

# Research on the Construction of the Evaluation Index System of the Vitality of Chengdu-Chongqing Economic Circle

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## Abstract

On January 3, 2020, the sixth meeting of the Central Committee of Finance and economics put forward the construction of " Chengdu-Chongqing Twin-city Economic Circle " to cultivate the growth pole of high-quality development in the western region. Therefore, the development strategy of Chengdu Chongqing region has risen to the national level. However, in recent years, there are many problems in the development of Chengdu Chongqing area, such as imbalance, which has hindered the process of regional integration. On the other hand, vitality is not only a comprehensive reflection of a region's development capacity, but also an endogenous driving force to promote development. Therefore, it is necessary to measure the vitality of Chengdu Chongqing region, find out the key factors to enhance the vitality, and provide reference suggestions for the construction of Chengdu Chongqing dual city economic circle. However, at present, there are few studies on the evaluation of regional vitality, and the measurement of the vitality of Chengdu Chongqing region is extremely scarce. Based on the regional characteristics and relevant literature research, this paper establishes an index system composed of 20 indicators including night light data, POI data points and per capita GDP, which can evaluate the vitality of 140 districts and counties covered by the twin city economic circle in Chengdu Chongqing region. Using vitality to evaluate the development of Chengdu Chongqing region can provide theoretical support for the evaluation of regional vitality level and the identification of key factors to enhance regional vitality, and provide reference for the development of twin city economic circle in Chengdu Chongqing region.

## Keywords

Chengdu-Chongqing Twin-city Economic Circle; Vitality; Evaluation Index System.

## 1. The Connotation of Quantitative Analysis of Vitality

On January 3, 2020, the sixth meeting of the central financial and Economic Commission proposed to promote the construction of the two cities economic circle in Chengdu and Chongqing. It pointed out that the construction of the economic circle in Chengdu and Chongqing regions should be promoted, the role of the central city should be emphasized, the road of mutual promotion and cooperation should be taken, and the "double city records" should be implemented and performed together, so that Chengdu and Chongqing region become an important growth pole for the high-quality development of the West and become the national high-quality development pole Important regional economic and scientific and technological innovation centers, reform and opening up new Highlands, promote the better development of western regions. At the same time, as early as 2011 and 2016, the national development and Reform Commission has twice planned Chengdu Chongqing region, and with the support of the western development, the development of Chengdu Chongqing region has made great progress. However, due to the increasing uncertainty of the international situation, the domestic economy is facing great risks, and the strategic position of Chengdu Chongqing is

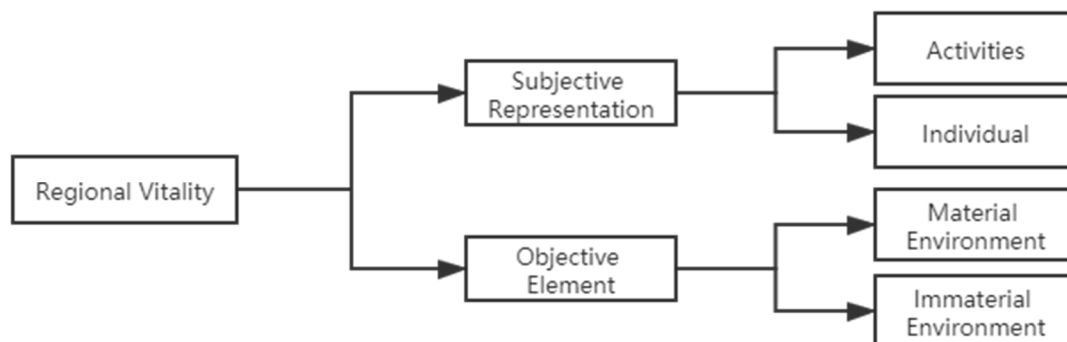
prominent. At the time of the third decade of the opening up of the west, the most potential Chengdu Chongqing region will be the focus of the new round of western development.

