# A Comparative Study on the Selection and Cultivation of Pillar Industries in Chengdu–Chongqing Region of China

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**Abstract:** Pillar industries are the growth points of the regional economy and support the development of the regional economy. At present, China is in the middle and late stage of industrialization. The economic growth mode is shifting to high-quality development. Industrial transformation and upgrading and structural adjustment are the current priorities. Therefore, reasonable selections of pillar industries are of great significance for sustainable economic development. This paper uses the input-output method to analyze the industrial relevance indexes of forty-two industrial sectors in Chengdu–Chongqing Region, compares the selection and cultivation of pillar industries in the two places, and concludes that the convergence of pillar industries in Chengdu–Chongqing Region is not conducive to the inter-city cooperation. And the two places need to expand the third industry and strategic emerging industries, and continuously optimize the industrial sectors that have comparative advantages in resource endowments, match the geographical environment, its carrying capacity, and the human environment, and fit the development direction of the region and city positioning as the pillar industries.

# 1. Introduction

During "13th Five-Year Plan" period of China, the new round of regional development pattern will be reshaped and updated with the new layout of the country's major strategies, and the role of regional core cities in larger fields and wider ranges will become more obvious. As central cities in the western region and national level, Chengdu and Chongqing are located at the intersection of the "Belt and Road" and the "Yangtze River Economic Belt" development strategy, with geographical advantages and strong economic strength. In March 2016, the Executive Meeting of the State Council passed the "Chengdu–Chongqing Region (CCR) Agglomeration Development Plan". This measure is conducive to exploring new urbanization construction, which is beneficial to the promotion of the western development and the interaction with major strategies. At this point, the relationship of Chengdu and Chongqing have great similarities in historical culture, geographical environment and so on, resulting in a high concentration of pillar industries. The formation of competitive pressure is not conducive to division of labor and cooperation and sustainable development.

At present, reasonable industrial structures can create more market opportunities. As the core content of the industrial structure, pillar industries are themselves regional economic growth points and support economic development. Therefore, it is very important to make a reasonable selection of pillar industries in this context.

Based on the calculation of the influence coefficient and induction coefficient of each industry, this paper selects the pillar industries in Chengdu and Chongqing through the input-output method, and evaluates them by analyzing development status and industrial structure formed. Combining the comparison of the cultivation ways of the pillar industries in the two places, the general rules of the

selection of pillar industries in the two places is drawn, and suggestions on how to select pillar industries reasonably are proposed to promote the sustainable, coordinated and high-quality development of the regional economy.

## 2. Theoretical basis and literature review

The pillar industries and the leading industries have a deep theoretical connection, and both have similarities in definitions and characteristics. At a certain stage, the leading industries can be upgraded to become regional pillar industries. In other words, pillar industries are developed from leading industries to a certain extent. From the perspective of domestic and foreign research, the leading industries theory and their selection criteria can also be partially applied to pillar industries.

# 2.1 Pillar industries theory

The development of the modern economy firstly lies in the development of regional leading industries. The core of regional industrial construction is to select leading industries reasonably, and determine their scale or speed according to the scientific selection module<sup>[1]</sup>. In the 1950s, Hirschman proposed the term "leading industry". Rostow elaborated on it and proposed three concepts that are leading growth sector, auxiliary growth sector and derivative growth sector<sup>[2]</sup>. He believed that leading industries were able to rely on scientific, technological progress or innovation. And leading industries accessed to new production function, through faster than action "disproportionate growth" in the other products to effectively promote the development of other related industries. Xue believed that the pillar industries referred to the industries that adapted common or applicable technologies in the current period to adapt to the needs of the society and the market, and became the country or region's main source of financial accumulation. This type of industry strengthened of leading industries and the development of emerging industries<sup>[3]</sup>. Wang defined pillar industries as industries that accounted for the largest proportion of gross domestic product (GDP), strong correlation and stable and extensive resource and product market<sup>[4]</sup>. Su defined pillar industries as industries or industry groups that occupied important positions in the national economic system and had large scale of industries, playing supporting roles<sup>[5]</sup>. Dai and Shen considered the contribution of pillar industries to the national economy and believed that pillar industries were the main body of a country's industrial system during a certain period of time<sup>[6]</sup>. Xiong and Wu combined the viewpoints of many scholars and defined pillar industries as industries that can support regional economic growth, promote social progress, and be beneficial to environmental protection at a certain stage of economic development with fast development speed and relatively large industrial connection<sup>[7]</sup>.

