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Research on Identification of Industrial Clusters in Qinghai Province Based on Composite Location Entropy

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Abstract

Qinghai Province is rich in natural gas, petroleum, non-ferrous metals and other resources. Resource-based industries are very important for Qinghai's economic development. Based on the industrial data of more than 25 industries from 2003 to 2011, this paper uses the location entropy method to measure and judge the agglomeration degree of resources industry in Qinghai Province, and identifies the industries forming industrial clusters. The results show that the industrial clusters in Qinghai Province may exist in the oil and natural gas mining industry, non-ferrous metal smelting and rolling processing industry, non-ferrous metal mining and mining industry, ferrous metal smelting and rolling processing industry, chemical raw materials and chemical products manufacturing, non- Metal mining and mining industry as well as power, heat production and supply. Among them, the non-ferrous metal smelting and calendering industry, chemical raw materials and chemical products manufacturing industry as the dominant industries in Qinghai Province still maintained a certain upward trend, while the oil and gas mining industry, non-ferrous metal mining and processing industry and a few other dominant industries showed different degrees of decline.

Key Words: Location entropy; Industrial cluster; Measure and judge

Introduction

Research on industrial clusters has been active since the end of the last century. In foreign countries, relevant research focuses on the existence, degree and identification ideas and methods of industrial clusters. However, a unified industrial classification standard has not been formed, the definition of industrial boundaries has been vague, and the criteria for determining industrial clusters have not reached consensus. Identification research on industrial cluster should include the above three aspects (Hansen, 1994).

At present, the international research on industrial clusters has formed three different ideas from the perspective, purpose and nature of research. Established two qualitative identification methods of location entropy and Porter case analysis (Cameron, 1996). And four methods of quantitative identification can be used such as input-output analysis, principal component analysis, multi-clustering and graph theory.

Establishment of Compound Location Entropy Model

At present, location entropy is used as a measure of regional industrial advantage in the research of industrial layout. And the size of location entropy is the basic embodiment of industrial geographical layout. Different districts have different land area, residential population, productivity level, intensity of production activities and economic scale. It cannot measure the advantages and disadvantages of regional industries accurately, if we choose the proportion of products produced by the region in the whole economic system (Elusion, & Glaeser, 1999). The location entropy is proposed to make up for this deficiency. Location entropy uses relative value as a comparative index, which effectively avoids the impact of different scales and levels of development of the region, and better reflects the advantages of industries in different regions. When analyzing the internal industrial structure of the region, we can calculate the location entropy of different industries in different periods to study the evolution process of regional superior industries and grasp the changing trend of each industry. Thus, we can grasp the weak links in economic development accurately, define the position of the dominant industries clearly and formulate targeted industrial development plans to promote economic growth in an all-round way (Lazer, 2001).

We compare the level of regionalization of industries by comparing the location entropy of industries in different regions. Thus, location entropy is called specialization rate which reflect the situation of regional division of labor. Generally, the location entropy is expressed by the ratio of the proportion of the production value of an industry in the gross domestic product of the region in which it is located and the total output value of the industry in the economic system in the total output value of all industries in the economic system (Alessia & Fiorenza, 2006). Calculated as follows:

$$LQ_{ij} = (X_{ij} / \sum_{i} X_{ij}) / (\sum_{j} X_{ij} / \sum_{j}\sum_{i} X_{ij}) \quad (1)$$

Where X is the industrial output value, i represents the region, Xij is the output value of the j industry in the i region, $\sum_{i} X_{ij}$ is the total regional output value, $\sum_{j} X_{ij}$ is the total output value of the j industry in the economic system, $\sum_{j}\sum_{i} X_{ij}$ is the total output value of all industries in the economic system.

When the location entropy is greater than 1 significantly, the industry in this region has a high degree of specialization, obvious scale advantage, strong production capacity and higher production level. The products are exported to other regions of the economic system while satisfying the consumption demand of the region which produced by the industry. Thus bringing more income to the region and promoting regional economic development. When the location entropy is in the interval [0.85, 1.15], the degree of specialization of this industry in this region is basically equal to that of the whole economic system, and the production of this industry in this region basically keeps a balance with the demand. When the location entropy is less than 1 significantly, the industry has a lower degree of specialization, production capacity and production level. Products produced by the industry cannot meet the consumption needs of the region, and needs the production input from other regional. The industry is in a competitive disadvantage position in the region (Tokatli, 2007).