Due to the competition relationship between Chengdu and Chongqing over the years, there is no industrial division and complementary relationship between the two regions. The pillar industries are highly homogeneous and there is no real urban agglomeration. There is no substantial progress in the coordination and cooperation of urban policies, strategic docking of spatial development and unified market construction. Secondly, the radiation capacity of Chengdu and Chongqing in regional economy needs to be strengthened and the leading role of core cities can be played well. On the other hand, there are no secondary hub cities in the middle of Chengdu and Chongqing, which leads to the low degree of network integration of urban agglomeration and poor regional development balance. In 2017, the GDP of Chengdu Chongqing was about 5.09 trillion, which still has a very obvious gap with the three developed economic regions in China in terms of quantity. Therefore, how to build the double city economic circle of Chengdu Chongqing region, reduce the gap between the developed areas, and how to deal with the development of the polar core cities and promote the development of other cities in the region are the major issues that must be solved in the process of constructing the economic circle of Chengdu Chongqing double cities.

Since the reform and opening up, China has made great achievements in various fields of national development. How to keep the vitality of economic and social development in the new era has become an era topic. The paper summarizes the laws of economic and social development in China and the general views of academia. It is an important means to keep sustainable development and stimulate the vitality of the city to realize cooperative development in the new situation by fully stimulating the scale effect of big cities, enhancing the external radiation ability of core cities and playing a leading role. Therefore, the deep-seated research on the regional vitality enhancement has been widely concerned. Whether a region has vitality means whether it can have more attraction, thus bringing together funds, talents and technology, and taking advantage of competition with other regions. From this point of view, vitality is the vitality of regional development and the great endogenous power to promote regional development. However, there is little basic research on vitality at home and abroad. The concept of vitality has not been recognized by academic circles. Vitality is an abstract concept. Although it is obvious to have vitality, it is not easy to measure the vitality of a region quantitatively. The quantification of vitality should consider three aspects: the dimension of vitality, the index system of vitality evaluation and the method of vitality measurement. In terms of the current relevant literature, many scholars put the evaluation of vitality on the medium and micro level, namely, starting from the urban space vitality and the vitality of the urban detail public space, such as Jiang Lei (2013) takes the urban street as the research entry point, and pays attention to the micro elements and environmental characteristics of vitality [1]. However, the research on regional vitality at macro level is very scarce, and more theoretical support is needed for this research direction. In addition, there are many deficiencies in the relevant research on the evaluation index system. Most of the researches default to the basic hypothesis based on statistics, namely, independent hypothesis of variables. The implicit relationship between variables and the error level of variables themselves are not taken into account. However, there are many obvious inadaptability in the traditional methods for the quantification of vitality. It is necessary to study the quantification of vitality from the above three aspects.

Therefore, this paper, through the relevant literature and theory, to Chengdu Chongqing double City Economic Circle vitality measurement. Among them, the regional vitality can comprehensively reflect the level of economic and social system development in a region. Through the study, it can provide theoretical support for the evaluation of regional vitality level

and the identification of key factors for regional vitality improvement, and provide reference for the development of the double city economic circle in Chengdu and Chongqing.



**Fig 1.** Research dimensions

## 2. Methods and Principles for the Establishment of Vitality Evaluation System

### 2.1. Composite Index Method

At present, there are two mature methods used by domestic and foreign scholars in the establishment of vitality evaluation system: main index method and compound index method. The main index method uses big data such as POI (Point of Interest), LBS (Location Based Service) and night light data as the main index to reflect the vitality intensity. The composite index analyzes vitality by selecting multiple indicators including social, economic, environmental and so on. Vitality is a more abstract and diverse concept, which is impossible to measure directly. In this study, the classical theory in the research field of urban vitality is used for reference, and the composite index method is adopted to decompose the vitality into various indicators that have an impact on it and are easy to be directly measured. Therefore, a reasonable selection of impact factors plays a positive role in achieving the purpose of research.

### 2.2. Selection Principle

In order to comprehensively and accurately measure the regional vitality intensity, the index selection follows the following principles:

(1) Scientific principle. Scientific nature is the core of research; therefore, the selection of indicators should conform to the scientific principle. Here the scientific principle mainly contains two aspects of meaning: one is the selection of indicators need scientific theoretical support, with clear connotation and accurate definition. Second, the influence of scientific analysis index on the research object should be able to measure and reflect the quantitative or qualitative characteristics of regional vitality.

(2) The principle of comprehensiveness and dominance. Because the active intensity is an abstract concept which is affected by many factors, it is impossible to measure the active intensity accurately by using a single factor. However, it is meaningless to list the influencing factors one by one, whether in theoretical research or practical application. Therefore, it is necessary to choose the leading indicators that can comprehensively reflect the characteristics of the research objects.