# 2.2 Pillar industries selection

The first is the benchmark theory on the selection of pillar industries. At present, the Hirschmann benchmark and the "two benchmarks" proposed by Shinohara Sandaihei in 1957 were widely used. Hirschman benchmark was also known as correlation effect benchmark, which required the key selection of industries to be supported based on the degree of mutual relation and dependence among industries. Such relation between industries was called industrial correlation degree<sup>[8]</sup>. However, Hirschman did not point out a method to measure the degree of industrial relevance. Therefore, on this basis, domestic scholars have proposed new and suitable selection criteria for China based on the actual situation of the country. Zhou proposed the growth stamina benchmark, the shortage replacement elastic benchmark and the "bottleneck effect" benchmark. These standards were conducived to alleviating the existing structural contradictions and promoting industrial development<sup>[9]</sup>. However, some scholars questioned this. Meng summarized a theory that confuses industry selection and industry support. Based on this, Meng put forward the judgment of leading industry<sup>[10]</sup>. Some scholars believed that the selection of pillar industries should consider their characteristics. Specifically, Xiong and Wu believed that in addition to the existing leading industry selection criteria, the selection of regional pillar industries should also consider "technical innovation benchmarks", "International Competition Benchmark" and "Sustainable Development Benchmark"<sup>[11]</sup>. In addition, there are many selection criteria that have not yet reached consensus in the academic circle, so these won't be repeated too much.

The second is the quantitative method research on the selection of pillar industries. There is currently a high concentration of pillar industries among cities in China, which leads to the convergence of regional industries and lack of competitive advantages, which is not conducive to sustainable development. Moreover, whether the industry contributes to economic growth playing a leading and supporting role is not a simple judgment of the output value. Therefore, it is more practical to judge and select pillar industries through quantitative analysis. Judging from a large amount of literature resources, the current research methods used by domestic and foreign scholars include input-output method, factor analysis method, relative comparative advantage index method, principal component analysis method, analytic hierarchy process and its derivative order of magnitude analysis method, grey cluster analysis method, etc. However, in addition to the input-output method, the other methods have different degrees of subjectivity and difficulty in calculation, which could lead to the low credibility of the pillar industries selected. Therefore, the input-output method could be regarded as more universal selection<sup>[12-14]</sup>.

# 3. Methodology

## 3.1 Theoretical basis of input and output method

Under the guidance of certain economic theories, the input and output method is to compile the input and output table, establish the corresponding input-output model, and study the interdependence between the various parts of the economic system in terms of input and output. The input and output method integrates economics, statistics and mathematics, and is a quantitative analysis method for complex phenomena.

## 3.1.1 Introduction of input and output method

Simply put, the input-output method is to compile a chessboard-style input-output table based on the number of product transactions between various sectors of the national economy. Each horizontal row in the table reflects the distribution of a certain department's products among other departments, and each column reflects the product input of a certain department from other departments in the production process. Calculating the input coefficient according to the input-output table, that is, the number of products input by other departments per unit output of each department, and compile the input coefficient table. These coefficients can be used to establish a system of linear equations, calculate the impact of the change of final demand on the production of various departments through the inverse principle of matrix algebra, or conduct other analysis and research.

Therefore, input-output tables and input-output models are the basic tools of industry association analysis, including two types of physical and value types. The most widely used tools are value type analysis tools.

	Output		Intermediate use						Total
Input			1 2		j	n		use	output
	1	x <sub>11</sub>	x <sub>12</sub>		x <sub>1j</sub>		x <sub>1n</sub>	y <sub>1</sub>	X <sub>1</sub>
Intermediate	2	x <sub>21</sub>	x <sub>22</sub>		x <sub>2i</sub>		x <sub>2n</sub>	y <sub>2</sub>	X <sub>2</sub>
input	:	:	÷			÷		E	:
	i	x <sub>i1</sub>	x <sub>i2</sub>		x <sub>ij</sub>		x <sub>in</sub>	y <sub>i</sub>	X <sub>i</sub>
	÷	:	:				:	ŧ	:
	n	x <sub>n1</sub>	x <sub>n2</sub>		x <sub>nj</sub>		x <sub>nn</sub>	y <sub>n</sub>	X <sub>n</sub>
Added val	ue	G <sub>1</sub>	G <sub>2</sub>		$G_j$		G <sub>n</sub>		

Table 1 Simplified value input-output table

#### Value unit

Total investment	X <sub>1</sub>	X <sub>2</sub>		X <sub>i</sub>		X <sub>n</sub>		
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The economic meaning of each element in Table 1 is,

x\_ij represents the value of the number of products in the i-th sector consumed in the production of the j-th industrial sector;

X\_i represents the total annual product value of the i-th industry sector;

y\_i represents the value of the final product provided by the i-th industry sector;

G\_j represents the total value added created by the j-th sector.

