y12	0.627669	0.770383	0.595918	0.772018	0.74878	0.64393	0.804402	0.709014
Y13	0.629027	0.828662	0.611735	0.786446	0.693263	0.676932	0.744612	0.710097
Y14	0.621154	0.886525	0.583504	0.811015	0.655079	0.655855	0.694856	0.701141
Y15	0.64413	0.876073	0.608906	0.821438	0.68472	0.688699	0.727139	0.721586
Y16	0.636006	0.894581	0.604781	0.831026	0.679103	0.686631	0.72097	0.721871
Y17	0.644584	0.889401	0.59873	0.83032	0.673187	0.677147	0.712497	0.717981
Y18	0.653435	0.860395	0.586277	0.808538	0.658321	0.665088	0.692324	0.703483
Y19	0.64352	0.84707	0.582778	0.800456	0.645988	0.648024	0.679402	0.692463
Y20	0.634599	0.903767	0.606857	0.833941	0.685755	0.688247	0.728789	0.725994
Mean	0.648785	0.808268	0.610139	0.784615	0.711133	0.671563	0.757705	

## 6 Analysis of the Results

The strength of correlation is judged based on the following:  $(0, 0.4]$  for weak correlation,  $(0.4, 0.65]$  for average correlation,  $(0.65, 0.85]$  for large correlation, and  $(0.85, 1]$  for very large correlation.

### 6.1 Correlation Analysis Using Indicators of Shanghai's Cruise Economy as a Reference Series

The correlation degree of each indicator of the cruise economy is calculated by taking each indicator of the cruise economy as a systematic reference series, and the correlation degree of each indicator of the international consumption center city to each indicator of the cruise economy is calculated. In the overall calculation of the correlation degree, there are almost no indicators with weak correlation degree, and the selected indicators are all positive indicators, indicating that the development of international consumption center city has a certain promotion effect on the cruise economy.

Through the correlation calculated from the indicators of the whole cruise economy as a reference sequence, we can get: Y6 Shanghai GDP (tertiary sector)>Y2 Number of outbound trips organized by Shanghai travel agencies > Y7 Total retail sales of consumer goods (wholesale and retail trade)>Y8 Total retail sales of consumer goods (accommodation and food services)>Y9 Per capita disposable income > Y10 Shanghai's foreign exchange earnings of inbound tourists > Y12 Value added of Shanghai tourism industry>Y11 Shanghai domestic tourism revenue > Y3 Number of international conventions and exhibitions organized > Y1 Number of inbound tourists received in Shanghai>Y5 Shanghai's GDP (secondary sector)>Y13 Shanghai's total imports>Y20 Number of vehicles operated by urban public buses and trams>Y15 Miles of road routes>Y16 Miles of highway routes>Y17 Miles of waterways mileage>Y14 Shanghai's total exports>Y18 Number of vehicles operating in urban rental cars>Y4 GDP of Shanghai (primary sector)>Y19 Total urban bus and tram passenger traffic. On the whole, consumption prosperity has the broadest impact on the cruise economy, followed by international popularity and transportation activity. This shows that the development of cruise economy needs to rely on the development of international consumption center cities. The development of Shanghai's tertiary industry is very important for the development of the cruise economy, which has far-reaching influence. The cruise economy is rich in connotation, involving transportation, catering, social services, etc., which is extremely close, and the development of the tertiary industry should be increased during the future development of the cruise ship. The length of the cruise ship docking time has a close connection with the supporting industries of the cruise industry, including transportation, catering, finance, social services, etc., which are all auxiliary industries in line with the cruise industry, which is positively correlated with the development of the tertiary industry.

Taking X1 (Shanghai hosts homeport cruise ships) as the reference indicator, the correlation of the indicators of international consumption center cities is as follows: Y2>Y6>Y8>Y7>Y9>Y3>Average>Y12>Y11>Y10>Y13>Y1>Y5>Y15>Y18>Y20>Y17>Y16>Y4>Y19>Y14

Among them, the larger correlation with X1 (Shanghai hosts homeport cruise ships) is the number of outbound tourism organized by Y2 Shanghai travel agencies and Y6 Shanghai GDP (tertiary industry). The greater correlation is between Y2 Number of outbound trips organized by Shanghai travel agencies and Y6 Shanghai's GDP (tertiary sector).

