

Evaluations on Competitiveness of Service Sector in Yangtze River Economic Belt of China Based on Dual-core Diamond Model

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Abstract—By expanding and innovating Michael Porter Diamond Model, a Dual-core Diamond Model is developed in this paper with innovation and openness as the core factors in consideration of the actual needs of the development of service sector in the Yangtze River Economic Belt of China. This paper establishes an evaluation indicator system of service sector competitiveness profitability to measure and evaluate the competitiveness of service sector in 11 provinces and towns in the Yangtze River Economic Belt through PCA (principal component analysis) based on the relevant information of the 11 provinces and towns mentioned above in 2015 and 2016. The research results indicate that the design of Dual-core Diamond Model is in line with the current situation and future development needs of the service sector in the Yangtze River Economic Belt, and the dual-core factors, namely, innovation and openness, have become the most important factors influencing the competitiveness of the service sector in the Yangtze River Economic Belt. Based on the model analysis results, it should propose strategies to enhance the competitiveness of the service industry in the Yangtze River Economic Belt. It needs to enhance innovation ability as well as to further expand trade in services. Firstly, encourage the growth of related industries and create a coordinated development cluster for the service sector. Second, intensify efforts in talent cultivation and build a talent system in alignment with the development of service sector. Third, improve the relevant legal system and innovate the service supervision and governance system in the service sector. Last, focus on a coordinated and integrated inter-region development.

Keywords—Dual-core diamond model; service sector; Yangtze river economic belt; principal component

I. INTRODUCTION

Eleven (11) provinces and towns, including Shanghai, Jiangsu, Zhejiang, Anhui, Jiangxi, Hubei, Hunan, Chongqing, Sichuan, Yunnan, and Guizhou, are included in the Yangtze River Economic Belt. They are the most developed regions in the Yangtze River Basin, accounting for 21.4% of China's national territory area and 40% of the China's national GDP. The Yangtze River Economic Belt accounted for 44.1% of the national GDP in 2018¹. The Yangtze River Economic Belt has unique potential for growth and obvious advantages in transportation, natural resources, industrial groups, human

resources and urban construction. Supporting the development of service sector is an effective strategy to facilitate the industrial innovation and transformation and enhance the industrial competitiveness in the Yangtze River Economic Belt, which is conducive to tapping into the potential of domestic demand in the upper and middle regions of the Yangtze River, forming a pattern of cooperation and interaction and mutual benefits of advantages throughout the Yangtze River's upper, middle, and lower sections, effectively reducing the regional development gap. From 2009 to 2016, the GDP of the service sector in the Yangtze River Economic Belt increased from RMB 6,283.8 billion to RMB 16,538.6 billion, accounting for 43.14% of national GDP in service sector, up from 29.08%². Directive Opinions on Promoting the Development of Yangtze River Economic Belt Supported by the Golden Waterway, Outline of Yangtze River Economic Belt Development Plan and other plans and policies have outlined the development needs for promoting the innovative and coordinated development, transformation and improvement of service sector in Yangtze River Economic Belt.

Some scholars have started to study industrial competitiveness under the framework of Michael Porter Diamond Model. Joshi incorporated the Diamond Model to examine the competitiveness of Indian automobile industry [1]. Yonghong constructed the evaluation indicator system of competitiveness of shipbuilding industry cluster based on the Diamond Model [2]. Esen studied the competitiveness of Turkish tourism industry by comparing with the Diamond Model [3]. Zhao utilized the Diamond Model to identify and examine the variables influencing the development of China's photovoltaic industry [4]. Based on the Diamond Model, Wu analyzed and investigated the competitiveness of China's coal sector [5]. Zheng et al. and Wan identified the variables influencing the trade in services sector of China and proposed countermeasures to enhance its competitiveness based on Porter's Theory of International Competitiveness Advantage [6][7]; Gu and Xia analyzed the main factors for enhancing the competitiveness of China's cultural industry based on the Diamond Model [8]. Zhuang et al. and Chen et al. believed that the four elements of Porter's "Diamond Model" are the

¹<https://baike.baidu.com/item/%E9%95%BF%E6%B1%9F%E7%BB%8F%E6%B5%8E%E5%B8%A6/5453694?fr=aladdin>

²Derived from *Statistical Yearbooks* of various provinces and cities.

main factors that affect the international competitiveness of the trade in services sector of China [9][10].

Based on researches on the level of growth of service sector in the Yangtze River Economic Belt, many scholars made an effort to establish an evaluation indicator system to identify the level of growth of service sector in the Yangtze River Economic Belt. Wu et al., Qian et al. and Zheng used factor analysis to evaluate the scale, structure, potential and benefits of service sector development in the Yangtze River Economic Belt [11-13]; Liu and Yao built models to evaluate the competitiveness of productive service sector and the development of modern logistics sector in the Yangtze River Economic Belt [14][15]; Xu et al. and Yang empirically analyzed the impact of human capital, transportation, income level and other factors on the development of service sector in the Yangtze River Economic Belt [16][17]; Wu et al. empirically tested the impact of market level of growth, economic level of growth, trade in services as well as the quantity of human capital and urbanization on the overall factor productivity of service sector in Yangtze River Economic Belt [18]. Yang et al. believed that carbon emission constraints and regression in technical level have a negative impact on the overall energy effectiveness of logistics sector in the Yangtze River Economic Belt [19]. Hu et al. and Sun et al. measured the amalgamation level of service sector in the Yangtze River Economic Belt [20-22]. Jing and Wang respectively adopted the Gray Relevance Total Analysis and Symbiosis Model to study the integrated development of service sector in the Yangtze River Economic Belt [23][24].