In a word, the location entropy is used to evaluate the production and service capabilities of industrial clusters, and it is considered as a necessary condition for the existence of industrial clusters that the location entropy is significantly greater than 1. It shows that some industrial clusters exist in production activities, but their location entropy is not significantly greater than 1, even less than 1. For this situation, we need more excavation, greater support, and more excavation.

It is obviously weak to use the location entropy calculated by industrial output value as a measurement index. Here, we use the composite location entropy as a measurement index to try to improve the recognition result. Based on the identification criteria of industrial clusters, factors such as the number of industrial enterprises and employees should be considered as well as the industrial output value (Yeung, 2007). We define:

Location Entropy of the Number of Industrial Enterprises (LQbij). Its formula is

$$LQ_{bij} = (B_{ij} / \sum_{i} B_{ij}) / (\sum_{j} B_{ij} / \sum_{j}\sum_{i} B_{ij}) \quad (2)$$

Location Entropy of Industrial Employees(LQεij). Its formula is

$$LQ_{eij} = (E_{ij} / \sum_{i} E_{ij}) / (\sum_{j} E_{ij} / \sum_{j}\sum_{i} E_{ij})$$

Location E (3)

Location Entropy of Industrial Output Value (LQpij). Its formula is

$$LQ_{pij} = (P_{ij} / \sum_{i} P_{ij}) / (\sum_{j} P_{ij} / \sum_{j}\sum_{i} P_{ij}) \quad (4)$$

Three types of location entropy play different roles and have different importance in the identification of industrial concentration. Therefore, the weighted average method is used to obtain the compound location entropy. The formula is as follows:

$$CLQ_{ij} = aLQ_{eij} + bLQ_{bij} + cLQ_{pij} \quad (5)$$

$$a+b+c=1 \quad (6)$$

$$0 \le a,b,c \le 1 \quad (7)$$

Where, a, b and c are weight coefficients of three kinds of location entropy respectively, which can be obtained by expert scoring or analytic hierarchy process.

Industrial cluster identification criteria

The three-dimensional identification method refers to identifying real industrial clusters from the three levels: industrial chain connection, number of enterprises in the same chain, the number and category of service institutions. Among them, the connection of industrial chain reflects the vertical complementary relationship within the cluster. The number of enterprises in the same link reflects the degree of competition within the cluster, and also reflects the vitality of the industrial cluster (Inomata, 2008; Roberta, Anna & Giovanna, 2009). The category and number of service institutions reflect the level of service shared by the members of the cluster and the level of support for competition.

Drawing from existing practical experience, we think that the identification criteria of industrial clusters should not be too strict. According to the framework of the "three-dimensional identification method" and the requirements of the three sub-standards (Ruan & Zhang, 2009; Belton, Dinghuan, Willia & Xiaobo, 2010) and in accordance with the principles of integrity, specificity, comparability and feasibility, we think the identification criteria of industrial clusters are as follows:

1) Identifies similar industries in different regions or across regions. According to the research purpose and available data, the industry and region of cluster can be determined from different levels of the country or region by the top-down industrial law. It can also be identified by local governments (or relevant institutions) use bottom-up location method according to the leading industry in the region. Most of the industrial clusters are within the scope of administrative divisions, but very few are cross-regional.
2) The industry is constructed by many similar or related enterprises and institutions. The industry in a particular geographical area are composed of a large number of similar or related SMEs, and can also include large enterprises. After the initial stage of development, the cluster should also have technical training, finance, quality monitoring and other service institutions to support the development of the cluster industry.
3) Location quotient of cluster industry is greater than 1. The location quotient coefficient of industry reflects the degree of specialization of regional industry relative to the whole economy. LQ>1 indicates that the level of specialization of industrial cluster is higher than the whole economy. The larger the LQ, the higher the professional level and the higher the degree of localization.
4) There are at least two connected departments in the industry chain. The core of the industrial cluster is to form a leading industry based on the concentration of related industries. The industrial clusters requires at least two related industrial sectors as the basis and support, reflecting the essence of division of labor and cooperation, and presenting the potential and necessity of further agglomeration.
5) There are at least two enterprises in one link of the industrial chain with the same activities. Competition is the essence and vitality of industrial clusters. In the same link, there are more than two enterprises with the same activities, competing in symbiosis. This promotes the development of support services such as finance, technology research and logistics et al.,

and ensure the vitality of the cluster and the driving force for sustainable development.

