What is used for World Factory to Produce Exports:

A Cross-country Comparison Based on Non-competitive Input-output Model

Huang Xianhai*, Yang Gaoju†
(College of Economics, Zhejiang University, Hangzhou, China)

Abstract: Based on Non-Competitive Input-Output model, we developed a method to analyze the composition of inputs of a country's export production, that is, a sector's *Domestic Complete Input Coefficient of Exports*, and *Domestic Complete Consumption Coefficient of Export Sector* and their structures. Using the non-competitive input-output tables provided by OECD for 1995, 2000, and 2005, we calculate and compare the corresponding indices of China, the representatives of developed countries (USA, Germany and Japan) and the representatives of developing countries (India, Brazil and south Africa). We get the following results: the coefficient eci^d of China's Energy sector is larger than those of the other sectors and other countries in the sample (average 0.338). This on the one hand shows that China's energy input in export sector is huge, but on the other hand implies the inefficient use of energy in China's export production sectors; Inputs for the export production in China's industrial sector mainly rely on Medium Technology and this trend becomes more and more significant (The coefficient value of Low Technology and Medium-low Technology sector is the largest in all industrial sectors).Though the coefficient values of the inputs for Low-tech and High-tech sectors are the lowest of all, the coefficient value of High-tech sectors increases dramatically (625.2%)), indicating that the technology level of export production has been improving; The coefficient value of Chinese High-class Services is less than that of other countries in the sample, indicating insufficient input in the export production of Chinese High-class Services and thus requiring further development. Moreover, the domestic input of China's Transport Sector in the export sector rises rapidly (151.4%), whose value is higher than those of all the other representative countries except South Africa. The above analysis shows that China should pay more attention to improving the efficiency of energy use in its export sectors and coordinating the "hardware" construction of transportation system and market-oriented "soft environment". Meanwhile, China should exert more efforts to develop high-class services such as finance and R&D to further strengthen its international competitiveness of exports.

Keywords: World factory; Exports production; Non-competitive Input-Output Model

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I Introduction

Since the reform and opening up, the foreign trade of China developed rapidly, especially after WTO, the average annual growth rate access 20%, and China has

* Huang Xianhai, Professor and vice dean, College of Economics, Zhejiang University, China.
† Yang Gaoju,Postdoctoral fellow. Fax: +86-0571-87951614.
add: College of Economics, Zhejiang University，No. 38, Zheda Road,
Westlake District, Hangzhou City, Zhejiang Province, China. E-mail: ygaoju@yahoo.com.cn.

become the world's second largest trading nation. Chinese-made products exported around the world, Made In China has become the "world factory" sign. However, many scholars have pointed out china received only minimal amount of "processing fees", which based on the lower labor and natural resource, in fact, "world factory" is only "world processing plant". (Song Yangyan, 2003; Yan Bochun, 2003). It shows that China is in the low-end position of the international specialization: at the bottom of the global value chain and the industry chain, and the huge volume of trade didn't bring much benefit accordingly. This seemingly contradictory phenomenon has attracted the concern of researchers and most research are based on the framework of Hummuls *et al*.(2001), analyzing how much of China's export-products is derived from domestic production, and how much by imports of parts and then exported after processing(processing trade)(Koopman *et al*., 2008； Lau *et al*., 2007).

We are interested in what is used for China to produce such a huge amount of exports. This includes a series of sub-problems: in the production process, what are the main domestic inputs and how much of inputs are imported? Which export production use domestic inputs the most, and which depends more on the imported inputs? It is clear that only after these questions are answered, can we have a more profound grasp of China's international trade and further explore how to optimize and upgrade the export structure. And this paper is aiming at answer above questions, and the remaining parts are arranged follows : the first part analyzes the trade product structure of China and other big trading countries, then is a further exploration using non-competitive input-output method, the last is a summary.

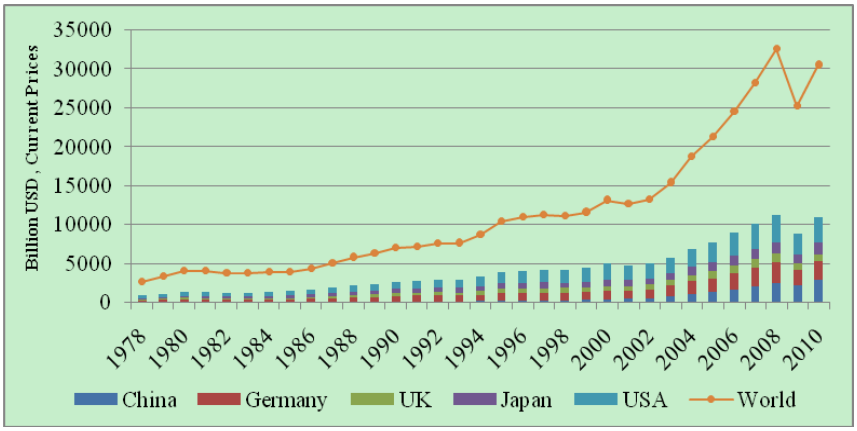

Figure 1 International Trade Volume, by Country/World: 1978–2010

Notes: Trade volume is sum value of export and import, Coverage: Hong Kong, China's re-exports are included. Beginning 93: figures are affected by the EU Intrastat system of recording trade.

Source: WTO, International Trade and Tariff Data.