To sum up, enhancing the competitiveness of the service industry in the Yangtze River Economic Belt can promote the integration and development of industries in the Belt, as well as enhance the international competitiveness of the Belt. Some scholars have made some explorations on industrial competitiveness based on Michael Porter Diamond Model. Today, however, with the rapid development of service sector today, the research on the competitiveness of China's service sector needs to be further deepened and strengthened. This is especially demonstrated in the fact that the choice of factors affecting the competitiveness of service sector is scattered. Many scholars choose the affecting factors directly based on Porter's "Diamond Model". The selection of indicators has a certain degree of similarity. However, this paper holds that Michael Porter Diamond Model is not applicable to all countries, and its degree of explanation with regard to the industrial competitiveness of developing countries is not sufficient. This article believes that enterprises can improve their efficiency and competitiveness through technological innovation, institutional innovation, sales channel innovation, etc. By expanding openness, actively participating in international market competition, learning advanced management experience, and introducing more advanced

knowledge and technology, we can enhance the competitiveness of enterprises. Therefore, this paper combines Michael Porter Diamond Model and the authentic circumstances and conditions of Yangtze River Economic Belt to construct a "Dual-core Diamond Model" with "innovation" and "openness" as the core factors, and proves that this model is feasible and scientific for the service sector of Yangtze River Economic Belt through empirical test evidence.

II. THE OVERALL DEVELOPMENT OF SERVICE SECTOR IN THE YANGTZE RIVER ECONOMIC BELT

A. The Development Scale of Service Sector in 11 Provinces and Towns in the Yangtze River Economic Belt

Development scale of service sector in the Yangtze River Economic Belt. From 2009 to 2016, the GDP contributed by service sector in 11 provinces and towns in the Yangtze River Economic Belt increased continuously (see Table I and Fig. 1), from RMB 6,283.8 billion to RMB 16,538.6 billion, at a rate of 163.19%, indicating that the service sector in the Yangtze River Economic Belt is following a desirable development trend, and its scale is expanding constantly. Although its growth rate fluctuates slightly, it holds steady at a relatively high level.

Comparative analysis on the development of service sector in 11 provinces and towns of Yangtze River Economic Belt and the overall development of service sector in China. The GDP contribution of service sector in the Yangtze River Economic Belt rose to 43.14% in 2016 from 29.08% in 2009 (see Table I and Fig. 2). The service sector in the Yangtze River Economic Belt has grown rapidly, especially in recent years. The booming knowledge-intensive modern service sector has improved the quality of service sector development and promoted the modernization and transformation of the services sector. The service sector in the Yangtze River Economic Belt holds great development potential and is a pillar for the development of China's service sector.

Development of service sector of 11 provinces and towns in Yangtze River Economic Belt. As evidenced by the 2015 and 2016 statistics (Table II), there are obvious imbalances in regional development in 11 provinces and towns in the Yangtze River Economic Belt. In terms of service sector GDP in each region, Shanghai, Zhejiang and Jiangsu, which are located in the lower reaches, ranked among the highest, while Yunnan and Guizhou provinces in the western region of China, stayed at the bottom. The service sector GDP of Shanghai, the city with the top-scale service sector was nearly four times that of Guizhou, the city with the smallest service sector scale. Anhui ranked last in the service sector productivity, which was equivalent to approximately 1/4 of the value of Shanghai.

TABLE I. GDP OF SERVICE SECTOR IN YANGTZE RIVER ECONOMIC BELT AND ITS PROPORTION IN THE GDP OF CHINA FROM 2009 TO 2016

| Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|--------|--------|---------|--------|--------|--------|--------|--------|
| GDP of service sector in 11 provinces and towns of Yangtze River Economic Belt (In RMB 100 million) | 62838 | 64882 | 89708.9 | 101387 | 116633 | 130088 | 145193 | 165386 |
| Growth rate of GDP of service sector in Yangtze River Economic Belt (%) | 15.25 | 3.15 | 27.68 | 11.52 | 13.07 | 10.34 | 10.40 | 12.21 |
| GDP of service sector in China (In RMB 100 million) | 154748 | 182038 | 216099 | 244822 | 277959 | 308059 | 346150 | 383365 |
| The proportion of GDP of service sector of the Yangtze River Economic Belt to that of China | 29.08 | 35.64 | 41.51 | 41.41 | 41.96 | 42.23 | 41.95 | 43.14 |

Data source: China Statistical Yearbook, and Statistical Yearbooks of various provinces and cities

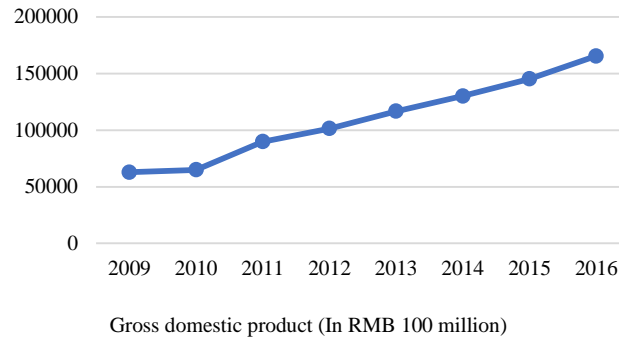
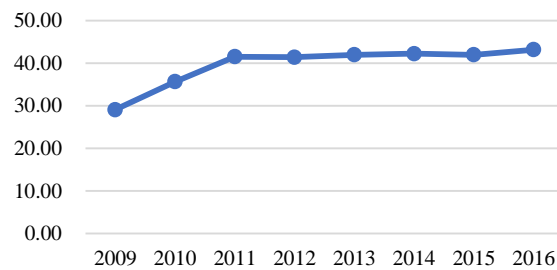


Fig. 1. Service industry in 11 provinces and cities of yangtze river economic belt.