#### **3.1.2** Index meaning of input-output method

Generally speaking, any changes in the production process of an industry will affect other industries through the relationship between industries. The influence of other industries on an industry is usually called sensitivity, and vice versa, influence. The sensitivity and influence of the industry are expressed by the induction coefficient and the influence coefficient respectively.

1. Sensitivity coefficient

$$S_{i} = \frac{\frac{1}{n} \sum_{j=1}^{n} A_{ij}}{\frac{1}{n^{2}} \sum_{i=1}^{n} \sum_{j=1}^{n} A_{ij}} (I, j=1, 2, 3, ..., n)$$
(1)

Where:  $S_i$ —the sensitivity coefficient of the i-th industrial sector affected by other industrial sectors.

A<sub>ii</sub>——the coefficient of the i-th row and the j-th column in $(I - A)^{-1}$ .

An industry with a sensitivity coefficient greater than 1 indicates that its sensitivity is above the average level in all industries and has a greater role in promoting economic development.

2. Influence coefficient.

$$T_{j} = \frac{\frac{1}{n} \sum_{i=1}^{n} A_{ij}}{\frac{1}{n^{2}} \sum_{i=1}^{n} \sum_{j=1}^{n} A_{ij}} (\mathbf{I}, \mathbf{j} = 1, 2, 3, ..., n)$$
(2)

An industry with an influence coefficient greater than 1 indicates that its influence is above the average level of all industries and has an important leading role in economic development.

#### **3.2** Pillar industries selection

Since the input-output table is compiled every five years, the basic input-output table is usually compiled every 2 and 7, and the extension table is compiled every 0 and 5. In addition to discussing the existing pillar industries selections in Chengdu and Chongqing, this paper also summarizes the general evolution of the pillar industries in the two places. However, the compilation of input-output tables has a time lag. Therefore, the input-output tables of 42 departments in Sichuan Province and Chongqing in 2002, 2007, 2012 and 2015 are selected for analysis, and the "double high" part whose sensitivity coefficient and influence coefficient are greater than 1 are selected as pillar industries of the region. Due to the limitation of basic data, Chengdu has not compiled an input-output table. The total economic volume of Chengdu accounts for about one-third of Sichuan Province. To a certain extent, the selection of pillar industries in Sichuan has guiding significance for Chengdu, so Sichuan Province's input-output table replaces data analysis. In addition, since the Sichuan input-output table cannot be downloaded, and the 2015 data has not yet been released, this paper only uses the data of 2002, 2007, and 2012.

## **3.2.1** Pillar industries selection in Chengdu

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Department	Code	Induction coefficient	Influence coefficient
Papermaking, printing, cultural and educational supplies manufacturing	10	1.3714	1.1053
Petroleum, coking products and nuclear fuel processed products	11	1.0718	1.1342

Chemical industry	12	2.4170	1.1168
Metal smelting and rolling processing industry	14	1.9518	1.1418

Data source: Based on Han Bin's "Industrial Relevance Research in Chengdu-Chongqing Economic Zone Based on Interregional Input-Output Analysis".

Department	Code	Induction coefficient	Influence coefficient
Oil and gas extraction products	3	1.0964	1.0509
Papermaking, printing ,cultural, educational and sporting goods	10	1.1345	1.0903
Petroleum, coking products and nuclear fuel processed products	11	1.3577	1.2054
chemical industry	12	2.4576	1.2038
Metal smelting and rolled products	14	2.7319	1.1930
General and special equipment manufacturing industry	16	1.2317	1.2141
Transportation equipment manufacturing	17	1.0012	1.2753
Communication equipment, computer and other electronic equipment manufacturing	19	1.1011	1.1523

Table 3 Pillar industries in Chengdu in 2007

Data source: According to the analysis and collation of "Sichuan Input-Output Table in 2007".

Fable 4 Pillar industries of	Chengdu in 2012
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Department	Code	Induction coefficient	Influence coefficient
Coal mining products	02	1.5460	1.0380
Papermaking, printing, cultural, educational and sporting goods	10	1.1626	1.0680
Petroleum, coking products and nuclear fuel processed products	11	1.2276	1.1061
Chemical product	12	3.3590	1.0709
Metal smelting and rolled products	14	2.8159	1.1935
General Equipment	16	1.1368	1.2331
Transportation equipment	18	1.0085	1.0944
Electrical machinery and equipment	19	1.0243	1.5603
Communication equipment, computers and electronic equipment	20	2.3165	1.2745
Electricity and heat production and supply	25	2.1169	1.0685

Data source: According to the analysis and collation of "Sichuan Input-Output Table in 2012".

