

## THE STUDY ON THE RCA AND COMPLEMENTARITY OF THE TRADE BETWEEN CHINA AND EU

The bilateral trade volume between China and the EU totals only \$2.4 billion when the establishment of diplomatic relations between the two parties in 1975. The bilateral trade volume reached \$27.23 billion in 2006, 11.35 times of the volume in 1975. After the expansion of the European Union to 25 members in May 2004, EU, exceeding Japan and America, becomes the biggest trade partner of China, while China becomes the second biggest trade partner of EU (next below America). Besides, the EU is the largest technology import place of source of China. This paper mainly analyzes the revealed comparative advantage, intra-industry trade index, and complementarity, then draws some related conclusions about the China-Euro commodity trade, with related data from the WTO statistic database and the International Trade Statistics from 1998 to 2006 published by WTO.

### 1. The revealed comparative advantage

Balassa (1965, 1977) brought up the index of revealed comparative advantage (*RCA*):

$$RCA_{ij} = (X_{ij}/X_{it}) / (X_{nj}/X_{nt}). \quad (1)$$

There  $X_{ij}$  represents the value of good  $j$  exported by country  $i$ , while  $X_{it}$  is country  $i$ 's total exports during the time of  $t$ .  $X_{nj}$  and  $X_{nt}$  stand for the total exports or imports of good  $j$  in the whole world, respectively. According to the differences between the problems analyzed, the value of exports represented by variable  $x$  in the formula may signify that the scope and product categories are different. We can figure out the comparative advantage of a country's some product in the world market in a regional market, and in another country's market. Comparative advantage is determined by *RCA*. If *RCA* exceeds unity, the country is said to have a comparative advantage in the production of some goods, or vice versa. Japan External Trade Organization assume that the exports of an industry has a notable comparative

advantage in some country or has stronger export competitiveness when *RCA* is larger than 1.25. It is advantageous but not significant in a country when *RCA* is between 0.8 and 1.25. It has a comparative disadvantage or weaker export competitiveness in a country when *RCA* is smaller than 0.8.

### 2. The index of intra-industry trade

Grubel & Lloyd (1975) addressed the *GL* index:

$$GL_j = 1 - \frac{|X_j - M_j|}{X_j + M_j}. \quad (2)$$

There  $GL_j$  represents industry  $j$ 's index of intra-industry trade. There is only intra-industry when  $GL_j$  is 0 while there is only intra-industry when  $GL_j$  is 1.

### 3. The index of trade complementarity

Peter Drysdale (1967) brought up the index of trade complementarity:

$$C_{ij} = RCA_{xi}^k \cdot RCA_{mj}^k \quad (3)$$

$$RCA_{xi}^k = (\bar{E}X_i^k / X_i^k / X) (X_w^k / X_w) \quad (4)$$

$$RCA_{mj}^k = (M_j^k / M_j) / (X_w^k / X_w) \quad (5)$$

There  $X_i^k$  and  $X_w^k$  represent the value of good  $k$  exported by country  $i$  and the world, respectively, and  $X_i$  and  $X$  are country  $i$ 's and the world's total exports, respectively.  $M_j^k$  and  $M_j$  represent the value of good  $k$  imported by country  $j$  and the same country's total imports, respectively. When country  $i$  has a notable comparative advantage in the production of good  $k$  ( $RCA_{xi}^k$ ) but country  $j$  has a notable comparative disadvantage in the same product, it means this two countries have trade complementarity in the trade of product  $k$ . Because there are so many products (industries), the comprehensive index of trade complementarity can be figured out by weighted average of indexes of trade complementarity displayed by different products (industries) under the circumstances. Weighting coefficients are the ratios of each product in the world trade, that is to say  $X_{kw} / X_w$ . The comprehensive index can be expressed as follows:

$$C_{ij} = \sum C_{ij}^k = \sum RCA_{xi}^k \cdot RCA_{mj}^k \cdot (X_w^k / X_w). \quad (6)$$

When  $C_{ij} > 1$ , it shows that the two countries's trade complementarity is strong and that is stronger with the value of  $C_{ij}$  larger, or vice versa.