Data source: Statistical Yearbook of various province and city

Fig. 2. Proportion of GDP of service industry of the yangtze river economic belt to that of China.

B. The Scale of Employees in the Tertiary Industry in 11 Provinces and Towns of the Yangtze River Economic Belt

Fig. 3 depicts the shifts in the number of workers in secondary and tertiary industries in 11 Yangtze River Economic Belt provinces and cities between 2008 and 2016. It is obvious that the development trend in the scale of employees in the tertiary industry was quite consistent with the trend in the production scale of service sector, which continues to rise, and the gap between the employment by the tertiary and secondary industries was widening. It is evident that the service sectors of various provinces and towns in the Yangtze River Economic Belt have better capacity in boosting employment and attracting human resources.

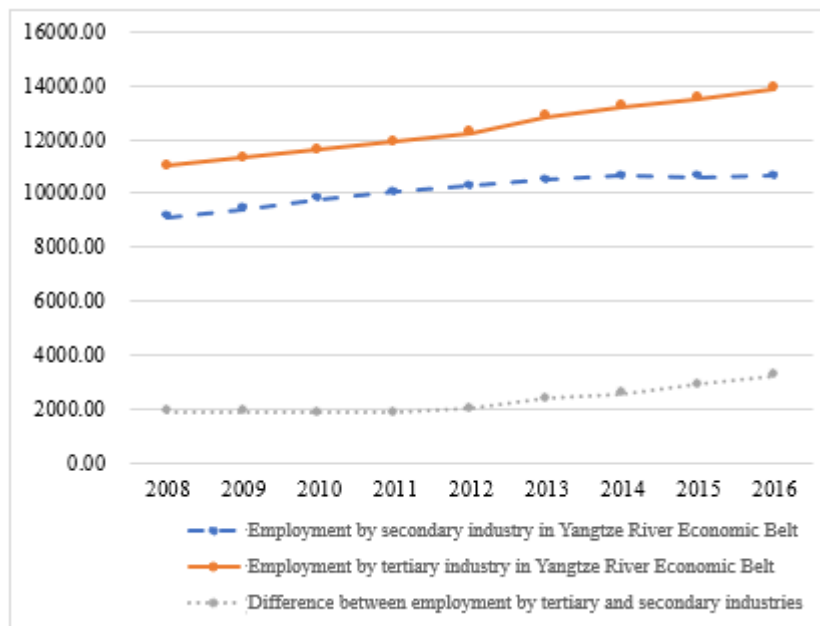
To sum up, the development of the service sector in the Yangtze River Economic Belt has become the powerhouse for the development of service sector in China. However, it still has certain shortcomings, such as a general lack of core technology, dependence on traditional industries in the

international market, and weak overall competitiveness in the service sector in the Yangtze River Economic Belt, especially in the middle and upper reaches of the Yangtze River. Therefore, a service sector driven by innovation will surely become a leading force behind economic development in the future. Meanwhile, with the high-quality economic development and the smooth progress in supply-side structural adjustment, the service sector in the Yangtze River Economic Belt needs to be further opened up in order to enhance economic benefits, encourage the modernization and transformation of industrial structures and raise the level of global industry competition. The efforts in the development of the service sector in the Yangtze River Economic Belt must be applied in a correct direction by seizing the emerging opportunities in global economic development and by identifying the strategies and routes that are aligned with the current development status and future development demands of the service sector in the Yangtze River Economic Belt.

TABLE II. GDP AND PRODUCTIVITY OF SERVICE SECTOR IN 11 PROVINCES AND TOWNS OF YANGTZE RIVER ECONOMIC BELT IN 2015-2016

| Year | Province/city | GDP of service sector (In RMB 100 million) | Service sector productivity | Year | Province/city | GDP of service sector (In RMB 100 million) | Service sector productivity |
|------|---------------|--|-----------------------------|------|---------------|--|-----------------------------|
| 2015 | Shanghai | 17274.62 | 20.19 | 2016 | Hubei | 14351.67 | 9.84 |
| 2016 | Shanghai | 19662.90 | 22.57 | 2015 | Hunan | 12796.87 | 8.98 |
| 2015 | Jiangsu | 34272.40 | 18.66 | 2016 | Hunan | 14631.83 | 10.30 |
| 2016 | Jiangsu | 38691.60 | 20.70 | 2015 | Chongqing | 7527.08 | 10.64 |
| 2015 | Zhejiang | 21341.91 | 14.86 | 2016 | Chongqing | 8538.43 | 11.46 |
| 2016 | Zhejiang | 24091.57 | 15.94 | 2015 | Sichuan | 13127.72 | 7.78 |
| 2015 | Anhui | 8602.11 | 5.02 | 2016 | Sichuan | 15556.29 | 8.99 |
| 2016 | Anhui | 9959.92 | 5.75 | 2015 | Yunnan | 6147.27 | 6.25 |
| 2015 | Jiangxi | 6559.63 | 6.69 | 2016 | Yunnan | 6875.50 | 6.78 |
| 2016 | Jiangxi | 7764.93 | 7.68 | 2015 | Guizhou | 4723.77 | 10.06 |
| 2015 | Hubei | 12819.76 | 9.03 | 2016 | Guizhou | 5261.01 | 10.39 |

Data source: China Statistical Yearbook, and Statistical Yearbooks of various provinces and cities



Data source: Statistical Yearbook of various provinces and cities

Fig. 3. Scales of employment by the tertiary industry and the secondary industry in the yangtze river economic belt and their difference.