Table 2, Table 3, and Table 4 reflect the evolution of the pillar industries in Chengdu from 2002 to 2012, which were screened out using the method of inductance coefficient and influence coefficient greater than 1. It can be seen that the pillar industries in Chengdu have gone through a process from less to more, but industry covers almost all pillar industries. From the analysis of the input-output table of Sichuan Province in 2012 (Table 5), Chengdu's current pillar industries that are concentrated in the chemical industry, equipment manufacturing industry, automobile manufacturing

industry, energy industry and electronic information industry. In the service economy era, it has become a consensus to make the service industry a new economic growth point. This is an issue that Chengdu needs to pay attention to.

# 3.2.2 Pillar industries selection in Chongqing

Department	Code	Induction coefficient	Influence coefficient
Papermaking, printing, cultural and educational supplies manufacturing	10	1.8962	1.2750
Chemical industry	12	2.8154	1.1513
Metal smelting and rolling processing industry	14	4.0493	1.3037
General and special equipment manufacturing industry	16	1.1750	1.1868
Transportation equipment manufacturing	17	1.5390	1.3483
Communication equipment, computer and other electronic equipment manufacturing	19	1.1999	1.2726
Leasing and business services	34	1.1465	1.0292

Table 5 Pillar industries Chongqing in 2002

Data source: According to the analysis and collation of "Chongqing Input-Output Table in 2002".

Department	Code	Induction coefficient	Influence coefficient
Papermaking, printing, cultural and educational supplies manufacturing	10	1.3838	1.2763
Petroleum processing, coking and nuclear fuel processing industry	11	1.4400	1.1112
Chemical industry	12	2.9597	1.0987
Metal smelting and rolling processing industry	14	3.3910	1.1983
General and special equipment manufacturing industry	16	1.3428	1.2394
Transportation equipment manufacturing	17	1.4848	1.3914
Communication equipment, computer and other electronic equipment manufacturing	19	1.2483	1.2081

# Table 6 Pillar industries of Chongqing in 2007

Data source: According to the analysis and collation of "Chongqing Input-Output Table in 2007".

Department	Code	Induction coefficient	Influence coefficient
Oil and gas extraction products	3	1.1858	1.0455
Papermaking, printing, cultural and educational supplies manufacturing	10	1.2573	1.1200
Petroleum, coking products and nuclear fuel processed products	11	1.2324	1.0962
Chemical industry	12	2.5195	1.0956
Metal smelting and rolling processing industry	14	3.4867	1.3067
General and special equipment manufacturing industry	16	1.1813	1.2108
Instrumentation and office machinery manufacturing industry	20	1.9305	1.6318

Table 7 Pillar industries of Chongqing in 2012

Data source: According to the analysis of "Chongqing Input-Output Table in 2012".

Department	Code	Induction coefficient	Influence coefficient
Oil and gas extraction industry	3	1.1831	1.0331
Papermaking, printing, cultural and educational supplies manufacturing	10	1.3462	1.1122
Petroleum, coking products and nuclear fuel processed products	11	1.2331	1.1120
Chemical industry	12	2.5151	1.1528
Metal smelting and rolling processing industry	14	3.3799	1.2670
General and special equipment manufacturing industry	16	1.1669	1.2086
Instrumentation and cultural office machinery manufacturing	20	1.8023	1.6518
Gas production and supply industry	24	1.0718	1.1273
Construction industry	25	2.9883	1.0157

Table 8 Pillar industries of Chongqing in 2015

Data source: Based on the analysis and collation of "Chongqing Input-Output Table in 2015".

It can be seen from Table 5, Table 6, Table 7 and Table 8 that from 2002 to 2015, Chongqing's pillar industries have undergone certain changes, but papermaking, printing, cultural and educational supplies manufacturing, chemical industry, metal smelting and rolling processing industries and general and special equipment manufacturing industry of the four departments always as its pillar industries. In 2012 and 2015, Chinese oil and gas extraction and construction industries rose. On the whole, Chongqing's pillar industries are roughly classified into the following categories that are automobile manufacturing, electronic information industry, equipment manufacturing, materials industry, energy industry and construction industry. From the perspective of the industrial structures formed by the three major industries, the secondary industry occupies a major position, among which

industries play a leading role, and most of them are traditional manufacturing industries. The extensive development trend is obvious, energy consumption is large, and pollution is more serious. Both the production method and the industrial chain still need to be improved.

### 4. Evaluation results and comparison of CCR pillar industries

#### **4.1** Analysis of development status

The results of pillar industries selection are different according to different methods. After referring to relevant materials and combining the previous pillar industries selection and regional delineation, this paper selects the representative industries in the evolution process of pillar industry in Chengdu and Chongqing to analyze their development status.

