An Empirical Analysis on the International Competitiveness of China's Electronic and Telecommunications Equipment Industry

—The Data from OECD Countries

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***Abstract*—China's electronic and communication equipment manufacturing industry has grown from strategic emerging industry to leading Hi-tech industry. So it will be of great theoretical and practical significance for government to make strategic plan of Chinese strategic emerging industry and high technology industry development. This paper uses principal component analysis and SPSS19.0 software and dates if OECD countries about the international competitive of electronic and communication equipment industry which is the best part of Hi-tech industries in China. The results show that the electronic and communication equipment industry in China gross output and exports is of significant growth, the competitiveness is rising, but its international status is still not high. The main reason of weak International Competitiveness are the low innovation ability, the lack of independent intellectual property, and the low-end locking in the division of labor of industry chain.**

Keyword-electronic and telecommunications equipment industry; industrial competitive advantage; international competitiveness; PCA

I. INTRODUCTION

Since the 1990s, the hi-tech industry has become the focus of technology and economic competition in the world[1]. Electronic and communication equipment manufacturing industry is one of the important part of Hi-tech industry, and it makes a breakthrough in the economic growth and the industrial structure upgrade. Since 2000, as electronic and communication equipment manufacturing industry represent that China's Hi-tech product value of exports to 26.98% average annual growth rate had been planned to 2010, that had begun running a trade surplus in 2004, had accounted for 18.1% of the global market and overtaken USA as the largest country in 2007. The value of Electronic and communication equipment manufacturing industrial exports had increased to $ 692.88 billion, shared is 26.19% of the world's total. We can't get an actual result if we only use evaluation methodology like RCA, TC, IMS etc. Because that evaluate only by outlet data, but don't consider import and domestic market factors, that would make the international competitiveness of industry in genuine strength country is undervalued, but overvalued in processing trade country [2]. So how to evaluate international competitiveness of China's electronic and communication equipment manufacturing industry scientific? This is a major problem to solve if the government wants to make the Hi-tech industrial policy.

The synthesized evaluation of Hi-tech industrial international competitiveness has become one kind of new research tendency, but how to choose the evaluation index still controversial. Michael Porter put forward the theory of competitive advantage has become a new normal form of international competitiveness. His "diamond model" system includes 4 key factors which effect industrial international competitive advantage: factor conditions; demand conditions; firm strategy, structure and rivalry and related; supporting industries, and 2 cofactors: government and chance [3]. Hi-tech industrial international competitiveness of developed country can be explained persuasive, but unsatisfactory for developing country or undeveloped area. Many academics based on the above consideration, it is done to improve and complement the previous theory. Rugman propose "Double diamond model" based on Canada [4]; Cho, D. Sung built "ninth element model" [5] ; Moon developed "double diamond model" generally for economic analysis of small nations[6]. Yulin Zhao built new diamond model of industrial international competitiveness that based on technological innovation [7]. Technological innovation is the core in this model, it promote the collaborative of 4 factors in Porter's "diamond model" to enhance industrial competitiveness. Those researches prepare the theoretical and methodological base, and the article studies for the experience from provided. However, those researches only evaluated among the areas in own country or industries in an area, but not had real evaluation for international competitiveness compare among nations. The article use the PCA (principal component analysis) and data of 22 OECD members to evaluate China's electronic and communication equipment manufacturing industrial international competitiveness based on the new industrial international competitiveness diamond model of technological innovation.

II. THE CONSTRUCTION OF THE EVALUATION INDEX SYSTEM AND DATA PROCESSING

According to the theory of international competitiveness diamond model and industrial competitive advantage that based on technological innovation. We can see the evaluation index system need index to directly reflect competitiveness that like: total value of output; value of added; value of exports; rate of profit; labor productivity, and also have the key factor to effect competitiveness that like: technological innovation; production factors; demand conditions; market structure and enterprise competition; supporting industries etc. In the conditions that economic globalization and industrial convergence, Hi-tech industry forms competitive market structure. It is hard to get data from other countries, so we don't consider the index of market structure and enterprise competition in the article, and we build the construction of the evaluation index system like following. (See Table 1)