III. THEORETICAL MODEL

Porter put forward the Theory of Industrial Competitiveness Advantage for the first time and established the Diamond Model, which provided a further theoretical framework and reference for evaluating industrial competitiveness by breaking through the Theory of Comparative Advantage [25]. After that, some researchers used the Diamond Model to study industrial competitiveness, and the others expanded the model. Rugman et al. expanded Michael Porter Diamond Model into the “Double-diamond Model” by integrating the actual situation in Canada [26]. Cho et al. built the “Nine-Factor Model” based on the real conditions of South Korea, and believed that this model can explain the formation of competitiveness in underdeveloped

and developing countries [27]; Moon et al. built a “Generalized Double-diamond Model” adapted to the economic development of small countries based on the “Double-diamond Model” [28]. Rui added a core factor, namely, the “ability in knowledge absorption and innovation” to Porter’s “Diamond Model” and built the “New Diamond Model” by incorporating the actual development situation of China [29]. Zhao expanded Michael Porter Diamond Model and built the “New Diamond Model” with innovation in science and technology at its core [30].

The competitiveness advantage of the service sector in the Yangtze River Economic Belt is still concentrated on the traditional field. To build a high-end industry with high value addition in the international division of labor and to maintain a

sustainable competitiveness, we must integrate independent innovation in open market competition. The Communist Party of China's 19th National Congress report makes it clear that "Innovation is the key driving factor for development." The report also suggests a number of new initiatives and targets, including to "increase the service sector's opening up scope and quicken the cultivation of new advantages in international economic cooperation and competition." At present, as the process of global economic integration continues to accelerate and competition in the international market becomes more and more extensive and fierce, China needs to further open up its market and encourages the service sector to "go global", which has become a part of China's national strategic deployment. This paper holds that the promotion of competitiveness in service sector is the key task under the "go global" strategy, as the improvement of competitiveness relies on the transfer of kinetic energy between old and new, while the key determinant of kinetic energy transformation lies in innovation. The analysis of competitiveness in service sector in Yangtze River Economic Belt by Michael Porter Diamond Model does not reflect the crucial role played by innovation and openness against the background of globalization and a knowledge-driven society. Based on this, this paper expands Michael Porter Diamond Model to build a "Dual-core Diamond Model" with "innovation" and "openness" as the core factors, in consideration of the current conditions and demands of service sector development in the Yangtze River Economic Belt (Fig. 4).

Innovation is the primary core factor. It includes

technological innovation, knowledge innovation and market innovation. Industrial innovation can facilitate product sales and product improvement, and enhance economic benefits. Therefore, the industrial innovation process is also the process of the formation and promotion of industrial competitiveness, which is the potential impetus behind the sustainable development of industrial competitiveness.

Openness is another core factor. If a country (region) opens up, its enterprises are confined to the domestic market. After opening up, this country's dominant enterprises can grow and prosper during their participation in international competition, while underdeveloped enterprises are winnowed out in the process which allows the surviving enterprises to enjoy more living space and achieve greater development. Therefore, only by encouraging the service sector to "go global" and taking part in the full-scale international division in full of labor can those enterprises get sustainable competitiveness in international competition.

Production factor is also the primary key factor. It refers to various inputs of resources needed for the development of service sector, including natural resources, knowledge resources, human resources and capital investment. Porter believes that the demands of rudimentary factors (climate, geographical location, unskilled labor, etc.) are on the decline, so is their influence on competitiveness; and that developing and putting in advanced factors (high-quality human resources, improved urbanization level) are essential for obtaining industrial competitiveness, as they have a dominant effect on the improvement of competitiveness.

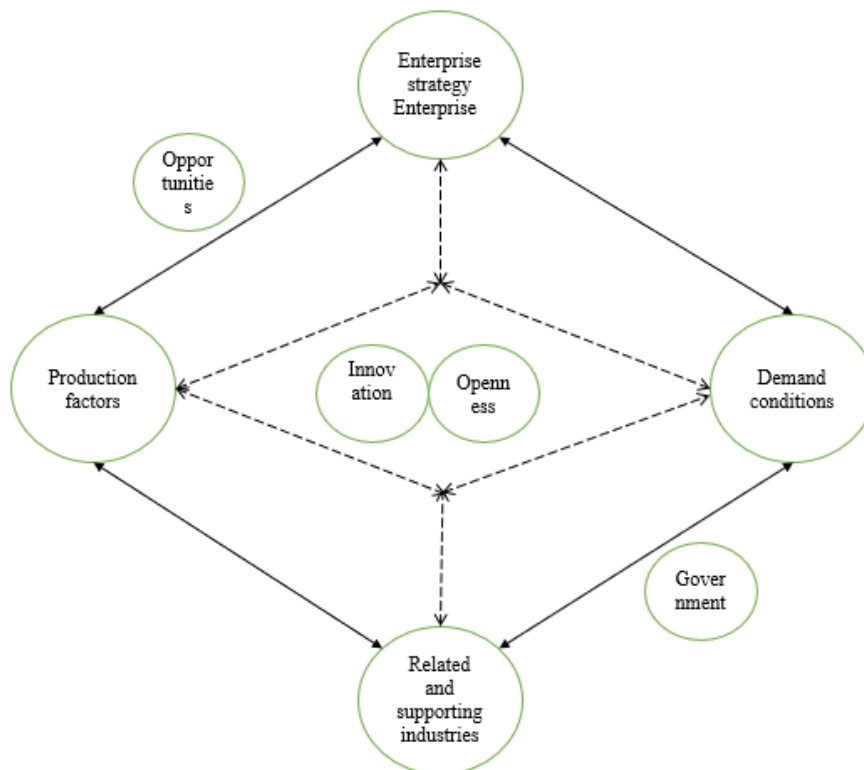


Fig. 4. Dual-core diamond model.