#### 4.1.1 Analysis of pillar industries in Chengdu

The first is the chemical industry. The development of the chemical industry has a positive effect on providing employment opportunities, invigorating the market and prospering the economy. In the chemical industry, Chengdu has a number of fast-growing, large-scale, and high-quality enterprises such as Sichuan Chemical, Yulong Chemical, Chenghua Co., Ltd. In 2016, Chengdu established a green chemical industrial park. The first phase of the plan is to develop energy-saving emission reduction, comprehensive utilization, and circular economy related industries. The second phase of the plan is to rely on Pengzhou's rich natural gas resources to support the development of natural gas chemicals, new materials and fine chemicals. It is expected to build a 100 billion-level industrial park by  $2022^{[15]}$ .

The second is the equipment manufacturing industry. The equipment manufacturing industry is the foundation of industrial development. It can be seen from Table 2 to Table 4 that Chengdu has great development prospects in the equipment manufacturing industry, which is embodied in the general and special equipment, electrical machinery and equipment. In the future, Chengdu will grasp the development direction of digitalization, networking, and intelligence in the manufacturing industry, and accelerate the cultivation and development of the equipment manufacturing industry.

The third is transportation equipment manufacturing industry. In Chengdu, the pattern of "seven cars and four machines" in the automobile and machinery industry has been formed for a long time. Although there are many brands, there are problems with the scale of the industry and the small influence of local brands. If the industry wants to continue to develop and become stronger and bigger, it is necessary to establish brand advantages and build local brand-name enterprises.

The forth is electronic information industry. The electronic information industry is represented as communication equipment, computers and electronic equipment. In 2016, the overall scale of Chengdu's electronic information industry reached 498.44 billion yuan, and the development trend is good. Chengdu has gathered a number of world-renowned companies such as Intel, Global Foundries, Dell, Lenovo, BOE, Texas Instruments and Huawei. The chain is relatively complete and occupies an important pole in the global electronic information industry.

#### 4.1.2 Analysis of pillar industries in Chongqing

The first is the chemical industry. The added value of the chemical industry and its share of GDP have increased year by year. Chongqing has three major chemical industry bases and parks, which provide impetus for the chemical industry to support the regional economy for a long time. However, the current chemical industry still has serious pollution and overcapacity problems. It is urgent to cultivate and develop the material chemical industry and fine chemical industry to promote green development.

The second is general and special equipment manufacturing industry. The transfer of international manufacturing to China has accelerated. Chongqing has obvious advantages in manufacturing. In 2016, the general equipment manufacturing industry achieved an output value of 48.87 billion yuan, an increase of 12 percent. This also shows that the general and special equipment manufacturing

industry still has a growing trend. It will still be the city's pillar industry in the future, but it should shift to intelligent manufacturing and develop high-end equipment manufacturing.

The third is construction industry. The construction industry is a pillar industry for regional economic development. In 2015, the total output value of Chongqing's construction industry was 625.694 billion yuan, ranking second among the twelve western provinces and cities. From 2011 to 2015, the cumulative added value of the construction industry was 586.229 billion yuan. At present, Chongqing is still promoting urbanization and the construction industry will continue to develop. However, there are still small total industrial scales, slower growth rates, weak corporate competitiveness, and irregular behavior of market entities. So Chongqing needs to find a new way for the development of the construction industry.

The fourth is automobile manufacturing industry. Chongqing has well-known companies such as Changan and Lifan and has formed an automobile industry cluster of 100 billion yuan. It has a great influence in the western and even the domestic. In 2014, Chongqing has surpassed Shanghai and Guangzhou, becoming the country's largest automobile production base. But at present, the industry still has problems such as weak scientific research and innovation capabilities, saturation of the auto sales market, and difficulty in the development of new markets. Chongqing should make use of the western market's potential for auto demand and the local existing industrial foundation, further rationally plan the industrial layout, enhance innovation capabilities, develop new energy vehicles, and make the automotive industry from the largest to the strongest.

#### 4.2 Analysis of industrial structure

#### 4.2.1 Analysis of Chengdu's industrial structure

At present, Chengdu is still in the mid-industrial development stage, and industry still plays a strong supporting role in regional economic development. According to the three industrial structure classification standards, from the perspective of Chengdu's regional GDP, Chengdu is early at the end of the century, the third industry's GDP accounted for more than 50 percent of GDP, and accounted for more than 40 percent of third industry's output value in Sichuan. This shows that the service industry has a great market demand in the city and has a significant influence in Sichuan Province. In 2016, the three industry structures were 3.9 to 42.7 to 53.4, and the employment structures were 16.1 to 32.8 to 51.1. The employment ratio in the third industry exceeded half for the first time, but the development of the service industry was only concentrated in wholesale and retail, catering, finance and so on. From the data the previous thesis, despite the large proportion of Chengdu's the third industry's gross output value, the pillar industries are still dominated by the secondary industry, especially the industrial sector, presenting a "two-three-one" structure. Judging from the numerical values of the inductance coefficient and the influence coefficient, except for the "double-high" sectors, the secondary industry mostly exhibits a high degree of inductance and a low influence. Similarly, in the third industry, such as the transportation and storage industry, financial industry and wholesale and retail, also present he phenomenon of one high and one low. Most of the third industries are still sectors with weak driving force and demand that need to support.

