Networked Industrial Agglomeration of Electronic Equipment Manufacturing Industry in Guangdong Province

Han Zhang[1], Jia An[2]

[1]*Lecturer. School of Economics and Management, Beijing University of posts and telecoms, BUPT, Beijing, China*

[2]*Professor. School of Economics and Management, Beijing University of posts and telecoms, BUPT, Beijing, China*

Email: zhanghan-2000@163.com

Abstract: In recent years, the agglomeration of China's electronic equipment manufacturing industry has developed rapidly, showing a trend of networked tendency. Guangdong province is a main industrial agglomeration area of electronic equipment manufacturing industry. The research on its agglomerative phenomenon and trend is representative. Firstly, we define the networked industrial agglomeration and briefly review relevant researches both at home and abroad. Then we analyze the current situation of the networked industrial agglomeration in Guangdong province and find some problems, such as low economic efficiency, lacking of creativity and international competitiveness, serious environmental pollution, and so on. On this basis, we start the empirical study of networked industrial agglomeration of electronic equipment manufacturing industry in Guangdong province so that we could make judgment about its development stage and tendency.

Keywords: networked industrial agglomeration; electronic equipment manufacturing industry (EEMI)

1. Introduction

The phenomenon of industrial agglomeration is prevalent in the world. The international competitiveness of an industrial cluster has been the core driving force of regional economic development. The industrial agglomeration appears earlier in developed countries than developing ones. China's industrial agglomeration grows faster in Guangdong, Zhejiang and Jiangsu province, especially in Yangtze River delta and Pearl River Delta. Recently the network theory in the micro economy has been used to research the industrial agglomeration.

2. Review

2.1 The Networked Industrial Agglomeration

Alfred Weber (1909) firstly proposed "industrial agglomeration" in his major book on the location of industry. Hakansson (1987) stated the network should mean economically the sum of relations in the process of exchanging and transfer resources. It includes subjects, interaction and resources "Fig. 1".

So the networked industrial agglomeration means that the subjects consolidate their effect and function in the usage of resources through the transference and diffusion to increase in value. Meanwhile, the interaction between different levels and connections of the subjects forms the networked industrial agglomeration.

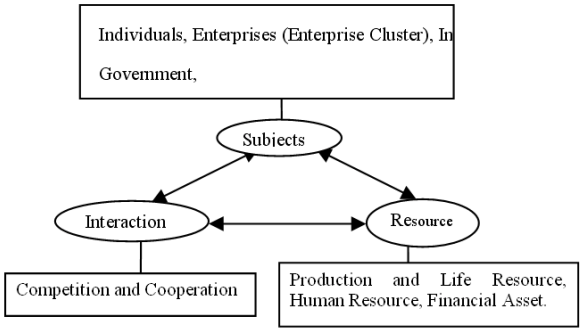

Figure 1. The basic formal pattern of industrial organizations[1]

The networked industrial agglomeration developed in four stages which were formation, growing, maturity and recession. It's so complex with the change in the mode of production and more professional social division of labour because of the interaction of various factors and relations in one area. Meanwhile, the internal subjects have cooperated more deeply and broadly based on trust and commitment with the technological progress in telecommunications. Therefore the core competence of the whole industrial cluster strengthen remarkably and the networked industrial agglomeration diffused fast through the learning and copying.

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2.2 Review on the Networked Industrial Agglomeration

The relevant research about the networked industrial agglomeration at home and abroad focused on the definition, the formation mechanism and motivation, etc. More qualitative analysis and less quantitative analysis.

The foreign scholars begin with the emerging industries and small business network. Williamson (1996) believe the cooperation of the enterprises could be explained by the network in the society because the firm organization exited in an expansive social environment. It was the first time that the network appeared in economics and managements. Richardson (1972) demonstrated the theoretical base of the networked organization from the complementation. Bourdieu (1980) , Robert Putnam (1995) and Swedberg (1997) deemed the social relations anywhere among the enterprises confined the individual and organization. Granovetter (1985) proposed "business groups" and "embeddedness" while he considered the economical behavior embedded in the network and institution which was built up by the society and had profound cultural significance. Hakansson (1992) and Snehota (1992) analysised the variables influencing the networked organizational structure and the composition of the network. AnnaLee Saxenian (1994) pointed out the competition of the organizational network in the Silicon Valley and the hierarchy of the big business in Boston's Route 128.