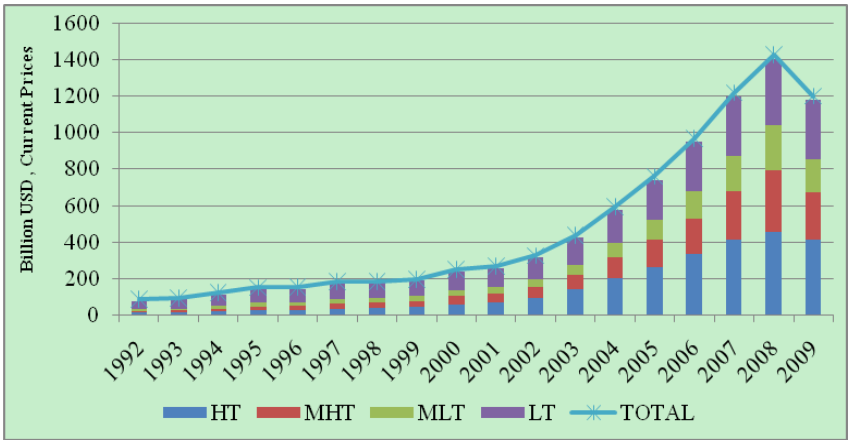

Figure 2 China's Exports Structure: 1992-2009

Notes: HT denotes High-technology industries, MHT denotes Medium-high-technology industries, MLT denotes Medium-low-technology industries, LT denotes Low-technology industries.

Source: OECD, Sti-Stan Bilateral Trade Database.

II Preliminary Analysis of Trade Data

According to the BEC Classification of UN, the industry categories under 111,121,21,31,42 and 53 are classified as intermediate products, the rest is as manufactured (Appendix 2). China's import and export data classified as BEC shows that there is a rapid rise of exports from 1995 to 2009 and the average annual growth rate is over 20% after 2002. From the view of the exports composition, the manufactured products weigh the most, while the intermediate products count a lower proportion (Figure 3). Figure 4 shows that China's imports also has a rapid growth since the accession to WTO. But contrary to the exports makeup, the intermediate products have a larger proportion and continue to rise, from 26.7% in 1995 to 51.1% in 2009.

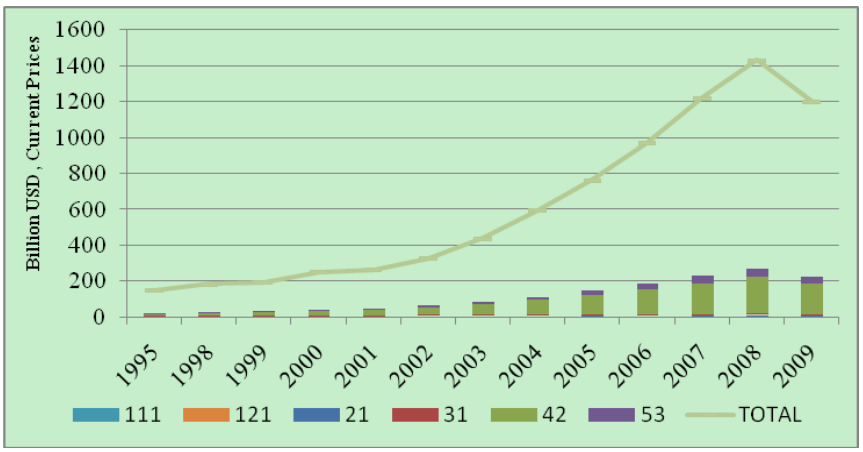

Figure 3 China's Export Structure in BEC Classification: 1995-2009

Notes: The industries denoted by the codes see Appendix 1. The original data of 1996 and 1997 is missing in UNCTAD.

Source: UN, UNCTAD.

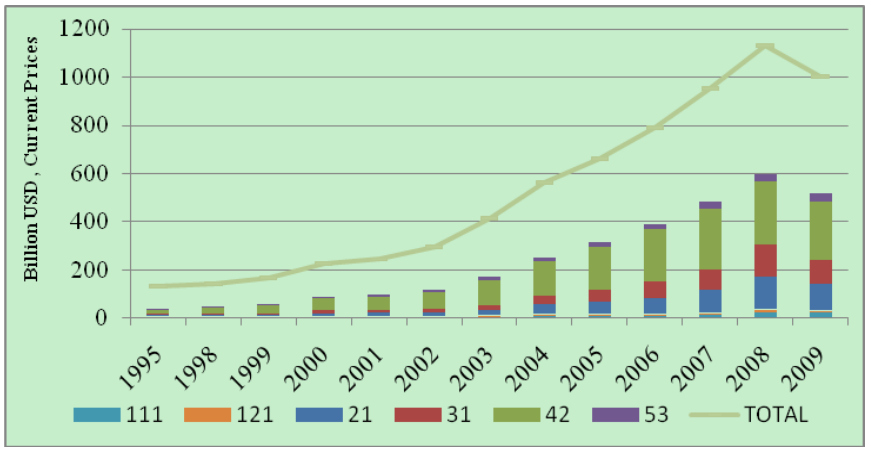

Figure 4 China's Import Structure in BEC Classification: 1995-2009

Notes: The meaning of codes and data source is same as Figure 3.

Comparing Figure 3 with Figure 4, we can find that from 1995 to 2009 on average, the imported intermediate products are 1.9 times of exported, and manufactured are 1.7 times. At the same time, the exported manufactured products are 4.5 times of exported intermediate products, while 1.5 times on imported, and this rate falls from 2.8 in 1995 to 0.9 in 2009. This shows that the basic pattern of China's foreign trade is importing a large number of intermediate products to produce the final goods then export out. [1]It is perhaps more telling if comparing China with other countries. As to export, except for Germany, the final product is less than 3 times of intermediate goods in both Japan and the United States (Figure 5). In the aspect of import, the imported intermediate products only about 36% of the overall even in Japan, who is heavily dependent on resources imports, and the proprotion is under 30% both in Germany and America, while the number of China is more than 40% in 2003 and more than 50% in 2007(Figure 6). That is to say, more than half of the imports are intermediate inputs that are used to produce final goods and then export.