TABLE I. THE EVALUATION INDEX SYSTEM OF HI-TECH INDUSTRIAL INTERNATIONAL COMPETITIVENESS

First Index	Second Index	Index Code	Index Introduction
Production Factors	Value Added Ratio	X1	value added accounts for the share of output value
	Profit Ratio of Production	X2	profit accounts for the share of output value
	Labor Productivity	X3	per capita output
Trade Competition	International Trade and Competition Index	X4	The ratio of import and export trade gap to total trade
	International Market Share	X5	The ratio of export value to the total export value in the world
Innovation Ability and Level	Intensity of R&D Expenditure Investment Intensity	X6	The ratio of R&D expenditure to value added
	R&D Personnel Investment Intensity	X7	The ratio of R&D personnel to total employees
	Patents	X8	the application of Hi-tech patents
Demand Conditions	Income Elasticity of Demand	X9	the relationship between sales revenue of products and average personal income
Complementary Industry	Per Capita Disposable Phone Line	X10	amount of Per Capita Disposable Phone Line
	Internet Penetration Rate	X11	The ratio of Internet user to the whole population

Unified index data acquisition is the key and difficult point to evaluate high-tech industrial international competitiveness. The article chooses 22 OECD member countries for comparison object according to unified standards, and the average for 2004-2008 data from different countries, to eliminate outside influence and economic volatility. The data was found and calculation arrived from Structural Analysis (STAN) Databases of OECD and China Statistics Yearbook on High Technology Industry (1995-2011). Because of the data is missing in some countries, so the article only choose 22 OECD member countries following: AUSTRIA; BELGIUM; CANADA; CHINA; CESKO; DENMARK; FINLAND; FRANCE; GERMANY; GREECE; ITALY; JAPAN; KOREA; MAGYARO; NETHERLANDS; NORWAY; PORTUGAL; RSZ; SWEDEN; SPAIN; SLOVENIJA; SLOVAKIA; USA;UNITED KINGDOM.

By using PCA method and SPSS19.0 software through data reduction, we get the KMO=0.62>0.5. It shows that has relationship between every variable, and it can be performed by factor analysis.

TABLE II. KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.661
Bartlett's Test of Sphericity	Approx. Chi-Square	153.137
	df	55
	Sig.	.000

III. ESTABLISHMENT OF COMPREHENSIVE MODEL OF PRINCIPLE COMPONENTS

According to the deciding rules of principal component number, principal component Eigenvalues must greater than 1 .Data processing results show the first 4 principal components (F_1, F_2, F_3, F_4) eigenvalue bigger than 1,Contribution rate is 84.034%(shown in Table 3).Comprehensive explanation of four principal component achieved 84.034%. Therefore principal component can perfectly explain the meaning of initial index and give preferably explanation of International Competitiveness in Electronic and Telecommunications Equipment Industry. Analysis of principal components load matrix, the first principal component of significant related factors are: Profit ratio of production, labor productivity, intensity of R&D expenditure investment, R&D personnel investment intensity, per capita disposable phone line, Internet penetration rate. these indicators can reflect the high technology product added value, high technology industry innovation capability , basic condition of informatization which support hi-tech industry technology innovation, collectively referred to

industrial innovation competence; related factors of second principal components were: patents, trade competitiveness index, international market share, these indicators can reflect the level of international trade of high technology industry, which refer to industry trade competence; the third principal component is closely related to value added rate, which reflect the input and output effect of high technology industry , we call it for industry productivity competence; the fourth principal components is related to domestic demand elasticity, which refer to industry demand competence.

Factor contribution rate should be normalized as weigh, using the formula $F=W_1F_1+W_2F_2 \quad W_3F_3+W_4F_4$ (W_1=39.834/84.034;W_2=21.569/84.034;W_3=13.329/84.034; W_4=9.303/84.034), then we can get comprehensive model of principle components:

$$F=0.474037F_1+0.256707F_2+0.158589F_3+0.1106668F_4$$

TABLE III. TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	4.382	39.834	39.834	4.382	39.834	39.834
2	2.373	21.569	61.402	2.373	21.569	61.402
3	1.466	13.329	74.731	1.466	13.329	74.731
4	1.023	9.303	84.034	1.023	9.303	84.034

Extraction Method: Principal Component Analysis.