Taking X2 (Shanghai hosts visiting port cruise ship) as a reference indicator, the correlation rankings of various indicators of international consumption center cities are Y20>Y16>Y14>Y1>Y17>Y15>Y5>Y18>Y13>Y4>Y3>Y19>Average>Y10>Y12>Y11>Y8>Y9>Y7>Y6>Y2. The correlation between Y20 Number of vehicles operated by urban public buses and trams, Y16 Miles of highway routes, Y14 Shanghai's total exports, Y1 Number of inbound tourists received in Shanghai, Y17 Inland waterway mileage, Y15 Miles of road routes, Y5 Shanghai GDP (the secondary sector), Y18 Number of vehicles operating in urban rental cars, Y13 Shanghai's total imports, and X2 (Shanghai hosts visiting port cruise ship) is greater than 0.85, which is in a high degree of correlation. range.

Taking X3 (Shanghai's homeport visitor volume) as a reference indicator, the correlation rankings of the indicators of international consumption center cities are as follows: Y2>Y6>Y8>Y7>Y9>Y3>Y13>Y5>Y12>Y11>Y10>Average>Y1>Y20>Y15>Y16>Y17>Y14>Y18>Y4>Y19. Y2 Number of outbound trips organized by Shanghai travel agencies and X3 Shanghai homeport visitors volume are highly correlated, while all other indicators are generally correlated.

Taking X4 (Visitors arrivals at the port of Shanghai) as the reference indicator, the correlation degree of each indicator of the international consumption center city is as follows: Y1>Y20>Y16>Y10>Y3>Y17>Y5>Y15>Y14>Y13>Average>Y12>Y18>Y4>Y11>Y8>Y19>Y9>Y7>Y6>Y2. among them, Y1 Number of inbound tourists received in Shanghai, Y20 Number of vehicles operated by urban public buses and trams, Y16 Miles of highway routes, Y10 Shanghai's foreign exchange earnings from inbound tourism, Y3 Number of international conventions and exhibitions organized, Y17 Inland waterway mileage and X4 Visitor arrivals at the Port of Shanghai are more correlated.

Taking X5 (Number of cruise lines) as a reference indicator, the correlation of the indicators of international consumption center cities is ranked as follows: Y6>Y2>Y7>Y9>Y8>Y11>Y12>Y10>Mean>Y13>Y5>Y3>Y1>Y20>Y15>Y16>Y17>Y14>Y18>Y4>Y19. among them, Y6 Shanghai GDP (tertiary sector), Y2 Number of outbound trips organized by Shanghai travel agencies, Y7 Total retail sales of consumer goods (wholesale and retail trade), Y9 Per capita disposable income, Y8 Total retail sales of consumer goods (accommodation and food services), Y11 Shanghai Domestic Tourism Revenue, Y12 Value Added of Shanghai Tourism Industry, and Y10 Shanghai's foreign exchange earnings from inbound tourism are more highly correlated with X5 (Number of cruise lines).

Taking X6 (Number of cruise-related policies in Shanghai) as a reference indicator, the correlation of various indicators of international consumption center cities is ranked as fol-

lows: Y2>Y3>Y8>Y7>Y6>Y9>Y13>Y1>Y5>Y10>Y20>Y15>Y16>Mean>Y12>Y17>Y11>Y14>Y18>Y4>Y19. Y2 Number of outbound trips organized by Shanghai

travel agencies, Y3 Number of international conventions and exhibitions organized, Y8 Total retail sales of consumer goods (accommodation and food services), Y7 Total retail sales of consumer goods (wholesale and retail trade), Y6 Shanghai GDP (tertiary sector), Y9 Per capita disposable income, Y13 Shanghai's total imports, Y1 Number of inbound tourists received in Shanghai, Y5 Shanghai GDP (secondary sector), Y10 Shanghai's foreign exchange earnings from inbound tourism are highly correlated with X6 (Number of cruise-related policies in Shanghai).