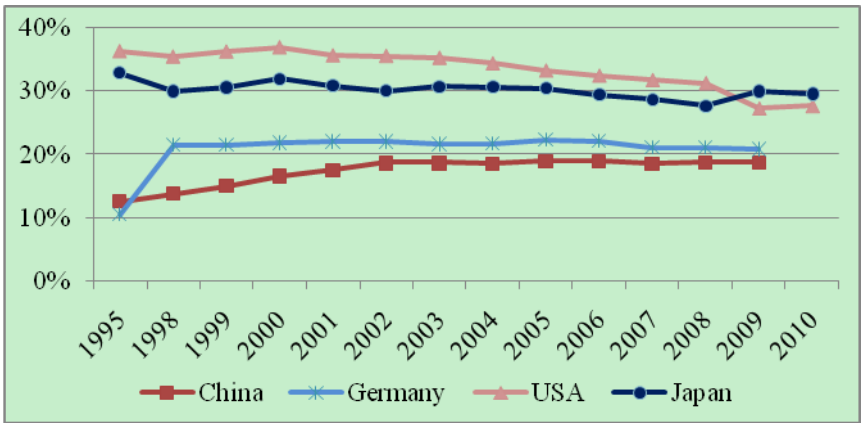

Figure 5 Intermediate Products Proportion of Exports by Countries: 1995-2010

Notes: Intermediate products are the sum of industries denoted by 6 codes in Figure 3.

Source: UN, UNCTAD.

[1] Absolutely, this process also contains a large number of domestic labor and intermediate product inputs.

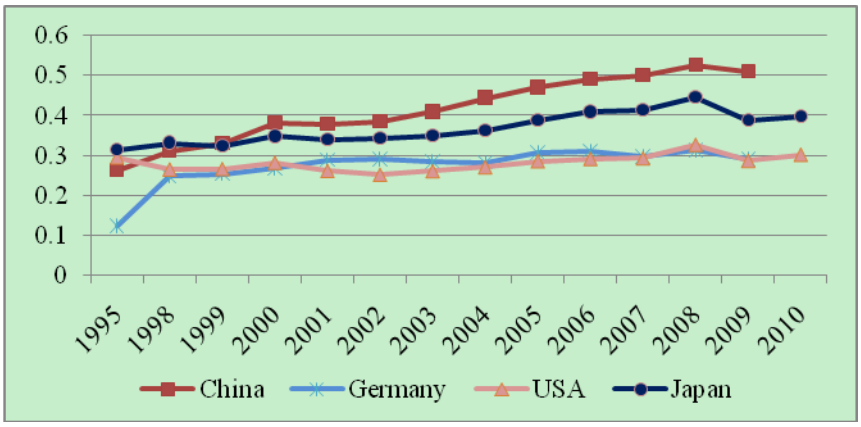

Figure 6 **Intermediate Products Proportion of Imports by Countries: 1995-2010**

Notes: Intermediate products are the sum of industries denoted by 6 codes in Figure 3.

Source: UN, UNCTAD.

III Analysis Based on the Input-output Method

It is hard to reflect the status of domestic inputs using BEC classification trade data, we turn to the method of non-competition input-output for further study, the specific method is: to calculate coefficients of domestic and import intermediate inputs of each department to unit export production, and to make the analysis of intertemporal and cross-country comparisons.

3.1 The method of analysis

A typical non-competitive input-output table as shown in Table 1:

Table 1 Non-competitive Input-output Model

Input \ Output		Intermediate use (1…n)	Total intermediate use	Final use					Industry output and imports
				Final consumption	Gross fixed capital formation	Exports	Others	Final use total	
Intermd-iate input	Domestic (1…n)	X^{di}		U^{dc}	U^{di}	U^{e}		U^{d}	X^{d}
	Imports (1…n)	X^{mi}		U^{mc}	U^{mi}			U^{m}	X^{m}
	Intermediate input total								
Initial input	Value added total	V							
	Total input	$(X)'$							

Notes: Upper-right mark d and m represent domestic products and import products; X^{di} and X^{mi} respectively represent the intermediate consumption matrix of domestic products and imports in the final production, U^{dc}, U^{di}, U^{e} denote column vector of consumption, gross capital formation, exports of domestic output. U^{mc}, U^{mi}, U^{m} denote the column vector of end-use of imports. X^{d}, X^{m} are the column vectors of total output and imports. V denotes the row vector of added value.

We can obtain supply and demand relationship as follows from horizontal direction of table 1:

$$\begin{aligned} &\sum_{j=1}^{n} x_{ij}^{di} + u_i^d = x_i^d \\ &\qquad\qquad (i = 1, 2 \ldots n, \\ &\sum_{j=1}^{n} x_{ij}^{mi} + u_i^m = x_i^m \end{aligned} \tag{1}$$

Where, $x_{ij}^{di} \in X^{di}$, $u_i^d \in U^d$, $x_i^d \in X^d$, $x_{ij}^{mi} \in X^{mi}$, $u_i^m \in U^m$, $x_i^m \in X^m$. Let $A^d = \left[a_{ij}^d \right] = \left[x_{ij}^{di} \middle/ x_j^d \right]$ and $A^m = \left[a_{ij}^m \right] = \left[x_{ij}^{mi} \middle/ x_j^m \right]$, and denote the direct consumption coefficient matrix of domestic products and imported goods respectively. Then (1) can be abbreviated into following matrix form:

$$\begin{aligned} A^d X + U &= X \\ A^m X^m + U^m &= X^m \end{aligned} \tag{2}$$

And thus:

$$X = (I - A^d)^{-1} U \tag{3}$$

Where, $(I - A^d)^{-1}$ denotes domestic complete demand coefficicient matrix (inverse of LeontiefMatrix), make $\bar{B} = (I - A^d)^{-1}$. Refer calculation method of final demand-induced production, suppose $\hat{E}$ to be a diagonal matrix, its main diagonal elements should be $\hat{e}_i = u_i^e \big/ x_i$ ($u_i^e \in U^e, x_i^d \in X_i^d$), The remaining elements are 0. We also assume that: a. proportion of intermediate inputs of various departments used in exports production are same; b. the proportion of intermediate used for export production is the same as the proportion of export out of total output. Then the *Domestic Complete Consumption Coefficient Matrix* $ECCM^d$ is