(3) Operability principle. The research on regional vitality measurement model and its application mainly includes two aspects: the construction of the measurement model and the practical application. For these two processes, the principle of operability of indicators is reflected in the following aspects: first, the model fitting process, the sample data comes from statistical data, so the indicators are required to have data availability; Second, in the actual

application in the measurement of regional vitality, the selected index as an independent variable has an impact on the vitality, so the index needs to have the characteristics of data description.

(4) the principle of compound dimension. This principle is also the foothold of model construction. From the actual point of view, Chengdu-Chongqing economic circle is a collection composed of various county economies with different area and size. Therefore, composite dimensional indicators can be used to overcome the effects of these differences, such as per capita, average annual growth rates, etc.

### 3. Establishment of Index System

Based on the quantitative analysis of vitality intensity, based on the full investigation of previous research results of scholars, this paper extracts the indicators of vitality intensity that are highly relevant to this study, as shown in Table 1 below:

By analyzing the indicators in Table 1, it can be found that these indicators are mainly focused on social, economic and environmental aspects, which indicates that scholars mainly start from the impact of economic and social development and spatial environment on vitality measurement at present, which is also in line with scholars' research theory on vitality quantification. Therefore, based on the existing mature theories, this paper constructs the influencing variables of vitality from the four aspects of economy, society, environment and culture, and constructs the index system from the subjective representation and objective elements of vitality quantification according to the above index selection principles and regional characteristics.

#### 3.1. Subjective Representation of Vitality

The subjective representation of vitality mainly starts from the subject of human and its vitalities. Lynch insists that a dynamic environment can continuously provide life opportunities, environmental needs and support people's development[5]. At the same time, from the perspective of behavior, some studies analyze the impact on vitality building by investigating people's gathering and staying time in a specific space. Therefore, from the perspective of human beings, this study chose the density of permanent residents at the end of the year as the representation.

(1) The density of resident population at the end of the year reflects the aggregation degree of regional population. The aggregation of population will inevitably affect the vitality, especially the vitality of regional economic circle. According to Feng LAN[6] et al. (2019), moderate population aggregation has a positive impact on vitality through scale effect, while excessive population aggregation may have a negative impact on vitality through crowding. Therefore, it is scientific and practical to use the density of permanent residents at the end of the year as an indicator of quantitative vitality.

The gathering of people is bound to produce a variety of vitalities. Yang · Gail[7] studies include three types of vitalities: first, necessary vitalities, which are necessary for human survival and development; second, spontaneous vitalities, which occur independently according to people's psychological preferences and external environment; third, social vitalities, which naturally trigger various social vitalities in the same area. If there are the first two kinds of vitalities and the gathering of people, social vitalities will have the objective conditions. Based on the comprehensive consideration of regional characteristics and the principle of index selection, this paper takes the results of these vitalities as the measurement index. As follows:

**Table 1.** Indicators and research methods of main research results of vitality intensity quantification

Study authors	Quantitative index of vitality	Research method
Jacobs	Multi-function, short streets, different levels of residential needs, sufficiently dense population and buildings, accessibility of parks and transport stations, and boundary vacuum	Empirical analysis
LAN et al	Per capita GDP, number of mobile phone users, number of students in school, per capita park green area, proportion of tertiary industry, year-end resident population, unemployment rate	Entropy method
Wang Yuzhuo	Plot ratio, rail transit convenience, green space coverage, shape compactness, road accessibility, district centrality, land diversity, space hydrophilicity, building density	Spatial clustering, kernel density
Wang Hai et al	People flow, vitality content diversity, cultural atmosphere, space commercial vitality income, land price, green coverage rate, open space rate, ground pavement rate, traffic perfection	Analytic hierarchy process, expert scoring method
Mao Weisheng et al	Per capita GDP, per capita total wages, infrastructure level, per capita fiscal expenditure, per capita total retail sales of social consumer goods, population density, proportion of tertiary industry	Entropy method, GWR Model
Jiang Lei	The street vitality is studied from the micro perspective, including: number of people, location (distance from the city center), number of infrastructure facilities such as schools, road density, greening rate	Questionnaire survey, factor analysis
Lynch	Vitality, feeling, fitness, accessibility and control	Empirical analysis
Long Ying et al	Traffic accessibility, population density, land use classification, greening rate, location, function density, road intersection density	Multiple linear regression
Su Jingxiang	The number of people per square kilometer, the number of road intersections and land use types, and the number of POIs of shopping, financial and communication service stores	Mchagen comprehensive evaluation method
Sung et al	The objective indicators of building environment variables include: land use combination, density, block size, building age, accessibility and boundary vacuum to verify Jacobs' theory	Spatial TOPSIS
Wu et al	Residential non residential land area balance index, intersection density, block area, standard deviation of building age, population density, the nearest distance to the nearest water source, park, etc.	Regression analysis
Zeng et al	Population density, number of food service places, road density, distance between schools, hospitals, shops, building density, banks, diversity of urban land use	TOPSIS, entropy method
Zhang Ying	Function density, accessibility, rich building age, greening rate, development intensity of construction land, road network density, intersection density, hydrophilicity, culture and location	GIS spatial analysis
Zhang Mengqi	Per capita GDP, unemployment rate, number of people engaged in natural science and technology, GDP growth rate, per capita electricity consumption, proportion of tertiary industry, greening rate	POI data, spatial analysis
Lv Mingyang	GDP per capita, fixed investment proportion, per capita resident savings, per capita financial budget expenditure, per million scientific and technological personnel, employment rate, per capita water consumption, greening rate	Principal component analysis