IV. EVALUATION RESULTS AND ANALYSIS

According to comprehensive model of principle components, we use SPSS19.0 software, then we can get each factor scores of Electronic and Telecommunications Equipment Industry International Competitiveness and comprehensive score ranks from 23 countries. Details shown in Table 5

TABLE 5 ELECTRONIC AND TELECOMMUNICATIONS EQUIPMENT INDUSTRY INTERNATIONAL COMPETITIVENESS SCORE RESULT AND COUNTRY RANKING

countries	industrial innovation competence score	industry trade competence score	industry productivity competence score	industry demand competence score	Comprehensive score	Ranking
USA	2.565147	2.360396	2.431594	1.380508	2.360306	1
FINLAND	4.155419	0.943365	-1.5251	0.817293	2.060573	2
JAPAN	1.724558	3.076464	0.281781	-0.40621	1.606988	3
SWEDEN	3.077975	-0.18625	-1.29092	-0.12233	1.192999	4
DENMARK	1.617035	-1.08024	-0.08658	0.564135	0.53793	5
CANADA	0.995904	-0.30123	0.340787	-0.12953	0.434477	6
FRANCE	1.03894	0.220249	0.281873	-1.64897	0.411253	7
UK	1.323425	-0.86567	0.71659	-1.23966	0.381585	8
NORWAY	1.111074	-1.10655	0.093139	0.67051	0.331605	9
AUSTRIA	0.78991	-0.45512	-0.00577	0.357894	0.296306	10
GERMANY	0.702118	-0.04231	0.36536	-0.98558	0.270839	11
KOREA	0.368019	1.182417	-1.16248	-0.34735	0.255192	12
BELGIUM	0.336995	-0.71583	-0.16672	-0.11101	-0.06274	13
ITALY	-0.81489	-1.17443	1.387926	1.055634	-0.35084	14
GREECE	-1.65941	-2.06017	2.226915	1.748045	-0.76887	15
NETHERLANDS	-1.20227	-0.05221	-1.96818	0.42346	-0.84859	16
SPAIN	-1.3728	-1.2166	0.413298	0.257574	-0.86902	17

SLOVENIJA	-0.52562	-1.93773	1.082869	-2.85523	-0.89084	18
CHINA	-4.50796	4.277294	1.253731	-0.53908	-0.89976	19
SLOVAKIA	-2.48445	0.509791	-1.86383	0.698563	-1.26513	20
MAGYARORSZ	-2.62361	0.123963	-1.25247	0.305555	-1.37668	21
CESKO	-2.35253	-0.38226	-1.01583	-0.10065	-1.38555	22
PORTUGAL	-2.26297	-1.11732	-0.53799	0.206416	-1.42204	23

The empirical evaluation results shows that China Electronic and communication equipment manufacturing industry overall competitiveness is relatively low, among 23 countries, it ranked nineteenth, only higher than Slovakia, Hungary, Czech and Portugal, belongs to weak international competence country. In the four principal component affecting the international competitiveness of Chinese high-tech industry, trade competitiveness has significant advantages, with 4.277294 points ranked the first; industry productivity competence also has certain advantages, ranked seventh; but industrial innovation competence is too weak, the score was -4.50796, ranked the last one; industry demand competence is also weak, score -0.53908, ranking nineteenth. This is the cause of Chinese high technology industry exports in low-end locking and low international competence

China's electronic and communication equipment manufacturing industry trade competence perform outstanding, has strong international advantage competence. From 1995 to 2010, China's exports of electronic and communication equipment manufacturing industry continued rapid growth, from 71.2billion yuan in 1995, in 2010 rose to 1958.9billion yuan (about $293billion), nearly 28 times increase. product Exports of China Electronic and communication equipment manufacturing industry in 2008 is up to $239billion, more than the United States which ranked two ($87.3billion) and Japan ($84.6billion)which ranked three. From the import and export product structure, an average of TC indexi n China from 2004 to 2008 is 0.0726, which shows our electron and communication equipment manufacturing industry has weak trade competence advantage. Under the background of globalization, the fierce competition in the international market can promote the domestic export enterprises development. from the " nationality " aspect, the three kinds of foreign-invested enterprises accounted for a major position, in 2006, its exports volume reached $139.1billion, accounting for 80% of the total export volume ; in 2009 , the proportion get further expansion, accounted for up to 87%. This shows that high export of china electron and communication equipment manufacturing industry cannot fully reflect the international competence, in contrast, it should be strengthened.