Demand condition is the fourth key factor. It refers to the demands for service products in a country's market. It is generally believed that the average income level of a country or the income level of the majority of its population reflects the representative demand of this country. Domestic enterprises are domestic market-oriented, so their investment, production and sales are mainly guided by domestic market demand. The size and nature of a country's market influence the scale and efficiency of production, will have a huge impact on promoting industrial development and stimulating industrial improvement and innovation, and are important factors determining whether enterprises can build up their international competitiveness.

Related and supporting industries are the also key factors, which refer to the upstream industries and complementary industries related to service sector. The competitive advantage of an industry does not stand alone, but are also correlated with related industries and they can complement each other to form stronger competitive advantages through cooperation and sharing resources; Supporting industries help downstream industries adapt to changes in market demand quickly and improve their competitive advantages. The stronger the related and supporting industries are, the more they can drive the development of the industry through inter-industry association assistance.

The quaternary key factors are enterprise strategy and enterprise structure. They refer to the choice and decisions by service enterprises in terms of objectives, management and organizational structures. In the fierce competition in the domestic market, an industry can enhance its local competitive advantage through forcing manufacturers to participate in competition in the international market, and finally enhance its international competitiveness. Therefore, if an industry is in line with the industrial competitiveness advantage of the country in terms of strategy and structure, the competitiveness of the industry will be developed accelerated and reinforced.

In addition to the above factors, there are two variables that have an impact on industrial competitiveness, namely, government and opportunity. The government directly influences the industrial competitiveness through policies, and opportunities create new possibilities for the promotion of industrial competitiveness by transforming the existing competitive environment and order. However, government and opportunity are not the decisive influencing factors of industrial competitiveness, and it is difficult to represent them with economic data, so this paper does not include them in the indicator system and quantitative economic model analysis.

IV. EMPIRICAL ANALYSIS

This part establishes the evaluation indicator system of competitiveness in the service sector of Yangtze River Economic Belt based on the "Dual-core Diamond Model", and applies PCA to measure and evaluate the competitiveness in the service sector of Yangtze River Economic Belt from a variety of perspectives, including innovation, openness, production variables, demand dynamics, associated and supporting industries, company strategy, and organizational structure.

A. Rely on the "Dual-Core Diamond Model" to Build the Evaluation Indicator System of Competitiveness in the Service Sector of Yangtze River Economic Belt

1) *Innovation*. The improvement in innovation ability facilitates the improvement in industrial productivity and competitiveness. Investment in R&D funds encourages enterprises to actively pursue scientific and technological innovation, management innovation, product innovation and market innovation, thus enhancing the development of emerging service industries. This paper makes reference to the method developed by Liu et al. (2019), where the number of patents obtained and R&D funds are adopted as indicators representing innovation ability [31]. The "number of valid inventive patents" for the current year is the number of patents obtained, and the R&D funds ratio is the ratio of R&D funds to GDP.

2) *Openness trade dependence reflects the degree of participation and dependence of a nation's economic development on the international market*. Many domestic scholars use trade dependence to measure a country's degree of openness to the global market. In this paper, export (import) dependence is selected to represent the degree of openness [32][33]. Formula: export (import) dependence = import (export) amount/GDP of a country (region).

3) *Production factors*. On the one hand, urbanization level reflects the development of infrastructures, including its transportation, information, and communication systems (region). The higher the urbanization level is, the stronger its support for the development of service sector will be. Urbanization not only facilitates the development of modern service sector, but also brings in high-end service sector and injects new impetus into urban economic development. On the other hand, the inputs of essential human resources of essence to enhancing industrial competitiveness. The service sector provides intangible products, and the service is provided by people engaged in the service sector. Therefore, the employment by the tertiary industry represents the development scale and potential of the service sector to a certain extent. In this paper, the urbanization level is selected by the method proposed by Zhuang [9], and the employment by the tertiary industry is taken into consideration to represent the production factors. Formula: urbanization level = urban population/total population.

4) *Demand conditions*. This paper draws from the practice of Mou [34], and selects per capita GDP to represent demand conditions; The per capita disposable income of urban and rural residents is chosen as the demand condition using the techniques proposed by Huang and Deng [35]. The former reflects the economic level of growth of a country (region), while the latter two reflect its purchasing power.

5) *Associated and auxiliary industries*. The secondary industry serves as the basis and starting point for the tertiary sector's growth. Without the former, there would be virtually no demand for the latter in society. The development of the tertiary sector itself determines whether it can grow into an

advantageous industry and participate in international competition. This paper selects the labor productivity of the secondary and tertiary sectors based on the practices of Zhuang [9], Lan and Dou to represent related industries and supporting industries [36]. Formula: The secondary (tertiary) industry's labor productivity is calculated by dividing the number of jobs it employs by the added value of its output.

6) *Enterprise strategy and structure*. Because of the profit-seeking nature of capital, foreign investors always choose enterprises with better development potential when

making capital investment decisions. Enterprises that attract foreign investment can not only introduce advanced hardware facilities and attract excellent human resources, but also enhance their technological level and management ability. This paper draws from the practices of Lan and Dou in selection of the overall amount of foreign direct investment to represent the enterprise strategy and structure [36].