6) The industrial name of the cluster is determined by the three-digit National Economic Industry Classification (GB/T4754-2011). This is based on China's standards. It is difficult to adopt the industry classification standard of unified digits since different countries have different industrial sub-engineering degrees. At present, the three industry classification standards can appropriately express the industrial content of China's clusters. Of course, for cross-industry issues within the cluster, improvements to current standards will be needed.
7) Based on the principle of pure department, the members of the industrial cluster are determined according to the linkage of the industrial chain, the number of enterprises in the same chain and the supporting service organizations. Firstly, the main industries (or services) of the enterprises or institutions are classified according to the pure sectoral principle that they have the same production process, consumption structure or economic use. Secondly, the industrial clusters are determined according to the vertical linkage of the industrial chain, the symbiotic enterprises in the same link and the supporting institutions serving them within the vertical and horizontal boundaries formed by the cluster leading industries and related industries. That is, the members of the cluster are determined by the input-output linkage established between different departments. Companies that operate a variety of products (services) use their main products to determine sector ownership. Enterprises that have a new role in the cluster industry are also members of the cluster.
8) Cross-regional cluster members are the sum of the members of each regional cluster. Cross-regional industrial clusters show cluster form in a single region, and also show as industrial clusters when linked together. Under the premise of corresponding integration of the cluster's industry categories, the boundary of the cross-regional cluster is the sum of the members of each regional cluster.

Empirical research based on Qinghai Province

China's national economic industry division standards were first published in 1984, and were revised three times in 1994, 2002, and 2011 respectively. The latest version is based on the revision of the International Standard Industrial Classification, and combined with the current level and trend of economic development in China; the classification of economic sectors is improved and improved again. The industry classification standard of this part of the empirical research is the national economic industry classification standard GB/T4754 - 2011, and the boundary standard takes the administrative division as the geographical boundary and analyzes the identification of relevant industrial clusters in Qinghai province (Puga, 2010); Wei & Liefner, 2012).

In view of the acquisition of relevant data of China's industrial economy, the two-digit industry was selected for industrial cluster research. Considering the integrity and reliability of the data, the data is derived from the National Institute of Statistics industrial statistics database. Twenty-five of these industries were selected from the annual data of industrial distribution by region from 2003 to 2017. The location entropy of industrial output value, enterprise number and employment number of related industries in Qinghai province were calculated.

Table 1: Location entropy of industrial output value, enterprise number, and employment number in Qinghai province in 2017

Serial number	Industry	Employment	Enterprise quantity	Industrial output value
1	Coal mining and washing	1.12	2.74	2.03
2	Oil and gas extraction	7.48	3.11	8.64
3	Ferrous metal mining and dressing	1.71	2.42	0.65
4	Non-ferrous metal mining and dressing	3.60	4.45	3.64
5	Non-metallic mining and dressing	4.63	1.82	1.45
6	Agricultural and sideline food processing	0.32	1.17	0.28
7	Food manufacturing	0.60	1.60	0.57
8	Wine, beverage and refined tea manufacturing	1.18	1.56	0.70
9	Textile industry	0.23	0.22	0.21
10	Textile and garment, clothing industry	0.41	0.43	0.26
11	Paper and paper products	0.00	0.00	0.00
12	Petroleum processing, coking and nuclear fuel processing	0.95	1.28	0.69
13	Chemical raw materials and chemical manufacturing	3.71	2.54	1.80
14	Pharmaceutical manufacturing	1.13	3.42	0.85
15	Non-metallic mineral products	1.17	1.34	0.80
16	Ferrous metal smelting and rolling processing	3.53	4.88	1.27
17	Non-ferrous metal smelting and rolling processing	7.83	4.36	5.72
18	Metal products	0.10	0.25	0.08
19	General equipment manufacturing	0.58	0.23	0.23
20	Special equipment manufacturing	0.08	0.18	0.04
21	Railway, marine, aerospace and other transportation equipment manufacturing	0.03	0.11	0.03
22	Electrical machinery and equipment manufacturing	0.10	0.42	0.14
23	Computer, communications and other electronic equipment manufacturing	0.01	0.07	0.01
24	Instrumentation manufacturing	0.24	0.22	0.08
25	Electricity, heat production and supply	1.84	2.71	2.25

In 2017, there were 8 industries with industrial output value location entropy greater than 1.25, 14 industries with enterprise number location entropy greater than 1.25 and 7 industries with employment number location entropy greater than 1.25 in Qinghai Province. See Table 2-4 for details.