#### 4.2.2 Analysis of Chongqing's industrial structure

The industrial structure of Chongqing is similar to that of Chengdu. Considering the absolute value of the industrial influence coefficient, the pillar industries structure formed is "two-three-one", but its internal development is different. And the proportion of GDP presents a "three-two-one" structure. From 2002 to 2012, the contribution rate of Chongqing's secondary industry to GDP was higher than 55 percent, and even more than sixty percent in most years. This excessive contribution rate did not fall below 50 percent until 2013. The secondary industry has played a significant role in Chongqing's economic growth. Chongqing also needs to cultivate the third industry as the pillar industry and the transformation and upgrading of traditional manufacturing industries to promote the continuous optimization of the industrial structure.

#### 4.3 Comparison of Chengdu-Chongqing pillar industries selection

The selection of regional pillar industries will be affected by a variety of factors. The stage of industrial development, urban development positioning, resource endowments, and geographical environment differences will cause different results. This paper will combine these factors to make an analysis of the situation in Chengdu and Chongqing. There are simple comparisons.

The first is the same stage of industrial development. Both Chengdu and Chongqing are still in the mid-stage of industrialization. Although the output value of the third industry has exceeded that of the secondary industry, the pillar industries are still supported by the secondary industry. This is one of the reasons for the convergence of the pillar industries in the two places.

The second is the development position of cities. The development positions of city in the two places are roughly the same. Table 9 summarizes the city positions of Chengdu and Chongqing. Similar city positions make the pillar industries of the two places have great similarities, forming a cooperative and competitive city relationship.

City	Main positioning
Chengdu	Functions of economic center, science and technology center, cultural and creative center, foreign exchange center, and comprehensive transportation hub in the western region
Chongqing	Economic center, financial center, trade and logistics center, technological innovation center, and shipping center in the upper reaches of the Yangtze River

Table 9 Chengdu-Chongqing positioning

Thirdly, the structure of factor endowments is different. In terms of labor, the total population of Chongqing is more than twice that of Chengdu, so the labor force of Chongqing is more advantageous. In terms of capital, the per capita level of Chongqing is not as good as that of Chengdu. Chengdu's capital advantage is more obvious. In other words, Chengdu has a technological comparative advantage over Chongqing. In summary, Chengdu has comparative advantages in capital and is suitable for the development of capital and technology-intensive industries. Chongqing has comparative advantages in labor, and labor-intensive industries are more suitable. The "1" in the city's "6+1" pillar industry pattern refers to labor-intensive industries<sup>[16]</sup>.

Fourthly, geographical environment is different. Chengdu began to develop the electronic information industry in the 1990s. At the same time, Chongqing vigorously developed the automobile manufacturing industry and the chemical industry. This made Chengdu more advantageous in terms of science technology, labor's technology and proficiency, while industry of Chongqing is better, especially heavy industry. The electronic information industry, automobile manufacturing and chemical industry have always been the pillar industries of Chengdu and Chongqing respectively. These led to differences in the specific requirements and tasks of the development of the above industries as pillar industries in both places.

# 5. Cultivation path of Chengdu and Chongqing region pillar industries

If an industry sector needs to grow into a pillar industry, it cannot do without government guidance and policy support. Just like the serial replacement shown by pillar industries and the stage in the life cycle of the industry, an industry sector cannot continue to be a pillar industry. New sectors will emerge and replace it or the old industry could change itself, transform and upgrade to a new pillar industry. In this chapter, combined with the selection of pillar industries in Chengdu and Chongqing region, this chapter will elaborate the cultivation path of pillar industries in Chengdu and Chongqing region from four aspects, for instance, how to cultivate emerging industries into pillar industries, how to transform and upgrade old pillar industries to new pillar industries, how to determine the proportion of pillar industries according to policy guidance, and how to promote the development of pillar industries by industrial synergy and industrial correlation of leading industries and makes a simple comparison.

#### 5.1 Cultivation path of pillar industries in Chengdu

The first is to make the pillar industries better and stronger. Chengdu needs to promote the integration of the electronic information manufacturing industry and the software industry and accelerate the transformation and upgrading of the automobile manufacturing industry. Then the traditional equipment manufacturing industry is developing in the direction of digitization and intelligence to improve product intelligence and quality. It is necessary to accelerate the commissioning of the PetroChina and Sichuan Petrochemical Refining and Chemical Integration Project.