The indicator system is established based on the factors selected above, as shown below in Table III:

TABLE III. THE EVALUATION INDICATOR SYSTEM OF COMPETITIVENESS IN THE SERVICE SECTOR OF YANGTZE RIVER ECONOMIC BELT DEVELOPED BASED ON THE "DUAL-CORE DIAMOND MODEL"

| Target level | Factor level | Indicator level |
|--|------------------------------------|---|
| The evaluation indicator system of competitiveness in the service sector of Yangtze River Economic Belt developed based on the "dual-core Diamond Model" | Innovation | X1: Invention patents |
| | | X2: Ratio of R&D funds to local GDP |
| | Openness | X3: Export dependence |
| | | X4: Import dependence |
| | Production factors | X5: Level of urbanization |
| | | X6: Employment by the tertiary industry |
| | Demand conditions | X7: Per capita GDP |
| | | X8: Per capita disposable income of permanent urban residents |
| | | X9: Per capita disposable income of permanent rural residents |
| | Related and supporting industries | X10: Productivity of secondary industry |
| | | X11: Productivity of tertiary industry |
| | Enterprise strategy and structure. | X12: Paid-up amount of foreign direct investment |

B. Data and Variables

1) *Selection and description of variables*: innovation: X1: invention patents (Nr.), X 2: ratio of R&D funds to local GDP (%); Openness: X3: export dependence, X4: import dependence; Production factors: X5: level of urbanization, X6: employment by tertiary industry; Demand conditions: X7: per capita GDP, X8: urban dwellers' per capita disposable income, X9: income available per person in remote areas; Related and supporting industries: X10: productivity of secondary industry, X11: productivity of tertiary industry; Enterprise strategy and structure: X12: paid-up amount of foreign direct investment.

2) *Data source*: In order to create two data sheets, this study chooses cross-sectional data from 11 provinces and cities in the Yangtze River Economic Belt in 2015 and 2016. Relevant indicator data come from *Statistical Yearbook* of 11 provinces and towns in Yangtze River Economic Belt and *China Statistical Yearbook*.

C. Setting of Measurement Model

This paper evaluates the competitiveness of service sector in Yangtze River Economic Belt through Principal Component Analysis. Principal Component Analysis (PCA) is a dimension-reducing statistical method that selects a small

number of key variables from multiple variables by linear variation. The majority of the information from the original variables may still be found in principal components, and there are far fewer principal components than there were original variables.

PCA is applied on the basic data of 2015 using SPSS software, with results shown in Table IV and Table V.

Through PCA, two principal component eigenvectors are extracted. It can be seen from Table IV that the first and second principal components contribute 71.49% and 14.132% of the variance, respectively. The first two primary components' combined contribution rate is 85.622%, which contains most information and can significantly explain most variations of the original data. Therefore, the first two components are selected as comprehensive indicators in replacement of the 12 original indicators to evaluate the competitiveness of service sector in 11 provinces and towns in the Yangtze River Economic Belt.

The coefficient of each indicator in the two principal components is obtained by comparing the data of each indicator corresponding to components 1 and 2 in the composition matrix in Table V against the open square root value of eigenvalue corresponding to principal components. The principal component is expressed as follows:

TABLE IV. EIGENVALUE AND CUMULATIVE CONTRIBUTION OF VARIANCE OF THE PRINCIPAL COMPONENTS OF THE COMPETITIVENESS IN SERVICE SECTOR OF YANGTZE RIVER ECONOMIC BELT IN 2015

| Component | Initial eigenvalue | | | Extracted quadratic sum | | |
|-----------|--------------------|---------------------|---------------------------|-------------------------|---------------------|---------------------------|
| | Total | Variance percentage | Cumulative percentage (%) | Total | Variance percentage | Cumulative percentage (%) |
| 1 | 8.579 | 71.490 | 71.490 | 8.579 | 71.490 | 71.490 |
| 2 | 1.696 | 14.132 | 85.622 | 1.696 | 14.132 | 85.622 |
| 3 | .715 | 5.955 | 91.577 | | | |
| 4 | .584 | 4.863 | 96.440 | | | |
| 5 | .164 | 1.363 | 97.803 | | | |
| 6 | .154 | 1.283 | 99.087 | | | |
| 7 | .052 | .430 | 99.517 | | | |
| 8 | .044 | .363 | 99.880 | | | |
| 9 | .012 | .099 | 99.979 | | | |
| 10 | .003 | .021 | 100.000 | | | |
| 11 | 2.324E-16 | 1.936E-15 | 100.000 | | | |
| 12 | -1.283E-16 | -1.069E-15 | 100.000 | | | |

TABLE V. COMPONENT MATRIX IN 2015

| Indicator | Component | |
|---|-----------|-------|
| | 1 | 2 |
| Invention patents (Nr.) | .911 | -.160 |
| Ratio of R&D funds to local GDP | .930 | .186 |
| Export dependence (%) | .927 | -.073 |
| Import dependence (%) | .863 | -.352 |
| Urbanization rate | .795 | .317 |
| Employment by the tertiary industry (unit: 10,000 people) | .153 | .907 |
| Per capita GDP (RMB) | .994 | -.009 |
| Per capita disposable income of permanent urban residents (RMB) | .951 | -.088 |
| Per capita disposable income of permanent rural residents (RMB) | .947 | .088 |
| Productivity of secondary industry | .516 | -.563 |
| Productivity of tertiary industry | .929 | -.159 |
| Paid-up amount of foreign direct investment (unit: 100 million dollars) | .842 | .476 |