(2) GDP per capita. The per capita GDP can best reflect the overall situation of a region. Assuming that the total population of a region changes little, the higher the regional GDP means

the better the economic development, which means that the region has a strong attraction and concentration for the elements of economic development.

(3) The per capita disposable income of residents reflects the economic strength from the income. The most direct indicator of economic level reflecting the results of the above-mentioned necessary vitalities is income, which plays an incentive role for people to engage in these necessary vitalities. The higher the income, the higher the enthusiasm of people to engage in such vitalities. Conversely, the exuberant enthusiasm will increase income, promote consumption, and then improve the overall vitality of the region.

(4) The proportion of the tertiary industry. The higher the proportion of the tertiary industry is, the more developed the service industry and transportation industry are, and the stronger the ability of attracting people to gather and lead people to consume, the more dynamic the region will be.

(5) Total retail sales of consumer goods per capita. Consumption is considered to be the "troika" that drives GDP. To a certain extent, the total amount of social consumer goods per capita indicates people's demand for commodity consumption. The more exuberant the demand is, the stronger the support for life function and human ability will be, and theoretically, the higher the vitality will be.

(6) Per capita investment in social fixed assets reflects the vitality of the market. Social fixed asset investment includes infrastructure construction, real estate investment and other forms. Social fixed asset investment is conducive to enhancing economic strength and promoting regional development.

(7) The number of theaters can objectively promote people to engage in spontaneous vitalities. It includes the number of cinemas, concert halls and theaters to reflect the degree of leisure services enjoyed by people. From the perspective of spontaneous vitalities, only by providing these leisure service places can people engage in spontaneous vitalities, form a crowd gathering, and enhance the regional vitality.

(8) Number of construction enterprises. The construction industry can not only attract the employment of workers, but also show the vitality of regional construction. Therefore, the more construction enterprises, to a certain extent, the more vigorous the regional development.

(9) Employment rate. The higher the employment rate is, the higher the utilization rate of means of production will be, and the higher the dynamic benefits will be.

Cultural vitality is also an important part of vitality. Cultural vitality can be understood from many angles, such as the protection of historical buildings, the continuation of traditional customs, the level of science and technology, the number of highly educated talents, and so on. However, combined with the regional characteristics of this study and the selection principles of indicators, the following five indicators are selected from the perspectives of cultural industry practitioners, the proportion of education and the cultural resources they enjoy, That is, (10) - (14) as a measure:

(10) The number of primary and secondary schools;

(11) The number of middle school students per 10000 people;

(12) The number of books in public libraries per capita;

(13) The number of middle school teachers;

(14) Cultural services. It is composed of schools at all levels, media organizations and literary and artistic groups. The organizations that provide cultural resources can greatly improve the level of regional cultural vitality.

(15) Local public expenditure per capita reflects the exuberant degree of social demand. The higher the fiscal expenditure, the higher the level of social construction in a region, and the stronger the demand for basic public services.