The high technical industry cluster of Zhongguancun in Beijing was firstly and mostly interested by scholars at home. They paid more attention to its development tendency and innovation network (Wangjici1997, 1998, 2000; Gaiwenqi 2002）. Fanxiaoping (2005) believed that network is the key to the effective industrial cluster. Lvqiang (2007) proposed paradox on the technology and organization in the networked innovation. Tangchangan (2008) investigated the different stages and diffusion processes in the networked industrial agglomeration. Mengtao (2009) indicated the characteristic of the industrial cluster was the networked organizational structure. Wangxiaoning (2005) paid more attention to the quantitative research on the networked industrial cluster.

3. The Networked Industrial Agglomeration of Electronic Equipment Manufacturing Industry (EEMI) in Guangdong Province

3.1 The Present Situation of EEMI in Guangdong Province

The EEMIs at Pearl River Delta, Yangtze River delta and Bohai Bay area are in the form of spatial clustering of many medium-small business, especially in Guangdong province. Guangdong province has a few electronic information industrial estates in cities such as Guangzhou, Shantou, Shenzhen, Zhuhai, Huizhou and Foshan. The absolute number in the main economical indexes of EEMIs in Guangdong province nearby to Hongkong and Taiwan is in the lead since the reform and open in China. The output value of the electronic information industry(EII) in Guangdong province was top of fifteen years in succession from 1992 to 2006 and increased 35.7 percent annually . "Table 1"

Table 1. Top 3 Provinces For The Scale of EEMI in China1

Year	Provinces (The Proportion）	Total of Three Provinces
1988	J（0.1930）S（0.1370）G（0.0906）	0.4206
1989	J（0.1941）S（0.1295）G（0.0833）	0.4069
1990	J（0.1798）S（0.1267）G（0.1261）	0.4327
1992	G（0.2556）J（0.1773）S（0.0987）	0.5316
1993	G（0.2806）J（0.1503）S（0.0935）	0.5244
1994	G（0.3031）J（0.1229）S（0.1094）	0.5354
1997	G（0.3268）J（0.1171）S（0.0848）	0.5287
1999	G（0.3345）J（0.1195）S（0.1005）	0.5544
2000	G（0.3203）J（0.1252）S（0.1116）	0.5573
2001	G（0.3459）J（0.1191）S（0.1094）	0.5745
2002	G（0.3689）J（0.1257）S（0.1022）	0.5968
2003	G（0.3778）J（0.1639）S（0.1221）	0.6638
2004	G（0.3639）J（0.1958）S（0.1278）	0.6874
2005	G（0.3642）J（0.1956）S（0.1272）	0.6870
2006	G（0.3595）J（0.1932）S（0.1185）	0.6712

Source:Xu Yong, "The Measurement and Evaluation of Regional ggregation of high-tech industry in China," Science & Technology Progress and Policy, vol.26, pp101-103, 2009.

There are prominent advantages in communication apparatus, household audiovisual equipment, PC and electronic device manufacturing in Pearl River Delta. The proportion of the industrial output value of all above in Guangdong is more than 95 percent since 2000.

The random networks has developed into scale-free networks in the EEMI of Guangdong province. For example, the EII stressed the large number of medium-small business owning the almost equal resource at the beginning in Shenzhen. It showed the characteristic of random networks without coreforce. Then Huawei and Zhongxing which possessed a great deal of recourses and social relations appeared in the period of 1990s and 2000s. They became the core enterprises around by other medium-small businesses in the EEMIs. It is the scale-free networks with a few knots.