Table 2: 2017 Qinghai Province industrial output value location entropy greater than 1.25 industry information table

Serial number	Industry	industrial output value location entropy
1	Oil and gas extraction	8.64
2	Non-ferrous metal smelting and rolling processing	5.72
3	Non-ferrous metal mining and dressing	3.63
4	Electricity, heat production and supply	2.25
5	Coal mining and washing	2.03
6	Chemical raw materials and chemical manufacturing	1.80
7	Non-metallic mining and dressing	1.45
8	Ferrous metal smelting and rolling processing	1.27

Table 3: 2017 Qinghai Province enterprise quantity location entropy greater than 1.25 industry information table

Serial number	Industry	Enterprise number location entropy
1	Ferrous metal smelting and rolling processing	4.88
2	Non-ferrous metal mining and dressing	4.45
3	Non-ferrous metal smelting and rolling processing	4.36
4	Pharmaceutical manufacturing	3.42
5	Oil and gas extraction	3.11
6	Coal mining and washing	2.74
7	Electricity, heat production and supply	2.71
8	Chemical raw materials and chemical manufacturing	2.54
9	Ferrous metal mining and dressing	2.42
10	Non-metallic mining and dressing	1.82
11	Food manufacturing	1.60
12	Wine, beverage and refined tea manufacturing	1.56
13	Non-metallic mineral products	1.34
14	Petroleum processing, coking and nuclear fuel processing	1.28

Table 4: 2017 Qinghai Province employment number location entropy greater than 1.25 industry information table

Serial number	Industry	employment number location entropy
1	Non-ferrous metal smelting and rolling processing	7.83
2	Oil and gas extraction	7.48
3	Non-metallic mining and dressing	4.63
4	Chemical raw materials and chemical manufacturing	3.71
5	Non-ferrous metal mining and dressing	3.60
6	Ferrous metal smelting and rolling processing	3.53
7	Electricity, heat production and supply	1.84

Setting a=0.3, b=0.3, and c=0.4 were used to calculate the complex location entropy of relevant industries using the complex location entropy model. Ten industries with the complex location entropy greater than 1.25 were selected, as shown in the following table:

Table 5: 2017 Qinghai Province composite location entropy greater than 1.25 industry information table

Serial number	Industry	composite location entropy
1	Oil and gas extraction	6.64
2	Non-ferrous metal smelting and rolling processing	5.95
3	Non-ferrous metal mining and dressing	3.87
4	Ferrous metal smelting and rolling processing	3.03
5	Chemical raw materials and chemical manufacturing	2.59
6	Non-metallic mining and dressing	2.52
7	Electricity, heat production and supply	2.27
8	Coal mining and washing	1.97
9	Pharmaceutical manufacturing	1.70
10	Ferrous metal mining and dressing	1.50

Conclusion

As a single measure, location entropy cannot directly judge the existence of industrial clusters, and needs to be further analyzed and identified in combination with other qualitative and quantitative methods. The recognition results are as follows:

Result 1: The highly specialized industries in Qinghai Province are oil and natural gas mining, non-ferrous metal smelting and rolling processing, non-ferrous metal mining and mining, and ferrous metal smelting and rolling processing. The composite location entropy of these four industries is greater than 3.

Result 2: The industrial clusters in Qinghai Province may exist in the oil and natural gas mining industry, non-ferrous metal smelting and rolling processing industry, non-ferrous metal mining and mining industry, ferrous

metal smelting and rolling processing industry, chemical raw materials and chemical products manufacturing, non-Metal mining and mining industry as well as power, heat production and supply.

Result 3: There are also industries that can develop vigorously in some industries with low composite entropy in Qinghai Province, such as electrical machinery and equipment manufacturing, food manufacturing, textile and garment, apparel manufacturing. Their industrial output value location entropy, enterprise quantity location entropy, and employment location entropy all increased significantly and continued to increase.

Result 4: Non-ferrous metal smelting and rolling processing industry, chemical raw materials and chemical products manufacturing Oil and gas mining industry as a dominant industry in Qinghai Province still maintains a certain upward trend.

Result 5: There are different degrees of decline in a few advantageous industries such as oil and natural gas mining and non-ferrous metal mining and mining.

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