China's electronic and communication equipment manufacturing industry productivity competence ranked fourth, with strong international competitiveness, but it still in the end of the value chain when it comes to international division status. So we need promote industry upgrade through technology innovation, then improve international division status.

China's electronic and communication equipment manufacturing industry has a low score of demand competence, ranked nineteenth. The main reason is that as a developing country with a large population, the per capita GDP of China and its per capita income is far below the level of developed countries. Accordingly, the information-based level is still relatively backward, network infrastructure is not perfect, the electronic and communication equipment manufacturing industry product demand is far from enough, all of these will stimulate product or service‘s improvement and innovation, then improve industry international competence.

Innovation capability of high-tech industry in china is low. From the innovation investment, R&D expenditure in China’s hi-tech industry is obviously inadequate, although it increased in recent years , in 2009 ,it reached 50.1billion yuan, but R&D expenditure intensity significantly low : in 2008, R&D input intensity is only 1.4%, only 13% of that in Japan, 12% of Finland , 11% of Sweden,8.5% of United States . in 2009 ; the R&D input intensity up to 1.9%, but only account for 5.8%of that in Finland R&D (32.9%) , the gap is still very obvious, and the trend of widening. This is a key factor of china’s export products structure in low-end locking positon.

Simultaneously, china’s hi-tech industry low labor productivity is also an important reason for the low international competence. China hi-tech industry labor productivity is slightly higher than the overall level of manufacturing industry and show an sustained growth, in 2010, it reached 684100 yuan / person, but compared with developed countries, there is still a huge gap, in 2009, china’s labor productivity is only account for 24.59% in France and USA , 30% in Japan and Germany

(5) Informatization level is low.22 members of the OECD per capita can simultaneously use 1.6 telephone lines, Internet penetration rate is up to 61.8% on average, while China's telephone lines per capita only 0.6, Internet penetration rate is only 10.8%, which shows that there is a big gap between China's informationization degree, it is also an important factor affect the international competitiveness of China's high technology industry.

V. CONCLUSION AND SUGGESTION

The Hi-tech industry is developing rapidly in China, industrial competitiveness is taking an ascend trend, but its international status is still despised. Although R&D Investment increased significant, it still far below developed country level. The weak innovation ability and the lack of proprietary intellectual property rights is the reason that “low-end locking” problem with division of labor in the industrial chain, that are further affect the output efficiency like profit ratio of production and labor productivity, etc. So, governments and enterprise have to be enlarging inputs to

science and technology, perfecting an innovative system about science and technology, building a reasonable and advanced mechanism to science and technology to improve the status in industrial chain.

International Trade and Competition index of Chinese hi-tech industry has a significant advantage over other countries, but foreign-invested enterprises play a primary role. Its proportion reaches 87%. It's very gratifying to see that private enterprises have shown strong upward trends in recent years. So, encouraging and guiding private enterprises piling into hi-tech industrial area, especially into the emerging industry area.

The weak line of Chinese hi-tech industrial international competitiveness is also in domestic demand. Expanding domestic demand and upgrading the demand structure can improve this factor. Meanwhile improving the living standards of its people and enhancing the quality of the entire nation. So, the government should encourage hi-tech enterprise to enhance market innovation, expand domestic market, build national brands, and serve the needs of hi-tech products for social construction.

The informatization level in supporting industries is an important factor to influence the Chinese hi-tech industrial international competitiveness. As a developing country, there are always some difficulties in construction development and technique popularization of informatization. China should quicken the pace that informatization builds to boost hi-tech industrial development at present, and provide strong support for our development in the long run.

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