A Dynamic Analysis on Cooperation Network of Science and Technology in Yangze River Delta

GONG WEI-JUN[1]
YU DONG[1]
JIANG ZHAO-HUA[1]
1. Dalian University of Technology, Department of Humanity and Social Science
No.2 Linggong Road Ganjingzi District Dalian, Liaoning Province, PRC

Abstract

The Yangze River Delta now enjoys the most prosperous science-economy and the most profound cooperative network of science & technology (CNST)in China. This paper obtains the number of papers published or co-published in Shanghai City, Jiangsu Province and Zhejiang Province, which are all within the region of the Yangze River Delta, during the years 1994 to 2005 from Chinese Full-text Database, and establishes a dynamic model of regional CNST with the scientific output data obtained above and the scientific input data of the corresponding year. In the Hopfield type non-linear neural network model

$$\frac{du_i}{dt} = \sum_{j=1}^{3} T_{ij} V_i + \alpha_i U_I + \beta_I U_i^{\,2} + I_I$$

where V_I is the number of papers, T_{ij} is the intensity of scientific cooperation between network units i and j , U_I is the scientific input of network unit i , and I_I is the impetus beyond the network. The author discusses the rules of adjustment and optimization of T_{ij} ,the intensity of scientific cooperation, and studies the development trend in regional CNST and the impetus of regional cooperation of science & technology.

1. Research in China and abroad on regional cooperation in science and technology

The region of Yangze River Delta, the geographic area which includes Shanghai, Suzhou and Zhejiang, enjoys the most prosperous economy, the most advanced science and technology, and the most developed culture. According to the general planning of Chinese mid-and-long-term programming on scientific and technological development as well as the economic and social development demand of this region, the construction of an innovation system should be pushed with great efforts, which will help to break the boundaries of administrative regions and to optimize the allot of scientific resources in a wider range, in a broader field and to a higher level, and thus bears great strategic significance in promoting the economic and social development in the Yangze Delta and even in the whole China[1].

The famous Eureka Plan was raised in Europe in the 1980s, aiming to intensify the all-round cooperation on science economy and technology between nations in Europe. This plan bears great significance for it is in its implementation that lies the hope of European

leaders to take the European and world development trend in economic technology under control[2].

Cooperation in science and technology bases on mutual benefit and thus is in favor of the scientific advance and economic development of each country. Chinese government also pays great attention to it. Upon the founding of People's Republic of China (PRC), China began to actively involve itself in the international cooperation. With the time passing by, China has established cooperation relationship with 152 nations and regions in the world. So far, China has participated in 899 international scientific organizations and established a long-term cooperation relationship in science and technology with European Communities[3].

Shanghai Bureau of Science and Technology encourages multinational corporations to establish R&D institutions in Shanghai, and by now more than 100 foreign enterprises have established their R&D centers in Shanghai with the approval of the municipality. The municipal government also encourages local colleges, universities and research institutions to widely participate in the international cooperation in way of jointly establishing R&D centers together with well-established universities, enterprises and research institutions. Shanghai Jiaotong University has established scientific cooperation relationship and joint laboratories with nearly 50 universities such like Cambridge University, MIT and Standford University. Likewise, Fudan University has also established Fudan-Manchester Biological Information Center[4].

2. Cooperative model of the Yangze River Delta

Table 1 The cooperation data between Shanghai & Zhejiang Province

Year	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996
Sum of the papers in Shanghai	37022	60463	54104	47544	44106	41561	34132	28108	25911	22273
cooperative intensity between S & Z	0.017287	0.017827	0.016593	0.015351	0.01485	0.015431	0.016161	0.012396	0.014442	0.016593
cooperative intensity between J & S	0.014757	0.013168	0.013475	0.01209	0.011783	0.011778	0.009149	0.007046	0.007147	0.006937
Sum of the papers in Zhejiang	58832	89529	74731	66056	56970	47827	34095	26864	22711	18728
Sum of the papers in Jiangsu	111471	187804	166090	145580	129420	113181	86241	70107	64227	55211
The year 2003's input in Shanghai	160.97	138.22	112.31	112.68	95.84	91.71	94.36	79.73	84.32	85.88
The year 2003's input in Jiangsu	211.81	165.02	133.41	108.85	71.96	61.03	57.28	62.60	60.71	72.91
The year 2003's input in Zhejiang	84.60	48.07	43.80	36.39	22.47	19.71	19.07	25.74	21.32	15.49
The number of science and technology personnel in Shanghai	18.51	17.24	16.52	14.91	15.81	13.13	13.30	11.19	11.42	11.08
The number of science and technology personnel in Zhejiang	22.41	21.23	20.45	19.85	20.34	20.53	21.54	19.55	19.63	19.76
The number of science andtechnology personnel in Jiangsu	10.73	7.18	6.52	5.78	5.52	4.96	5.27	4.67	6.22	7.18

2.1. The cooperative intensity model between Shanghai & Zhejiang

According to the data of Table 1, using the metrology software, regressive analysis gets the cooperative intensity model between Shanghai & Zhejiang, and regressive equation pass the value of Statistic in the t test.