$$F_1 = 0.3110ZX_1 + 0.3174ZX_2 + 0.3163ZX_3 + 0.2945ZX_4 + 0.2714ZX_5 + 0.0524ZX_6 + 0.3392ZX_7 + 0.3246ZX_8 + 0.3233ZX_9 + 0.1761ZX_{10} + 0.3172ZX_{11} + 0.2876ZX_{12} \quad (1)$$

$$F_2 = -0.1228ZX_1 + 0.1426ZX_2 - 0.0560ZX_3 - 0.2701ZX_4 + 0.2436ZX_5 + 0.6961ZX_6 - 0.0067ZX_7 - 0.0678ZX_8 + 0.0673ZX_9 - 0.4325ZX_{10} - 0.1222ZX_{11} + 0.3653ZX_{12} \quad (2)$$

$$F = \frac{71.490}{85.622} F_1 + \frac{14.132}{85.622} F_2 \quad (3)$$

Wherein $ZX_1 \dots ZX_{12}$ is the indicator value normalized by SPSS software. By applying this formula, the comprehensive scores of competitiveness in the service sector of 11 provinces and cities in the Yangtze River Economic Belt in 2015 are derived, as shown in Table VI. Table VI shows the gaps among 12 provinces and cities in terms of competitiveness of service sector.

Following the same measurement method, the comprehensive scores of competitiveness in service sector of 11 provinces and cities in the Yangtze River Economic Belt in 2016 are derived, as shown in Table VII.

TABLE VI. COMPREHENSIVE SCORES OF SERVICE SECTOR IN 11 PROVINCES AND CITIES IN 2015

| Ranking | Province/city | F1 | F2 | F |
|---------|---------------|---------|---------|---------|
| 1 | Shanghai | 5.2920 | -0.2472 | 5.0448 |
| 2 | Jiangsu | 2.9331 | 0.1074 | 3.0404 |
| 3 | Zhejiang | 2.2420 | 0.1704 | 2.4124 |
| 4 | Chongqing | -0.1936 | -0.0592 | -0.2528 |
| 5 | Hubei | -0.5581 | -0.0211 | -0.5792 |
| 6 | Hunan | -0.7899 | 0.0075 | -0.7825 |
| 7 | Anhui | -1.1951 | 0.2085 | -0.9866 |
| 8 | Sichuan | -1.3859 | 0.1160 | -1.2699 |
| 9 | Jiangxi | -1.5793 | 0.0624 | -1.5169 |
| 10 | Yunnan | -2.3608 | -0.1531 | -2.5139 |
| 11 | Guizhou | -2.4043 | -0.1916 | -2.5959 |

TABLE VII. COMPREHENSIVE SCORES OF SERVICE SECTOR IN 11 PROVINCES AND CITIES IN 2016

| Ranking | Province/city | F1 | F2 | F |
|---------|---------------|---------|---------|---------|
| 1 | Shanghai | 5.2638 | -0.3085 | 4.9553 |
| 2 | Jiangsu | 2.9421 | 0.2104 | 3.1525 |
| 3 | Zhejiang | 2.4159 | 0.1869 | 2.6028 |
| 4 | Chongqing | -0.1675 | -0.1392 | -0.3067 |
| 5 | Hubei | -0.5802 | 0.0185 | -0.5617 |
| 6 | Hunan | -0.7165 | 0.0455 | -0.6711 |
| 7 | Anhui | -1.1769 | 0.2709 | -0.9060 |
| 8 | Sichuan | -1.4794 | 0.1696 | -1.3098 |
| 9 | Jiangxi | -1.5421 | 0.0213 | -1.5208 |
| 10 | Yunnan | -2.5040 | -0.1900 | -2.6940 |
| 11 | Guizhou | -2.4554 | -0.2852 | -2.7405 |

D. Analysis of Model Results

As shown by comparing the 2015 and 2016 data, the scores and rankings of service sector's growth level among the 11 provinces and towns in the Yangtze River Economic Belt are relatively stable, indicating a healthy and robust development trend. While there are obvious gradients and gaps in the level of growth of service sector among those provinces and towns, they can be categorized into three classes. Class I include Shanghai, Jiangsu and Zhejiang, which are situated in the Yangtze River's lower reaches, Class II is composed of Chongqing, Hubei, Hunan, Anhui and Sichuan, and Class III consists of Jiangxi, Yunnan and Guizhou. It demonstrates the significant disparity between the upper, middle, and lower levels of the Yangtze River Economic Belt in terms of the development of the service sector.

It can be known from the basic data that the innovation indicator, namely, "the ratio of R&D funds to local GDP", of the regions in the lower reaches of the Yangtze River, which rank the top three, is obviously ahead of other regions. Chongqing, situated in the upper reaches of the Yangtze River and ranked above other regions in the middle and upper reaches of the Yangtze River, remains at the 4th place, because its indicators "export dependence" and "import dependence"

when compared to those other provinces and towns, are much greater. This is closely related to a series of measures implemented by Chongqing in recent years to speed up the development of inland highland for openness. Therefore, it is evident that "innovation" and "openness" are crucial factors to influence and determine the competitiveness of service sector.