Taking X7 (Cruise-related research) as a reference indicator, the correlation of various indicators of international consumption center cities is as follows:  $Y6 > Y7 > Y9 > Y2 > Y8 > Y11 > Y12 > Y10 > \text{Average} > Y13 > Y5 > Y3 > Y1 > Y20 > Y15 > Y16 > Y17 > Y14 > Y18 > Y4 > Y19$ . Among them, the correlation of Y6 Shanghai GDP (tertiary sector) and X7 (Cruise-related research) is very highly correlated, Y7 Total retail sales of consumer goods (wholesale and retail trade), Y9 Per capita disposable income, Y2 Number of outbound trips organized by Shanghai travel agencies, Y8 Total retail sales of consumer goods (accommodation and food services), Y11 Shanghai Domestic Tourism Revenue, Y12 Value Added of Shanghai Tourism Industry, Y10 Shanghai's foreign exchange earnings from inbound tourism, the average, Y13 Shanghai's total imports, Y5 Shanghai's GDP (secondary sector), Y3 Number of international conventions and exhibitions organized, Y1 Number of inbound tourists received in Shanghai, and Y20 Number of vehicles operated by urban public buses and trams are more highly correlated with X7 (cruise-related research).

## 6.2 Correlation Analysis Using the Indicators of the International Center of Consumption City-Shanghai as a Reference Series

The correlation calculated from the indicators of the whole international consumption center city as a reference sequence can be obtained as follows:  $X2$  (Shanghai Hosts Visiting Port Cruise Ships)  $> X4$  (Visitor arrivals at the Port of Shanghai)  $> X7$  (Cruise-related research)  $> X5$  (Number of cruise lines)  $> X6$  (Number of cruise-related policies in Shanghai)  $> X1$  (Shanghai hosts homeport cruise ships)  $> X3$  (Shanghai Homeport Visitor Volume). This suggests that the potential of cruise tourism and the support of related ancillary services in the cruise industry also have a contributing effect on the development of international consumption center cities. Among them, it is important to focus on the development direction of inbound tourism.

Taking Y1 (Number of inbound tourists received in Shanghai) as a reference indicator, the correlation of various indicators of the cruise economy is ranked as follows:  $X2 > X4 > X7 > X5 > X6 > X1 > X3$ . Among them, it is worth paying attention to the fact that, as a form of inbound tourism in Shanghai, the correlation between the cruise tourism and the number of inbound tourists received in Shanghai has reached a value of 0.88, which is a high degree of correlation, and the development of Shanghai's inbound tourism should be vigorously pursued. Taking Y2 (Number of outbound trips organized by Shanghai travel agencies) as a reference indicator, the correlation between various indicators of the cruise economy is  $X7 > X1 > X5 > X3 > X6 > X4 > X2$ . It shows that cruise tourism has become a common form of outbound tourism in Shanghai, with a correlation of 0.79, which is a high degree of correlation.

Taking Y3 (Number of international conventions and exhibitions organized) as a reference indicator, the correlation of cruise economy indicators is  $X_2 > X_4 > X_7 > X_6 > X_5 > X_1 > X_3$ . It shows that cruise inbound tourism can lead to the development of the convention and exhibition industry.

Taking Y4 (Shanghai GDP (primary sector)) as a reference indicator, the correlation of cruise economy indicators is  $X_2 > X_4 > X_7 > X_6 > X_5 > X_1 > X_3$ . Using Y5 (Shanghai GDP (secondary sector)) as a reference indicator, the correlation of cruise economy indicators is  $X_2 > X_4 > X_7 > X_5 > X_6 > X_1 > X_3$ . Taking Y6 (Shanghai GDP (tertiary sector)) as a reference indicator, the correlation of various indicators of the cruise economy is  $X_7 > X_5 > X_4 > X_2 > X_1 > X_6 > X_3$ . Among them, we should pay attention to the development direction of inbound tourism. On the contrary, the correlation between Shanghai homeport and GDP is average, and the construction of cruise homeport should be increased.

Taking Y7 (Total retail sales of consumer goods (wholesale and retail trade)) as the reference indicator, the correlation rankings of cruise economy indicators are:  $X_7 > X_5 > X_4 > X_2 > X_6 > X_1 > X_3$ . Taking Y8 (Total retail sales of consumer goods (accommodation and food services)) as the reference indicator, the correlation rankings of cruise economy indicators are:  $X_7 > X_4 > X_5 > X_2 > X_6 > X_1 > X_3$ . Taking Y9 (Per capita disposable income) as the reference indicator, the correlation rankings of cruise economy indicators are:  $X_7 > X_5 > X_4 > X_2 > X_6 > X_1 > X_3$ . Taking Y9 (Per capita disposable income) as the reference indicator, the correlation of cruise economy indicators is:  $X_7 > X_5 > X_4 > X_2 > X_6 > X_1 > X_3$ .