The second is to support the development of emerging industries and future industries to form new support for economic growth. Chengdu should guide by the market and government-driven, focusing on develop emerging industries. In accordance with the "1331" development ideas, Chengdu should focus on the development of high-end equipment manufacturing, energy conservation and environmental protection and the biological industry, and accelerate the development of new energy industry, advance the deployment of artificial intelligence and other future industries.

Thirdly, from the perspective of "Made in China 2025" and Chengdu's future industrial development goals, Chengdu should vigorously developing advanced manufacturing and "Internet+" and promoting the integration of the two are the direction. In the future, Chengdu will continue to develop pillar industries systems led by the electronic information industry and supplemented by the automobile manufacturing and equipment manufacturing industry.

The fourth is to strengthen the correlation and driving effect of leading industries. The benign interactive relationship between Chengdu's leading industry and other sectors of the industry has not yet formed, and its influence, driving and radiation effects are limited. Based on the above problems, Chengdu is actively improving policies and measures to create a good external development environment, and make every effort to build the "Made in Chengdu" brand, expand its reputation, and improve City competitiveness.

#### 5.2 Cultivation path of pillar industries in Chongqing

Firstly, Chongqing should adjust the structure of pillar industries to promote transformation and upgrading. Chongqing adheres to the supply-side structural reform and the "five development concepts", green development of the chemical industry, energy industry and equipment manufacturing industry, with the goal of reducing energy consumption and increasing benefits to vigorously foster the development of new materials and fine chemicals, promote shale gas apply, establish chemical industrial parks and continuously upgrade and transform the traditional chemical industry. Chongqing should continuously optimize the energy supply system to improve innovation capabilities and supply levels, promote "Internet +" and take the road of intelligent equipment manufacturing. For the construction industry, Chongqing issued a plan on how to promote the development of enterprises, the safety and intelligence of construction industry, informatization and industrialization development, create a good development environment, improve the quality of projects, provide talent guarantee and improve government services.

Secondly, Chongqing should build emerging industrial clusters by advantages. Chongqing has raised development funds, provided policy support to guarantee the talent team, continue to strengthened innovation and open cooperation, and accelerated the development of emerging industries. From 2013 to 2017, the contribution rate of strategic emerging industries to industrial growth was close to 40%, and the results were obvious. Chongqing will continue to improve talent introduction policies, promote the integration of production, education, increase R&D investment, and establish equity investment funds and carry out investment and financing system reforms to provide guarantees for project implementation, thereby promoting the development of emerging industries.

Thirdly, Chongqing should expand the proportion of intelligent and low-energy industries and shift to intensive development. At present, China is in the development stage of informatization and is limited by environmental resources. National and regional development should pay more attention to sustainability, so intelligent and green are the directions of future industrial development. Chongqing is fully aware of this and is actively building a new industrial system based on the electronic information industry.

Fourthly, Chongqing should enhance synergy between leading industries. It is believed that industrial synergy will promote industrial division of labor and produce a synergy effect of "1+1>2"<sup>[17]</sup>. In terms of inter-industry synergy, different industrial sectors can evolve from independence to mutual promotion, and ultimately achieve mutual benefit and win-win results. They can work together to make the regional economy develop rapidly and stably. At present, strategic emerging industries and advanced manufacturing industries have become the mainstay of Chongqing's industrial economic. Strengthening the synergy of these leading industries can achieve high-end and high-quality industries and the transformation to pillar industries, which is beneficial to regional development.





Fig. 1 Cultivation path chart of pillar industries

Combining the analysis of the selection and cultivation path of the pillar industries in Chengdu and Chongqing, it is not difficult to find that the convergence of industries in the two places is more serious, As shown in Fig. 1, they basically follow national policies and development orientation as the main line to promote the transformation and upgrading of industries to intelligent, high-end, and green industries. Both places can grasp the right direction in the cultivation of pillar industries, continuously improve technology and quality.

There are still differences in the planning and key setting of specific measures. A simple comparison is made of the differences. The first is the difference in talent protection measures. Chongqing has introduced local talent introduction methods. And Chongqing has established a talent service hall and a one-stop service platform to provide greater service convenience. The measures are better than Chengdu's measures that rely on the state. The second is technological innovation. Both places attach great importance to technological innovation. Investment in this area is gradually increasing to promote the coordinated development of industry, university and research. However, Chengdu also attaches great importance to the protection of intellectual property rights, only by increasing the protection of intellectual property rights, the original creators will be more motivated. Thirdly, in terms of brand building, in Chengdu, from the past situation, there is a lack of local brands. And Chongqing has done a better job in this aspect, so Chengdu needs to pay more attention to brand building.