$$ECCM^d = (I - A^d)^{-1} \hat{E} = \bar{B}\hat{E} \tag{4}$$

Meaning of the elements of matrix $ECCM^d$ can be explained as follows: row of the matrix denote the direct and indirect total output of a sector that inputed in export production; the columns denote the direct and indirect total consumption of domestic output by a sector's unit export production. Further reference to calculation method of the influence coefficients and sensitivity coefficients, sum elements of row i of the matrix $ECCM^d$ toget the direct and indirect inputs required of i sector for the unit export production, which called *Domestic Complete Input Coefficient on Export* (eci^d). The greater of its value, the more domestic input of a sector to exports production, namely the greater support. Similarly, sum the column j of the matrix, we can get the direct and indirect domestic output consumption of a export sector to others, called *Domestic Complete Consumption Coefficient of Export* (ecc^d), the greater of its value, the more domestic consumption by a export sector, and then the effect on other sectors is stronger:

$$eci^d = \sum_{j=1}^{n} eccm_{ij}^d$$
$$ecc^d = \sum_{i=1}^{n} eccm_{ij}^d \quad (5)$$

If $eci^d > ecc^d$ for a sector, which indicates that the sector input more in the export production, but its own export consumption of other sectors less, can be called "input-based sector"; if $ecc^d > eci^d$, which indicates that even the sector input less in the export sector, but its own export consumption of other sectors more, which push the growth of other sectors, can be called "pull-based sector"; if $eci^d \approx ecc^d$, which indicates that input and consumption of a particular sector are the same, then the sector can be called "balanced sector".

If we replace the A^d in (4) to A^m, then we can calculate the import complete consumption coefficient matrix of exports production, and thus we can further get the *Import Domestic Complete Input Coefficient on Export* and the *Import Complete Consumption Coefficient of Export*.

$$eci^m = \sum_{j=1}^{n} eccm_{ij}^m$$
$$ecc^m = \sum_{i=1}^{n} eccm_{ij}^m \quad (6)$$

add $ECCM^d$ to $ECCM^d$, we get the *Total Complete Consumption Coefficient Matrix* $ECCM^t$: $ECCM^t = ECCM^d + ECCM^m$, then we can calculate the total input coefficient eci^t and total consumption coefficient of export ecc^t.

$$eci^t = eci^d + eci^m$$
$$ecc^t = ecc^d + ecc^m \quad (7)$$

Thus we can get the proportion of domestic complete input out of the total input and the proportion of china's complete consumption out of total consumption.

$$pi = eci^d / eci^t$$
$$pc = ecc^d / ecc^t \quad (8)$$

The higher value of pi, exports depend more on domestic input not imports, and the greater value of pc indicates unit export can bring more domestic output.

3.2 Data and results analysis

According to the above calculative method, based on 1995, 2000 and 2005 non-competitive input-output tables provided by OECD, we calculate and analyze China's indexes of 3 years, then we compare the indexes with those in the representative developed countries, such as United States, Germany, Japan (the major trading nations), and representatives of developing countries, like Brazil, India, South Africa (similar stage of development). As the non-competitive input-output table provide by OECD is based on ISIC Rev. 3 which is divided into 48 sectors, to facilitate the analysis, we classify the manufacturing into Low-technology industries,

Medium-low-technology industries, Medium-high-technology industries and High-technology industries based on the OECD technical classification[1], in order to analyze the input conditions of different level industries to export production; Meanwhile, in order to reflect the energy consumption of export sector, we view Mining and quarrying (energy), Coke, Refined petroleum products and nuclear fuel, Production, collection and distribution of electricity, Manufacture of gas, Distribution of gaseous fuels through mains , Steam and hot water supply as the Energy Sectors. In addition, since Post & telecommunications, Finance & insurance, Computer & related activities, Research & development are key development areas of high-class servers sectors, we view them as the High-class Service Sector to analyze its inputs to export sectors. Taking into account the continuous development of industrialization will result in lower proportion of the agricultural sector, leading to weaker input and output relationship with other sectors, the agricultural sector will therefore be listed separately; Finally, taking into account the efficiency of the transport sector will also affect export production, like the large number of processing production in the southeast of China requires a lot of energy such as coal, natural gas, which need to be delivered from the central and western regions, and thus we view Water transport, Land transport; Transport via pipelines, Air transport, Supporting and auxiliary transport activities; Activities of travel agencies as the Transport Sector.[2] The result of average value of coefficient of above sectors is shown in the following tables 2-4. Comparison of data in Table 2 to 4, we can find:

(1) The *Domestic Complete Input Coefficient on Export* of Energy Sector is the greatest in all nations. But the coefficient of china is significantly higher than all other countries.

Specifically, the trend of coefficient of China's energy sector eci^d was upward in volatility for 3 years[3], which increased from 0.179 in 1995 to 0.46 in 2000, then dropped to 0.376 in 2005, totally increased 109.8% in 10 years, showed that the energy consumption of Chinese export production is on rise. While of the representatives of the developed countries, the United States' corresponding value of 3 years are 0.188, 0.108 and 0.142, which dropped 48.7%, Japan are 0.132, 0.126 and 0.191, upped 44.8%, Germany: 0.125, 0.118 and 0.149, increased 19.3%. Obviously, both the absolute value and magnitude of changes are much lower than China's performance. In the representatives of developing countries, only Brazil has the similar performance as China, large value and large rise: 0.205, 0.380, 0.452, and an increase of 1.2 times, while the values of India (0.254, 0.287, 0.280) and South Africa (0.199,0.237,0.206) are lower than China and only increase slightly (10.3% and 3.4%).