y=1.770E-02 + 1.118E-03 x -4.842E-03 **X1** -1.685E-02 **X2**

y_cooperative intensity between Shanghai & Zhejiang

x: per capita S&T input in Shanghai

X1: The number of papers in Zhejiang / the number of papers in Shanghai

X2: The S&T input in Zhejiang / the S&T input in Shanghai

Table 2 The pertinence test of the Model

Model	R	Std. Error of the Estimate	R Square Change	F Change	Sig. F Change
1	.924(a)	7.3439878156082E-04	.855	11.759	.006

Table 3 The t test of the Model

Model		Unstandardized Coefficients		t	Sig.
		B	Std.Error		
1	(Constant)	1.770E-02	.002	10.295	.000
	per capita S&T input in Shanghai	1.118E-03	.000	4.687	.003
	X1	-4.842E-03	.002	-2.004	.092
	X2	-1.685E-02	.004	-3.745	.010

2.2. The cooperative intensity model between Shanghai & Jiangsu

According to the data of Table 1, using the metrology software, regressive analysis gets the cooperative intensity model between Shanghai & Jiangsu, and regressive equation pass the value of Statistic in the t test_

y= 6.074E-03 + 2.122E-04 **u**

y_cooperative intensity between Shanghai & Jiangsu

u: per capita S&T input in Shanghai * The number of papers in Jiangsu / The number of papers in Shanghai

Table 4 The pertinence test of the Model

Model	Adjusted R Square	Std.Error of the Estimate	Change Statistics	
			R Square Change	F Change
1	.740	1.4083382803841E-03	.773	23.774
a Predictors:(constant), the intensity in Jiangsu				
b Dependent variable: The cooperative intensity between Shanghai & Jiangsu				

3. *Two Models of Cooperation*

The two models are classified by the cooperative intensity between regions which is defined as the following[5],

$$T_{ij} = \frac{S_{ij}}{x_i + x_j} \qquad \_1\_,$$

where x_i and x_j represent the intellectual output in regions i and j, S_{ij} the joint intellectual output in regions i and j, T_{ij} cooperative intensity.
Definitions above, simple and clear, emphasize particular on the quantitative and positivism research on the cooperative intensity. The numbers of papers on science and technology in the corresponding regions are taken as the index of intellectual output. One minor point to note is that both papers and patents should be taken into account when calculating the intellectual output. However, due to the difficulties in collecting the data on cooperative patent output, only the number of papers from Chinese Full-text Database is collected and analyzed.

4. *Prospect and suggestions on the future cooperation in the Yangze River Delta*

It will not only accelerate the industrial upgrade in YRD but also help to improve China's comprehensive national power to strengthen the scientific and technological cooperation and centralize the S&T resources in YRD. On the basis of the above models and analysis, the following prospects on the cooperative intensity on science and technology of Z-S(Zhejiang Province and Shanghai) and S-S(Suzhou Province and Shanghai) in 2010 are made.

It is predicted, based on the development trend of papers, input and personnel on science and technology in Zhejiang Province and Shanghai in the past 10 years, that Z-S ratio of sum of papers will approach 2, the input ratio will be 0.7 and Shanghai per capita S&T input will reach 28. According to Formula (2), Z-S cooperative intensity will reach 0.0275 in 2010. Similarly, it is calculated that J-S cooperative intensity will be 0.024 in 2010 based on Formula (3).

In order to achieve the highly S&T cooperation in the Yangze River Delta, the S&T input and the talent introduction in Shanghai should be guaranteed since Shanghai enjoys the most advanced science and technology within the Yangze Delta region. Jiangsu and Zhejiang can thus obtain rich S&T resources through their cooperation with Shanghai to upgrade their science and technology and then support the development of Shanghai and, finally achieve the common development of the whole region.

The following suggestions are proposed in order to promote the regional scientific and technological cooperation in the Yangze River Delta.

- An innovation system should be constructed in the YRD region to intensify the scientific and technological cooperation, optimize the scientific and technological resources and to realize the common development in the region, which has great significance in the long run.

- Relevant systems should be established. Systems of scientific and technological cooperation are not sufficient and it's government's duty to establish efficient systems to promote the technical transfer and resource sharing. For instance, governments can establish policies to encourage regional scientific and technological cooperation and priorities should be granted to cross-region cooperative programs and projects. Guidance and supervision should be strengthened and measures should be taken to restrict local block-out and to enhance the free exchange of production factors.
- General planning should be made in the national scientific and technological planning. A particular national plan on the promotion of regional scientific and technological cooperation should be established, which can start with mature program and forms a regional cooperative planning system in the end.
- The Eureka Plan can be taken for reference to innovate models of regional scientific and technological cooperation.

References

1 Wang. Lijun, The Study on An innovation System of the Yangtze Delta Region by Shanghai Jiangsu and Zhejiang pp45-47, China Science and Technology Forum,2003

2 Super Start Reader, An Introduction to Eureka Plan

3 Dai. Yanjun, The Status Quo and Measures of China International Technology Cooperation, Study and Management of Science and Technology, 2001

4 Yang. Liuchun, The Technology Cooperation In the Yangtze Delta Region, Jiangsu Science and Technology Journal,2004.3.20

5 Long. Liantang et al, The Quantitative Analysis of the Regional Producing Cooperation in China, Technological progress and Measures, pp 62-64, 2006