### 3.2. Objectivity Elements of Vitality

The objective elements of vitality emphasize more on the space environment, which includes not only the objective material environment, but also the non-physical environment including social economy. Li Hao (2008) emphasized in his research that human and environment are a whole, human behavior and objective environment are a complete system of interaction, and objective environment promotes human subjective vitalities, so environmental space has a profound impact on human behavior [9]. Only the gathering of people, there is no objective environment as the carrier of people and their vitalities, which is the main body of creating vitality, and the vitality will not produce and last. A good external macro environment can attract the gathering of vitality elements and promote the improvement of vitality. Therefore, under the guidance of summarizing the previous research results and the principle of data availability, this paper selects the following factors as the indicators to describe the dynamic objectivity elements.

(16) Night light data. Feng LAN[6] (2019) and others established a city vitality measurement model based on the night light data of NPP visible infrared imager radiometer (viirs), and found that there was a high positive correlation between the city vitality and the night light data of npp-viirs.

(17) POI data points. POI data points are used to reflect the diversity of people's vitalities. Zhang Mengqi [8] (2018) used POI data points to analyze different types of POI data and urban functional diversity, and then conducted quantitative research on urban vitality.

**Table 2.** Vitality strength quantitative index system

Index	Indicator meaning	Code
Year-end resident population density	Crowd aggregation	X1
Urbanization rate of permanent population	Reflecting urban construction	X2
Proportion of tertiary industry	Characterizing the quality of economic structure	X3
Per capita GDP	Regional economic development	X4
Per capita local public expenditure	Measure social construction index	X5
Total retail sales of consumer goods per capita	Reflect consumption power	X6
The number of students in ordinary middle school of every 10000	Reflect cultural vitality	X7
Road network density	Accessibility of transportation	X8
Per capita disposable income of residents	Social and economic strength	X9
Per capita public library collection	Embody cultural vitality	X10
Night light data	Comprehensively reflect regional vitality	X11
POI data points	Reflect the diversity of vitalities	X12
Cultural services related	Reflection of cultural communication	X13
Transportation facilities	Convenience of travel environment	X14
Green coverage	Reflect the objective physical environment	X15
Number of primary and secondary schools	Cultural facilities	X16
Rate of employment	Reflect the quality of macro economy	X17
Per capita investment in social fixed assets	Vitality of market economy	X18
Cinema related	Spontaneous vitality carrier	X19
GDP per land	Reflect the economic environment	X20
Number of middle school teachers	Reflecting the development of cultural undertakings	X21
Number of construction enterprises	Regional economic vitality	X22

(18) The urbanization rate of permanent residents is an indicator of urbanization degree. City is a collection of regional economic and social development, and a place where various elements including people are highly concentrated and distributed. Therefore, the higher the urbanization rate means that more people will flow into the regional built-up areas, bringing growth potential to the vitality.

(19) Road network density can represent accessibility. In a region, people and various elements need to constantly communicate and flow, so a developed route network is needed to carry out these mobile vitalities. To a certain extent, the more perfect the road network, the stronger the accessibility.

(20) The average GDP reflects the economic environment. GDP per land is used to reflect GDP. Its practical significance is to reflect the GDP per unit area and objectively explain the average level of the regional economic environment.

(21) transportation facilities, reflecting the convenience of travel. The more abundant the transportation facilities are, the better the regional transportation environment is, the closer the communication with other regions is, and the higher the vitality is, including the sum of the facilities related to bus stations, long-distance bus stations and railway stations.

(22) green coverage. Good environment can attract people to engage in some entertainment and leisure vitalities spontaneously, that is to say, to produce so-called spontaneous vitalities. To sum up, the index system established in this paper is shown in Table 2.

## 4. Conclusion

Regional vitality is a highly complex system which is composed of multi factors and multi-level interwoven. The following three problems should be considered in the quantification of regional vitality: one is the level of quantification, the other is the dimension of quantification, the other is the choice of quantitative method. The vitality can comprehensively reflect the level of economic and social system development in a region. Based on the actual development and extensive literature research of Chengdu Chongqing area, this paper establishes a set of 20 including night lighting data, POI data points and per capita GDP from four aspects of economy, society, environment and culture and subjective representation and objective elements of vitality quantification. The index has the regional characteristic vitality influence factor system, this system can explore the regional development balance from the perspective of the vitality of the Chengdu Chongqing economic circle, so as to evaluate the development of Chengdu Chongqing region, can provide theoretical support for the identification of the key factors of the regional vitality level and the regional vitality promotion, and provide theoretical support for the development of the economic circle in Chengdu and Chongqing. The exhibition provides reference.

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