To combine the domestic input in export production of Energy Sector with the China's export data, we can find that China had become the world's sixth largest exporter in the 1990s, and ranked No. 3 in 2004, but the energy consumption of unit export production is much higher than other countries and still on the rise. This means that China use less per capita natural resources than world average to make mass-produced industrial products for world. Thus, China provides high energy-consuming products to world, and the cheaper domestic energy price because

[1] http://www.nsf.gov/statistics/seind04/c6/tt06-01.htm.
[2] Details of industrial classification see Appendix 2.
[3] 3 years indicate: 1995, 2000 and 2005.

subsidies,[1] means China offers energy and environment subsidies to the whole world.[2] But this kind of "subsidy" has brought unexpected results: energy consumption and largest carbon dioxide emissions country[3], the endless anti-dumping investigations and various trade barriers, and deteriorating trade environment (Yabin Zhang *et al.*, 2010). Obviously, China's situation of foreign trade must be improved as soon as possible, since it is bound to be unsustainable with limited energy. Although the export of energy coefficient has dropped after 2000, it is still higher than that of countries besides Brazil, which means there is still much work to do for China in energy saving.

(2) China's domestic investment in agriculture of export production ranked second, similar to Brazil and India, but significantly higher than the representatives of the developed countries.

The coefficient of agriculture rapidly increased from 0.153 to 0.215 (up by 40%), and then fell slightly to 0.192, the overall decrease is 10.6%, which is similar to India (0.179, 0.132, 0.154) and Brazil (0.147, 0.159, 0.194) in value, but different in trend. India continues to decline (reduced by 14%), Brazil has continued rise (31.4%). The value of South Africa is close to that of the developed countries and much lower than that of China, India and Brazil. The highest value of South Africa is only 0.097 (down by 39.2%), and Germany is 0.033 (up by 30.1%), Japan is up to 0.01 (up by33.4%), the United States is not more than 0.057 (decreased by 41.9 %)

The condition of inputs to the exports production of agricultural departments, which is connected with the proportion the agriculture accounts for in the national economy and the industrial structure of exports. The proportion the agriculture accounts in the whole economy in China decreased from 13.1% in 1995 to 7.2% in 2005, the percentage of India and Brazil are 15.1% and 5.1% in 2005, while the figures of South Africa, America, Germany and Japan are 2.7%, 1.4%, 1.1% and 1.4% respectively; At the same time, the Textile and Clothes covers a large part in export in our country, hitting the mark 14.4%, which needs much agricultural inputs. And the ratios in India and Brazil are 13.3% and 3.5%, while in South Africa, America, Germany and Japan, the figures appear to be much smaller, reaching 0.8%, 1.4%, 2.5%, and 0.9%. Both of the two factors contribute to the result: Input from agricultural departments to the exports production occupies a larger proportion in China, indicating that the industrial structure and the export structure in our country need to be improved. The proportion of the agriculture accounts for in the national economy and the export products based mainly on agricultural inputs should be reduced.

(3) Input from transportation industry to the exports production increases dramatically, exceeding other typical countries except South Africa. During the last decade, the eci^d in China has increased by 151.4% (from 0.064 to 0.109 then to 0.160), while the average value of the three years in Brazil is 0.029 (increased by 7.4%), India 0.04 (decreased by 3.6%), Japan 0.038 (increased by 20.7%), Germany 0.07 (increased by 6.9%), The USA 0.047 (decreased by 18.3). In South Africa, where the relevant figure

[1] China has offered price subsidies for energy using since reform and opening up, and detailed description see: Qin Zhou et al(2011).

[2] Study of Gang Fan , et al (2010) found that approximately 14-33% (20% or more) of the actual domestic emissions in china are caused by the consumption of other countries.

[3] Data is from China's National Development and Reform Commission Energy Bureau: http://www.china.com.cn/chinese/PI-c/696499.htm ,visit on 5-17,2011; "China's low-carbon economic development report (2011) ": http://politics.people.com.cn/GB/1026/14250355.html.

is similar to China, the index tends to grow lower (from 0.22 to 0.186 to 0.181, decreased by 17.9%).

The large amount of inputs from transport department to the exports production may seems contradictory in consideration of the fact that the considerable scale of the transportation system construction is taking place in China. According to the data from China's national bureau of statistics, by the end of 2010, China has ranked the second on earth in the length of railway business (91,000 km). And in the index of High speed railway operational mileage, China has reached NO.1 with 8,358 km. At the same time, China also ranks the second in the world with 74,100 km highway mileage. What's more, China has the world's second largest aviation transportation system. A world leading transportation system should be characterized by very convenient and efficient transportation service with low price. So that can cut down the cost of exporting transportation fee. However, an embarrassing fact is that it is more expensive to deliver a product from Guangzhou to Beijing than America. As reported, one of the reasons is that the road and bridge toll are high and have no tendency to be lower. The toll, mentioned above, takes one third percentage of the cost of the transportation firms. The logistic cost that is mainly made up of road toll fees in China, which takes twenty percentage of the GDP, is highest in the world. We can conclude in some way that the large-scale construction of the transportation system has not taken the shoulder of pushing the economy forward.

(4) In the domestic input of industry department to exports department, secondary technical input ranks first and is on the rise, low technical input ranks second and fluctuates down while high technical input ranks last with the fastest roaring velocity.

The ratios of eci^d of Medium-low-technology industries in 3 years rise steadily, ranged from 0.077 to 0.112, and ended 0.126, which was on a persistent rise (64.6%). The ratios of eci^d Medium-high-technology industries jumped from 0.095 to 0.152 rapidly and then fell back to 0.128, with a rise of 34.1% in the whole. Low technology has also witnessed the upward spiral similar as the secondary and high technology (from 0.072 to 0.113 to 0.094, increased by 31.4%). The eci^d in high technology has overall increased by 625.2%, from 0.006 to 0.026 to 0.043. The production of exports in China is primarily based on secondary technology, with high technology inputs surging and low technology inputs diminishing, which indicating that the technology level in exports production is forging ahead.

The domestic investment structure of China's industrial sector to export production is similar to representative developing countries, while trends varied. For example, in Brazil it's mostly Medium-technology in industrial investment, while the Low –medium-technology coefficient eci^d shows a slight downward trend(0.091, 0.093, 0.088, 2.7%), the Medium-high-technology essentially shows a upward trend(0.061, 0.060, 0.096，59%), and the Low-technology coefficient eci^d continues to rise(0.047, 0.050, 0.073, 54.2%), the high technology coefficient is the smallest and remained unchanged(0.005, 0.007 , 0.005, -9.3%); India and South Africa, although based on medium technology in the input structure as well, difference between the various departments is very small. Particularly in India, its investment in the four technical departments is more balanced. On the other hand, the basic characteristics of developed countries: more balanced investment in all sectors, the gap between High-technology coefficient eci^d with other departments is very small.