### 6. Conclusions and recommendations

From the analysis of the selection and cultivation of the pillar industries in Chengdu and Chongqing, Chengdu and Chongqing are still in the transitional stage from mid-industrialization to late-industrialization. Although the pillar industries are not single, they are concentrated in the industrial sector and need to be actively expanded the third industry and continuously optimize the industrial structure. Combined with the research on pillar industries before 2002, the developments of pillar industries in the two places have also shifted from labor-intensive industries such as agriculture, forestry, animal husbandry and fishery to capital and technology-intensive industries such as chemical industry, general equipment manufacturing, transportation equipment manufacturing, and electronic information industry. These are also in line with the characteristics of urban development in the middle and late stages of industrialization. However, as dual-core cities in the western region, the pillar industries of the two regions have converged. They are concentrated in manufacturing, electronic information industry, energy and chemical industries. The cultivation methods are also relatively similar, which restricts the cooperation between the two places to a certain extent. It also provides ideas for other cities to develop and select pillar industries. Based on the research on the pillar industries in Chengdu and Chongqing, this paper puts forward the following suggestions for selecting reasonable pillar industries, promoting the economic and sustainable development.

The first is to consider the comparative advantage of resource endowments. The particularity of regional resource endowments determines the differences in regional industry selection and industrial structure. Regions should choose labor-intensive industries, resource-intensive industries, capital-intensive industries, and technology-intensive industries based on their resource endowment advantages. For example, the eastern coastal areas of China benefited from reform and opening up. And the economy developed earlier than the western regions. The economic strength, scientific and technological strength, and educational level far exceed those of the western region. Therefore, capital and technology-intensive industries should be vigorously developed and formed as the leading industries. As China's largest grain production area and old industrial base, the northeast plain has the foundation and advantages for the development of labor-intensive industries. Besides, Xinjiang in the west is rich in mineral resources and can develop resource-based industries.

The second is to consider the geographical environment and its carrying capacity. Geographical environment is the foundation and source of human survival and economic development. And geographical environment is particularly important for resource-based industries<sup>[18]</sup>. For example, Shanxi Province, although rich in coal resources, is deeply inland and poor in water resources, transportation and logistics conditions restrict economic development. Chengdu and Chongqing are adjacent to each other, and the geographical environment is not very different. The mineral resources are relatively abundant. Therefore, the energy industry occupies an important position in the two places. However, Chengdu is mostly plain and its environmental carrying capacity is slightly lower. It is obvious to all that the air quality in Chengdu is poor in recent years, indicating that the development of the industry has exceeded the carrying capacity of the environment. The industries have caused harm to environment, and ultimately the people living here will be retaliated by nature. The smog phenomenon in most areas of China at present also reminds us that we must consider the advantages of the geographical environment and its carrying capacity in order to make the economy faster and better and insist on sustainable and green development.

The fourth is to create a good humanistic environment. The cultural environment will provide enterprises with a good soil for survival and development, thereby attracting outstanding enterprises to settle in and promoting industrial development. For example, the pioneering spirit of Chengdu, the city's inclusiveness and enthusiasm for consumption. These have allowed Alibaba, Hammer Technology, BOE and other high-tech industry giants to settle in. And the government can develop it into superior industries and pillar industries. It is a win-win situation for enterprises and regional development.

The fifth is to consider development orientation. The state will delineate pillar industries and emerging industries for a certain period in the future according to the level of national economic development and the stage of development. And regions should determine the pillar industries and emerging industries that are suitable for the local conditions. At present, China emphasizes that development should take the real economy as the main body, and puts forward the five development concepts of "innovation, coordination, green, openness, and sharing", revealing the laws of economic development. Regions should also implement this development concept and promote industrial upgrading and transformation, informatization, and intelligent development. Only if the development direction is right, the development effect will be good.

The sixth is to clear city positioning. City positioning is the core of urban development and competition strategy. Due to the convergence of city positioning between Chengdu and Chongqing, the selections of pillar industries are very similar. However, the two cities are dual-core cities in the western region, which undoubtedly increases competition and is not conducive to regional cooperation. China is actively carrying out regional economic integration and the construction of urban agglomerations. Each city should base on its own advantages and achieve scientific and clear positioning, so as to most effectively enhance the competitiveness of cities. The economic strength of large cities is stronger and the industrial system of large cities are reasonably positioned, focusing on differentiation and specialization, and injecting new vitality into economic development with different from other cities. In this process, reasonable pillar industries are selected as the support of the city.

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