The networked industrial agglomeration of EEMI in Guangdong province was in the stage of formation and the economic benefit of it was not good relative to the scale measured in terms of the entire assets contribution

[1] Abbreviation G is Guangdong province, J is Jiangsu province, S is Shanghai.

rate (EACR）, the liability/asset ratio (LAR), the industrial costs/ profit rate (ICPR), all-personnel labour productivity (APLP) and the Aggregate index of industrial economic benefits (AIIEB) “Table 2”. The homogenization of EEMI products as well as the deficiency of innovative talents and core technology weaken the international competitiveness of EEMIs in Guangdong. the environmental pollution was another trouble.

Table 2. Economic Benefits Indicator of EEMIs in Major Provinces and Municipalities in 2004 (%,Yuan Per Pperson)

Provinces	AIIEB	EACR	LAR	ICPR	APLP
Guangdong	147.23	8.36	63.02	3.75	87803
Jiangsu	188.30	8.52	65.97	3.59	151540
Shanghai	235.83	6.81	63.37	3.15	239805
Tianjin	276.14	20.69	43.52	10.91	208396
Fujian	213.74	13.51	63.77	7.27	160970
Beijing	225.62	6.64	54.18	4.02	229819
Liaoning	138.13	5.51	55.67	3.88	87964
Zhejiang	142.67	9.44	56.83	5.49	71695
Shandong	202.16	13.04	54.19	4.12	149281
Guangdong’s rank	7	6	4	7	8

Source:Statistics Bureau of Guangdong Province.Guangdong Statistical Yearbook, 2005.

3.2 The Empirical Analysis based on the modified model

Ellison and Glaeser（1997）proposed an index of industry concentration based on the Gini coefficient. The expression is:

$$I = \frac{G - (1 - \sum_{i=1}^{n} X_i)\ H}{(1 - \sum_{i=1}^{n} X_i)(1 - H)} \qquad (1)$$

Here I is the industry concentration index, I∈[0,1]. I=0 is the employment distributed in districts uniformly. I=1 is the employment distributed in only one district. G is spatial Gini coefficient, expressing the degree that the employment distribution of an industry deviates from the distribution of all industry employment in n districts, G∈ [0,1]. i is the partition number of the entire region, values 1,2,3 ... ... n; Xi is the employment in i district proportion of that in the whole region. Si is the employment of an industry in i district proportion of that in the whole region. H represents the Herfindahl index, H∈[0,1].

The idea of the formula is to measure the regional cluster level of an industry with the concentration of labor. We have a modified model assuming H tends to zero,1-H to 1 because enterprises data and regional sub-industry employment data in China are difficult to obtain as well as the Herfindahl index is hard to calculate:

$$I = \frac{\sum_{i=1}^{n} (X_i - S_i)^2}{1 - \sum_{i=1}^{n} X_i^2} \qquad (2)$$

I is the industry concentration index, Xi is the industrial output value of i division proportion of total regional industrial output value. Si represents the industrial output value of an industry in i division proportion of that in the whole region. The division represents prefectural-level cities in Guangdong province, the region refers to the whole Guangdong province here.

The calculating cluster index of some industries in Guangdong province according to formula (2) indicates the situation of networked industrial agglomeration of EEMIs in Guangdong. The cluster indexes of transportation equipment manufacturing industry and mining industries are higher than EEMI, owing to the geographical distribution of natural resources and regional resource consumption. The cluster index of EEMI in Guangdong is up after down in the period of 1989-2007, that is a process first scattered and then focus. It has tended to decentralized while the advantage of industrial clustering has not reflected from the year 1989 to 2002. the degree of the industrial agglomeration gradually increased from the year 2002 to 2007, showing further development of the industrial cluster network.