Being different from other developing countries, China's high technology is closer to representative developed countries. It is consistent with the reality of China's High-technology exports ranked in the world to some extent. A large number of high-technology export productions require a lot of domestic investment in this sector. But it is worth noting that, even China's high-technology export was in the first place more than other sectors in 2004, the investment was still based on the medium-technology, much higher than the high-technology. This also shows that China's high-tech products for export did not use high-technology in fact, but concentrated in the medium technology.

(5) Compared with other countries, China's domestic investment to high-end services for export is low.

The three years' coefficients eci^d of China's high-end service were 0.039, 0.074, 0.039, which showed upward and downward trend. The coefficients were lower than the representative developed countries like United States (0.053, 0.087, 0.097), Japan (0.087, 0.099, 0.104) and Germany (0.057, 0.051, 0.057), and also lower than some developing countries of India(0.046, 0.054, 0.082), Brazil(0.076, 0.074, 0.113) and South Africa(0.063, 0.084, 0.095).This shows that investment of the export sector in China's financial, information research and other high-end service sector is relatively insufficient. Actually, China's financial, R&D and other industries are difficult to play its role in promoting economic because of long-term institutional barriers (Sheng Jun, 2006; Yang Gaoju, 2010), and then it's easy to explain why the investment in the export sector is low.

(6)Similar to other developing countries, both the export of the medium-and high-technology and the high-technology accounted low in China, when the other almost more than 90%. The three years' proportions of the investment in the low-and medium-technology of China were 86.2%, 84.2%, 90.6%, and high-technology were 75.5%, 72.3%, 57.5%. While in the developed countries, the lowest is in the medium-and high-technology and the high-technology sectors in the United States, agriculture and energy in Japan, and sectors in addition to the high-end services in Germany.

Both the large imported inputs of high-technology in the export sector, and the major position of the medium technology in investment of export, shows that the status of Chinese high-technology industry in the international division of labor is not as high as its exports, which is same with conclusion of Huang Xianhai, Yang Gaoju (2010).

(7) Similar to other developing countries, China's exports of low technology sector was the highest consumption to domestic and still kept rising, while the exports of high-technology sector to domestic consumption was more close to the performance of the developed countries.

On the view of consumption of export sector to other sectors, the coefficient of the low technology sector ecc^d is the largest in China, which were 0.145,0.274 and 0.205, followed by high-technology(0.120, 0.123, 0.123) and medium technical (the Low-medium 0.087, 0.121, 0.111, the Medium-high 0.082, 0.066, 0.113). It's very similar to Brazil, India and South Africa, where the coefficient of the Low-technology and the Low-medium-technology ecc^d is the biggest factor, but China's coefficient is greater. The High-technology coefficient ecc^d in China was close to Japan(0.120, 0.112, 0.084) and United States(0.082, 0.066, 0.048),all are higher ranked among the

various departments. It's consistent to the fact that China's exports was based on high-technology and low-technology, obviously the sectors export more generally require more domestic investment.

(8)Compared with the value of coefficient eci^d and ecc^d in these two types of countries, agriculture, energy, high-end services are typical input-based sector (except for South Africa's energy, the United States' agriculture), and high technology is a typical investment-driven department. However, low-technology sectors are for driving in developing countries, while input based in developed countries; and the medium technology sectors are balance or input based in developing countries, while drive based in developed countries. It shows that developing countries including China highly depend on low-technology, so we need to emphasize the leading role of medium-technology exports in developing the domestic economy rather than the high-technology.

IV Conclusion and Implication

In this paper, we use non-competitive input-output method to analyze intermediate inputs in export production and its composition of the various departments of the Chinese export sector. By carrying out a comparative analysis of intertemporal and cross-border, we conclude that:

1. Among the samples, the energy consumption of export production in China is highest, showing that China's export-oriented policy and energy-intensive production is not sustainable. China's highly dependence on export demand and low energy using efficiency is the basic reason why China offers energy subsidies to importing countries. Thereby reducing reliance on export and expanding domestic demand, significantly improving energy using efficiency are the solutions to the problems;

2. China's domestic input of transport sector to export sector is higher than most countries in the sample, which is a sharp contrast with the domestic large-scale transport system. Blindly construction of transport facilities without appropriate market environment does not necessarily bring about economic growth, but cause unnecessary waste and loss. Only cooperating the "hardware" construction and market-oriented "soft environment" management well, may increase the productivity of the transport sector;

3. Most China's domestic input of industrial sectors to export sector are focused on medium technology. Input of high-tech is little but increases rapidly, which should be maintained. However, the lack of key technologies and lots of inputs in high-tech also shows that only enhance innovation capability can China become the "world factory";

4. Domestic input of high-end service sector to exports production is obviously insufficient, which should be increased. The key reason of the development of Finance and R& D sector not well is the system and institutional barriers. Only by further reform and opening up, can we fundamentally solve above problem.

There is a certain flaw in above analysis. That is unable to analyze labor input in export production, which will be left to discuss in follow-up study.