Taking Y10 (Shanghai's foreign exchange earnings from inbound tourism) as the reference indicator, the correlation of various indicators of the cruise economy is  $X_4 > X_2 > X_7 > X_5 > X_6 > X_1 > X_3$ . Taking Y11 (Shanghai Domestic Tourism Revenue) as the reference indicator, the correlation of various indicators of the cruise economy is  $X_7 > X_2 > X_4 > X_5 > X_6 > X_1 > X_3$ . Taking Y12 (Value Added of Shanghai Tourism Industry) as the reference indicator, the correlation of cruise economy indicators is:  $X_7 > X_4 > X_2 > X_5 > X_6 > X_1 > X_3$ . Taking Y13 (Shanghai's total imports) as the reference indicator, the correlation of cruise economy indicators is:  $X_2 > X_4 > X_7 > X_5 > X_6 > X_1 > X_3$ . Taking Y14 (Shanghai's total exports) as the reference indicator, the correlation of cruise economy indicators is:  $X_2 > X_4 > X_7 > X_6 > X_1 > X_3$ .

From the correlation between cruise ship indicators and Y4-Y14 indicators, it can be seen that cruise ship inbound tourism shows a good trend, but the correlation between Shanghai homeport and the consumption prosperity of international consumption center cities is general, and should increase the construction of cruise ship homeport.

Taking Y15 (Miles of road routes) as the reference indicator, the correlation of cruise economy indicators is:  $X_2 > X_4 > X_7 > X_6 > X_5 > X_1 > X_3$ . Taking Y16 (Miles of highway routes) as the reference indicator, the correlation of cruise economy indicators is:  $X_2 > X_4 > X_7 > X_6 > X_5 > X_1 > X_3$ . Taking Y17 (Inland waterway mileage) as the reference indicator, the correlation of cruise economy indicators is:  $X_2 > X_4 > X_7 > X_6 > X_5 > X_1 > X_3$ . Taking Y17 (Inland waterway mileage) as the reference indicator, the correlation of cruise economy indicators is:  $X_2 > X_4 > X_7 > X_6 > X_5 > X_1 > X_3$ . Taking Y18 (Number of vehicles operating in urban



rental cars) as the reference indicator, the correlation of cruise economy indicators is:  $X_2 > X_4 > X_7 > X_6 > X_5 > X_1 > X_3$ . Taking Y19 (Total urban bus and tram passenger traffic) as the reference indicator, the correlation of cruise economy indicators is:  $X_2 > X_4 > X_7 > X_6 > X_5 > X_1 > X_3$ . Taking Y20 (Number of vehicles operated by urban public buses and trams) as the reference indicator, the correlation of various indicators of the cruise economy is as follows:  $X_2 > X_4 > X_7 > X_6 > X_5 > X_1 > X_3$ . The above indicators show that Shanghai's cruise tourism has a greater positive influence on Shanghai's transportation development, especially the correlation between inbound tourism indicators and the transportation activity indicators of the international consumption center city is very high. Transportation Activity Indicator correlation is very large.

## 7 Conclusion

Through the grey correlation model, the cruise economy indicators are firstly taken as the reference sequence to study the influence degree of the international consumption center city on the cruise economy, and then the cruise economy indicators are taken as the reference sequence to study the influence degree of the cruise economy on the indicators of the international consumption center city, and the main constraints of the cruise economy on the international consumption center city and the main constraints of the international consumption center city on the cruise economy are derived, specifically: the cruise economy system is divided into two dimensions of tourism potential and service support, the international consumption prosperity and transportation activity. The main constraints of cruise economy on international consumption center city and the main constraints of international consumption center city on cruise economy are respectively derived as follows: the cruise economy system is divided into two dimensions: tourism potential and service support, and the international consumption center city indicator system is divided into three dimensions: international popularity, consumption prosperity and transportation activity. The grey correlation results indicate that with the cruise economy as the reference index system, the consumption prosperity dimension of international consumption center city has the greatest influence on the cruise economy system, followed by international popularity and traffic activity; with the international consumption center city as the reference index system, the number of ships visiting the port of Shanghai cruise ships and the number of tourists visiting the port have the greatest influence on the international consumption center city, so it is necessary to vigorously develop the inbound tourism of cruise ships.

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