We use factor analysis to evaluate economic benefits of 10 manufacturing industries in Guangdong province according to 8 basic evaluation indices（X1, X2, ……, X8）: overall labor productivity, industrial output value, total assets, average balance of current assets, average balance of net fixed assets, debt ratio, the main business income and total profit. In order to analyze the relationship between Cluster index and economic benefits, the cluster index was added as a variable X9. Then we have a correlation coefficient matrix while Bartlett test showed P <0.001. It means the correlation matrix is not a unit matrix and factor analysis could be done. Eigen values and the proportion of total variance explained of the principal component analysis as “Table 3”:

Table 3. SPSS 13.0 analysis result

Factor	Initial Eigen Values	Variance Proportion (%)	Cumulative Variance Proportion (%)
X_1	5.753	63.918	63.918
X_2	2.739	30.433	94.351
X_3	0.423	4.698	99.049
X_4	0.051	0.568	99.617
X_5	0.033	0.371	99.988
X_6	0.001	0.011	99.998
X_7	0.000	0.002	100.000
X_8	0.000	0.000	100.000
X_9	0.000	0.000	100.000

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As the cumulative percentage of X_1, X_2, X_3 is 99.05% we may use these three main components to evaluate economic benefits. Then rotate the component matrix and have the results:

Table 4. Rotated Component Matrix

Factor	F1	F2	F3
X_1	-0.115	0.972	-0.135
X_2	0.993	-0.036	-0.101
X_3	0.996	-0.043	-0.066
X_4	0.992	-0.070	-0.093
X_5	0.996	0.069	-0.037
X_6	0.531	-0.710	0.449
X_7	0.994	-0.034	-0.094
X_8	0.705	0.683	0.117
X_9	0.133	0.900	0.395

The first principal factor (F_1) has a large loading on "total industrial output value (X_2)", "total assets (X_3)", "average balance (X_4)", "net fixed assets average balance (X_5)" and "the main business income (X_7)". Wang Zhongzhi (2007) named several indicators reflecting the size of the industry as "Industrial-scale targets". The second principal factor (F_2) has a large loading on "overall labor productivity (X_1)" and "cluster index (X_9)" reflecting the industry's operational efficiency and economic benefits, so we call them "industrial efficiency target". As the third principal factor (F_3) did not load on some indicators as the first two and the first two principal factors reflect 94.35% of the information we could ignore it.

Linear equations of the two principal factors are as follows:

$$F_1 = 0.056X_1 - 0.134X_2 - 0.151X_3 - 0.173X_4 - 0.042X_5 - 0.795X_6 - 0.133X_7 + 0.565X_8 + 0.795X_9$$
$$F_2 = -0.134X_1 - 0.1X_2 + 0.998X_3 + 0.999X_4 + 0.988X_5 + 0.507X_6 - 0.051X_7 + 0.657X_8 + 0.064X_9 \quad (3)$$

Substituting values of X_1, X_2, ……, X_9 to F_1 and F_2, we can get the "industrial scale" and "industrial efficiency" scores of 10 manufacturing industries of Guangdong province. The composite scores of the 10 manufacturing industries by totaling F_1 and F_2 according to their respective contributions to the proportion of variance could obtain. "Table 5".

Table 5. Composite Score of Manufacturing Industries in Guangong Province

Rank	Manufacturing Industry	Industrial Scale's Score	Industrial Efficiency's Score	Composite Score
1	Oil and gas mining industry	0.19	245．52	73.78
2	Black metal mining industry	0.03	15.35	4.73
3	EEMI	3.79	3.10	3.36
4	Transportation equipment manufacturing industry	0.85	6.63	2.53
5	Beverage manufacturing industry	0.12	6.32	1.98
6	Pharmaceutical Industry	0.12	5.24	1.65
7	Food manufacturing industry	0.18	4.71	1.53
8	Textile and apparel manufacturing industry	0.43	1.30	0.67
9	Furniture Manufacturing Industry	0.20	1.71	0.64
10	Educational and sports goods manufacturing industry	0.00	1.05	0.32

EEMI has an obvious advantage in the "industrial scale" in the 10 manufacturing industries. However it is lower in the "industrial efficiency" than oil and gas industry, mining industry, transport equipment manufacturing industry, beverage industry, pharmaceutical manufacturing and food manufacturing industry.

4. Conclusion

The networked industrial agglomeration of EEMIs developed rapidly relying on the historical, geographical and policy advantages in Guangdong province. At the same time the international competitive power was still weak because of the low economic efficiency and the deficient innovation.

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