Table 2 Inputs on Exports Production and Its Structure: China

China	eci^d			ecc^d			eci^d/eci^t			ecc^d/ecc^t		
	1995	2000	2005	1995	2000	2005	1995	2000	2005	1995	2000	2005
AGR	**0.153**	**0.215**	**0.192**	0.012	0.010	0.009	99.0	96.7	97.7	96.6	98.5	96.1
ENR	**0.179**	**0.460**	**0.376**	0.057	0.043	0.060	96.6	98.0	97.2	91.5	87.6	90.9
LT	0.072	0.113	0.094	**0.145**	**0.274**	**0.205**	92.7	90.6	94.6	95.1	93.3	95.4
MLT	0.077	0.112	0.126	**0.087**	**0.121**	0.111	95.2	94.5	95.0	94.1	93.9	92.9
MHT	**0.095**	**0.152**	0.128	0.082	0.066	**0.113**	86.2	84.2	90.6	91.6	94	92.6
HT	0.006	0.026	0.043	**0.120**	**0.123**	**0.123**	75.5	72.3	57.5	90.7	80.3	80.7
HES	0.039	0.074	0.039	0.014	0.017	0.008	99.6	98.8	98.6	93.5	95.3	88.1
TRS	0.064	0.109	**0.160**	0.081	0.076	0.104	99.5	99.0	97.7	95.7	97.7	95.5

Notes: *AGR* is *Agriculture*, *ENR* is *Energy*, *LT* is *Low-technology industries*, *MLT* is *Medium-low-technology industries*, *MHT* is *Medium-high-technology industries*, *HT* is *High-technology industries*, *HES* is *High-end services*, *TRS* is *Transport*; Bold figures are the top three in each column.

Table 3 Inputs on Exports Production and Its Structure: 3 Developing Countries

County	Industry	eci^d			ecc^d			eci^d/eci^t			ecc^d/ecc^t		
		1995	2000	2005	1995	2000	2005	1995	2000	2005	1995	2000	2005
Brazil	AGR	**0.147**	**0.159**	**0.194**	0.010	0.024	0.070	99.0	98.5	98.5	98.2	95.1	98.0
	ENR	**0.205**	**0.38**	**0.452**	0.010	0.015	**0.113**	90.4	92.5	92.4	86.0	89.0	87.7
	LT	0.047	0.05	0.073	**0.102**	**0.114**	**0.167**	95.7	96.6	97.5	96.9	96.7	96.7
	MLT	**0.091**	**0.093**	0.088	**0.102**	**0.067**	**0.125**	93.9	92.4	88.8	94.0	93.7	87.7
	MHT	0.061	0.06	0.096	0.046	0.051	0.108	90.8	86.6	84.8	93.3	92.4	90.0
	HT	0.005	0.007	0.005	0.011	0.036	0.022	59.4	40.6	37.7	80.2	77.8	72.8
	HES	0.076	0.074	**0.113**	0.002	0.006	0.004	99.3	97.9	97.9	96.2	93.4	94.3
	TRS	0.027	0.032	0. 029	**0.063**	**0.073**	0.039	81.4	100.0	100.2	84.6	89.9	97.9
India	AGR	**0.179**	**0.132**	**0.154**	0.007	0.010	0.013	99.6	98.9	98.8	98.4	97.1	98.7
	ENR	**0.254**	**0.287**	**0.28**	0.012	0.003	0.018	94.0	93.4	89.2	62.1	63.6	42.3
	LT	0.034	0.039	0.037	**0.079**	**0.080**	**0.095**	87.4	86.5	95.4	96.9	91.4	96.6
	MLT	0.032	0.041	0.044	**0.056**	**0.053**	0.049	89.6	80.5	88.3	87.8	85.5	84.4
	MHT	0.031	0.035	**0.049**	0.031	0.042	**0.056**	87.4	82.3	88.2	91.5	88.8	92.0
	HT	0.008	0.014	0.019	0.049	**0.079**	0.046	91.3	90.9	72.7	91.5	87.7	90.1
	HES	**0.046**	**0.054**	0.082	0.004	0.011	**0.094**	97.8	98.1	98.5	77.0	88.1	95.7
	TRS	0.043	0.034	0.042	**0.056**	0.051	0.051	97.8	98.4	99.7	90.8	92.3	93.0
South Africa	AGR	0.053	**0.097**	0.033	0.044	0.059	**0.072**	95.5	96.4	95.3	94.2	90.6	92.2
	ENR	**0.199**	**0.237**	**0.206**	**0.349**	**0.326**	**0.360**	98.6	98.6	90.5	91.5	84.1	91.5
	LT	0.033	0.046	0.037	**0.045**	**0.082**	0.055	93.0	91.8	92.2	91.8	91.1	91.7
	MLT	0.047	0.053	0.087	**0.083**	**0.092**	0.059	92.0	87.2	83.8	89.6	87.3	86.8
	MHT	0.04	0.049	0.032	0.027	0.041	0.034	74.1	68.1	74.3	89.2	82.2	81.3
	HT	0.002	0.003	0.003	0.004	0.005	0.005	64.5	58.4	38.2	88.2	81.2	75.6
	HES	**0.063**	0.084	**0.095**	0.017	0.020	0.028	98.8	98.5	99.1	94.0	91.8	93.5
	TRS	**0.22**	**0.186**	**0.181**	0.037	0.051	**0.089**	93.5	83.3	93.2	93.8	88.2	91.5

Notes: The meanings of short terms are same as Table 3.