V. RESEARCH CONCLUSIONS AND COUNTERMEASURES TO ENHANCE THE COMPETITIVENESS OF SERVICE SECTOR IN YANGTZE RIVER ECONOMIC BELT

A. Research Conclusions and Suggestions for further Researches in the Future

The study's findings demonstrate that there is still much room for improvement in the competitiveness of the service sector in the Yangtze River Economic Belt. The "Dual-core Diamond Model" developed and designed based on Michael Porter Diamond Model in this paper accords with the present situation and future development needs of the service sector in the Yangtze River Economic Belt. The feasibility and scientificity of the "Dual-core Diamond Model" are further verified by the evaluation indicator system of the competitiveness of the service sector in the Yangtze River Economic Belt built based on the "Dual-core Diamond

Model” and the quantitative model analysis on the 12 selected indicators. In addition, empirical analysis shows that “innovation” and “openness” have become the important factors that enhance the competitiveness of service sector in the Yangtze River Economic Belt. In this paper, the research on service sector is relatively macroscopic, Provincial level research and the research on segmented industry deserve a closer and deeper look while considering the failure to test the mechanisms by which innovation and openness affect the competitiveness of the service industry. In the future, modern service sector and high-end service sector will become the focus and key areas in the development of service sector in China, so the next step is to carry out researches on segmented modern service sector and high-end service sector to verify the mechanism transmission path of influencing factors, and focus on analyzing more responsible situations and seeking more effective ways to enhance the competitiveness of the service industry in the Yangtze River Economic Belt.

B. Countermeasures for Improving the Competitiveness of Service Sector in Yangtze River Economic Belt

Enhancing innovation ability. Continually improve the overall design and accelerate the formation of an innovative development model to serve the development of the service sector in the Yangtze River Economic Belt; continuously improving R&D and innovation capabilities, and developing outstanding products, technologies and services; further increasing R&D investment to raise the technological level; spearheading technological innovations with institutional innovations, integrating the resources of local governments, universities and research institutes, and establishing an innovation capability improvement system; attaching more importance to the significance of human resources in the middle and upper reaches of the Yangtze River, and allowing the expanding human resources to exert their potential strength and make use of late-mover advantages in the fierce international competition [37,38].

Further expanding trade in services industries. Firstly, we should introduce a scientific and reasonable competition mechanism, build an open and fair competition environment for businesses with laws and regulations, and boost service industry exports by expanding openness in service industry; Secondly, we should identify and determine the key areas of service sector, especially in the domains such as finance, medical care, education, culture, tourism and other fields. Meanwhile, we should orderly liberalize the fields of pension service, trade circulation and e-commerce, and actively promote the export of capital-intensive and technology-intensive services such as computer information services; Lastly, we should encourage the appropriate liberalization in service industry, mobilize and utilize more resources, reinforce the interconnection ties among various industries and accelerate the growth momentum under China’s significant and epoch-making “Belt and Road” Initiative. We should also strive to further realize market alignment and integration, and facilitate the process of East Asian integration by investing significant resources into the process of building a platform of multilateral cooperation for China-ASEAN in service industries, so as to incentivize more countries and regions to get involved into economic globalization. We

should make full use of both international and domestic markets to build a strong and dynamic industrial and market foundation for expanding service industry exports [39].

Encouraging the growth of interconnected industries and create a coordinated development amalgamation for the service sector. We should encourage the thorough and seamless integration of manufacturing and service industries and focus on accelerating the transformation and improvement of the logistics transportation industry in the traditional service sector and continue to tap into the enormous potential and resources of tourism and extend the industrial chains. We should also introduce corresponding preferential policies on financing and finance sector as well as industrial support policies in order to break the industrial dichotomy between manufacturing and service industries, and fully utilize cutting-edge technologies such as big data, AI, and the Internet of Things to encourage the thorough integration and coordinated expansion of manufacturing and service sectors as well as to encourage growth in the general competitiveness of the service industries.

Paying more efforts on talent cultivation and building a talent system in alignment with the development of service sector. We should carry out pilot talent training programs for service sector, introducing the relevant laws and regulations about trade services of various countries and cultivate the ability to proficiently use software and technology. We should also promote the cultivation of an entrepreneurial team proficient in international business, and accelerate the cultivation of a group of high-end talents specializing in financial insurance, cultural creativity, business consulting and other fields. We should strive for a balanced development of talents cultivation in various regions by focusing on the education and cultivation of the overall quality of non-urban population while improving the overall quality of urban population. We should promote the supply-side structural changes in the employment market for the service sector by maximizing the demographic dividends enjoyed by the Yangtze River Economic Belt, so as to conserve talents for the development of service sector and the promotion of competitiveness.

Improving the relevant legal system and innovate the service supervision and governance system in the service sector. Traditional supervision methods mainly rely on administrative power, which is difficult to adapt to the new economic modes in modern economy. Therefore, it is necessary to innovate supervision concept and enhance the flexibility and effectiveness of policies. In addition, we should make efforts to establish an early warning mechanism for service sector security; we should improve the judicial safeguard system, optimize the commercial dispute resolution system, and build a new co-governance mechanism based on integration of multi-dimensional supervision.

Focusing on coordinated and integrated inter-region development. We should highlight the radiating effect and the leading role of Shanghai, Jiangsu, Zhejiang and other regions, and actively solidify the strategic alliance of service sector among regions in the upper, middle and lower reaches of the Yangtze River Economic Belt. We should also encourage the

gradient transfer of service sector and development in industrial sector. We should transform the various resources and advantages under the opening-up policy over numerous regions and towns into the amelioration of the economy [40]. The “Belt and Road” Initiative, the plans for the development of the Yangtze River Economic Belt, and the New Western Land-sea Corridor have provided enormous potential and numerous opportunities for regions along the Yangtze River to discover a new form of opening up. Undoubtedly, inland areas may learn from the salubrious experience of economically leading areas and integrate it into their own development strategies in their efforts to reform their current system and they can definitely achieve the continuous upgrading and optimization of the development mode for opening up their industries and maximize their respective competitiveness in various fields.

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