Table 4 Inputs on Exports Production and Its Structure: 3 Developed Countries

County	Industry	eci^d			ecc^d			eci^d/eci^t			ecc^d/ecc^t		
		1995	2000	2005	1995	2000	2005	1995	2000	2005	1995	2000	2005
Japan	AGR	0.004	0.010	0.005	0.001	0.003	0.002	75.9	88.7	72.0	98.0	97.1	94.5
	ENR	**0.132**	**0.126**	**0.191**	0.006	0.005	0.007	87.8	84.1	81.6	45.1	43.5	32.5
	LT	0.031	0.036	0.032	0.014	0.018	0.016	97.0	96.6	93.2	95.0	95.4	90.5
	MLT	**0.093**	0.085	**0.154**	**0.136**	**0.137**	**0.194**	95.6	93.8	94.5	97.0	96.2	94.9
	MHT	**0.121**	**0.113**	**0.146**	**0.176**	**0.199**	**0.234**	97.3	95.6	88.8	97.4	96.5	94.1
	HT	0.043	0.038	0.009	**0.120**	**0.112**	**0.084**	84.2	77.1	55.9	93.2	90.6	84.6
	HES	0.087	**0.099**	0.104	0.004	0.004	0.003	99.6	99.7	99.6	96.7	98.6	98.3
	TRS	0.035	0.036	0.042	0.049	0.058	0.064	69.2	65.3	65.9	72.8	72.1	71.6
Germany	AGR	0.025	0.031	0.033	0.022	0.021	0.026	75.4	75.7	77.0	90.1	87.1	86.7
	ENR	**0.125**	**0.118**	**0.149**	0.039	0.027	0.064	69.2	54.8	50.6	59.0	40.4	50.1
	LT	0.032	0.030	0.033	0.052	0.059	**0.078**	76.7	70.8	71.0	83.3	80.8	81.4
	MLT	0.053	0.047	0.049	**0.074**	**0.067**	0.069	67.5	63.8	63.8	74.0	69.9	69.8
	MHT	**0.073**	**0.078**	**0.064**	**0.143**	**0.137**	**0.117**	72.8	68.2	67.0	83.4	77.6	76.7
	HT	0.015	0.013	0.007	0.057	0.063	0.033	50.3	42.9	32.6	78.9	72.9	69.2
	HES	0.057	0.051	0.057	0.026	0.032	0.037	96.7	87.5	90.7	93.0	89.6	89.1
	TRS	**0.072**	**0.062**	**0.077**	**0.109**	**0.086**	**0.102**	66.0	56.1	63.7	65.1	60.0	64.4
USA	AGR	0.057	0.036	0.033	**0.077**	0.054	**0.049**	97.0	92.0	91.9	98.0	94.4	93.5
	ENR	**0.188**	**0.108**	**0.142**	0.071	0.03	0.025	92.6	86.9	86.1	85.8	72.9	69.5
	LT	0.036	0.023	0.018	0.034	0.03	0.026	94.9	92.7	90.2	95.0	93.9	93.0
	MLT	0.047	0.041	0.041	0.044	0.05	0.048	92.3	85.6	84.1	92.0	86.2	84.8
	MHT	0.052	0.032	0.028	0.069	**0.063**	**0.056**	82.2	80.1	76.4	91.9	89.3	87.4
	HT	0.019	0.042	0.025	**0.082**	**0.066**	0.048	77.1	64.0	69.5	88.8	85.7	84.7
	HES	**0.053**	**0.087**	**0.097**	0.016	0.012	0.014	99.8	99.6	99.3	96.2	97.7	97.3
	TRS	**0.052**	**0.046**	**0.042**	**0.151**	**0.148**	**0.148**	98.6	99.2	99.3	98.0	97.5	96.7

Notes: The meanings of short terms are same as Table 3.

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Appendix 1

Main Category	Industries Classification in OECD Input-output Tables	ISIC Rev.3
Agriculture	1 Agriculture, hunting, forestry and fishing	1+2+3+4+5
Energy	2 Mining and quarrying (energy)	10+11+12
	8 Coke, refined petroleum products and nuclear fuel	23
	26 Production, collection and distribution of electricity	401
	27 Manufacture of gas; distribution of gaseous fuels through mains	402
	28 Steam and hot water supply	403
Low-technology industries	4 Food products, beverages and tobacco	15+16
	5 Textiles, textile products, leather and footwear	17+18+19
	6 Wood and products of wood and cork	20
	7 Pulp, paper, paper products, printing and publishing	21+22
	25 Manufacturing nec; recycling (include Furniture)	36+37
Medium-low-technology industries	11 Rubber & plastics products	25
	12 Other non-metallic mineral products	26
	13 Iron & steel	271+2731
	14 Non-ferrous metals	272+2732
	15 Fabricated metal products, except machinery & equipment	28
	22 Building & repairing of ships & boats	351
Medium-high-technology industries	9 Chemicals excluding pharmaceuticals	24ex2423
	16 Machinery & equipment, nec	29
	18 Electrical machinery & apparatus, nec	31
	21 Motor vehicles, trailers & semi-trailers	34
	24 Railroad equipment & transport equip nec.	352+359
High-technology industries	10 Pharmaceuticals	2423
	17 Office, accounting & computing machinery	30
	19 Radio, television & communication equipment	32
	20 Medical, precision & optical instruments	33
	23 Aircraft & spacecraft	353
High-end services	37 Post & telecommunications	64
	38 Finance & insurance	65+66+67
	41 Computer & related activities	72
	42 Research & development	73
Transport	33 Land transport; transport via pipelines	60
	34 Water transport	61
	35 Air transport	62
	36 Supporting and auxiliary transport activities; activities of travel agencies	63
	3 Mining and quarrying (non-energy)	13+14
	29 Collection, purification and distribution of water	41
	30 Construction	45
	31 Wholesale & retail trade; repairs	50+51+52
	32 Hotels & restaurants	55
	39 Real estate activities	70
	40 Renting of machinery & equipment	71
	43 Other Business Activities	74
	44 Public admin. & defence; compulsory social security	75
	45 Education	80
	46 Health & social work	85
	47 Other community, social & personal services	90-93
	48 Private households with employed persons & extra-territorial organisations & bodies	95+99

Appendix 2

Code	Industry
1	Food and beverages
11	Primary
111	**Mainly for industry**
112	Mainly for household consumption
12	Processed
121	**Mainly for industry**
122	Mainly for household consumption
2	Industrial supplies not elsewhere specified
21	**Primary**
22	Processed
3	Fuels and lubricants
31	**Primary**
32	Processed
321	Motor spirit
322	Other
4	Capital goods (except transport equipment), and parts and accessories thereof
41	Capital goods (except transport equipment)
42	**Parts and accessories**
5	Transport equipment and parts and accessories thereof
51	Passenger motor cars
52	Other
521	Industrial
522	Non
53	**Parts and accessories**
6	Consumer goods not elsewhere specified
61	Durable
62	Semi
63	Non
7	Goods not elsewhere specified