China-EU bilateral trade value amounted to US\$2.4 billion in 1975, when the two established their diplomatic relations. The figure rose to US\$5.306 billion in 1981 and US\$13.751 in 1990. In 1997, China began to enjoy a trade surplus with EU, and the value was US\$4.628 billion. In 2006, it reached US\$ 27.23 billion, 11.35 times as that in 1995. After the EU expanded to 25 member states in May in 2004, it surpassed Japan as China's top trading partner and China was the EU's second-largest trading partner, (after the United States) EU was also the biggest import source of China's technology import. The products exported from China to EU have changed from raw material as a majority to finished goods.

to EU-15, in several sectors, namely, clothing, textiles, office telecommunication and electrical machinery and apparatus (except in 1999), ( $RCA_y > 1.25$ ). On the other hand, China had a comparative or competitive disadvantage on the markets of EU-15 in sectors such as automobiles, steel & iron, chemicals and Power generating machinery, ( $RCA_y < 0.8$ ); Besides, China enjoyed a comparative but not revealed advantage in machinery transport equipment and Manufactures sectors ( $0.8 < RCA_y < 1.25$ ), and the advantage of machinery transport equipment and Manufactures was being strengthened seeing from the perspective of the change of the comparative advantage.

From 2000 to 2005 the EU25 had a revealed comparative advantage or a strong export competitive advantage, with respect to China, in several sectors, namely, Pharmaceuticals, Machinery and transport equipment, Automotive products, Telecommunications equipment (in year of

Table 1

China-EU bilateral trade value according to China statistics (unit: billion \$)

	1999	2000	2001	2002	2003	2004	2005
exports	30,25	38,23	40,94	48,26	72,13	107,25	143,8
imports	25,46	30,85	35,71	38,53	53,02	70,1	73,59
total	55,71	69,08	76,65	86,79	125,15	177,35	217,39

Source: International trade statistics 1998–2006 WTO.

\*1999–2003 data of EU-15, 2004–2005 data of EU-25.

Table 2

China-EU bilateral trade value according to the EU statistics (unit: billion \$)

	1999	2000	2001	2002	2003	2004	2005
exports	20,39	23,27	26,67	32,07	44,88	58,61	63,61
imports	52,69	64,54	67,62	77,28	107,8	157,84	195,78
total	73,08	87,81	94,29	109,35	152,68	216,45	259,39

Source: International trade statistics 1998–2006 WTO.

\*1999–2003 data of EU-15, 2004–2005 data of EU-25.

According to the formula of revealed comparative advantage index, we calculate the revealed comparative advantage indexes of the goods in trade between China and EU-15 or EU-25, using relative data from WTO database and The World Trade Report of 1998–2006 published by the WTO. The results are as follows:

The result shows that China had a revealed comparative advantage or a strong export competitive advantage, with respect

2000 and 2001),  $RCA_y > 1.25$ . On the other hand, EU25 had a comparative or competitive disadvantage on the markets of China in sectors such as Agricultural products, food, Fuels and mining products, fuels, Integrated circuits and electronic components, Electronic data processing and office equipment, textiles, clothing, chemicals (except 2005), Iron & Steel (from 2000 to 2002), Office and telecom equipment (from 2002 to 2005),  $RCA_y < 0.8$ . Besides,

Table 3

## RCA indexes of China with respect to EU-15 1999–2003

	1999	2000	2001	2002	2003
Manufactures	1,098	1,166	1,167	1,180	1,212
steel & iron	0,578	0,740	0,525	0,453	0,460
chemicals	0,479	0,463	0,457	0,387	0,364
machinery transport equipment	0,714	0,820	0,895	1,002	1,135
Power generating machinery	0,544	0,608	0,541	0,544	0,518
office telecommunication	1,212	1,295	1,568	1,992	2,594
electrical machinery and apparatus	1,597	1,664	1,797	1,852	1,797
Automotive products	0,048	0,066	0,072	0,079	0,076
textiles	2,864	3,198	3,200	3,303	3,412
clothing	4,103	4,347	4,015	3,617	3,424

Source: calculations based on data from WTO statistics database and The World Trade Report in 1998–2006 published by the WTO.

EU25 enjoyed a comparative but not revealed advantage in Manufactures, Office and telecom equipment (from 2000 to 2001), Telecommunications equipment (in year of 2002 and 2005), Iron & Steel (from 2003 to 2005), ( $0.8 < RCA_{ij} < 1.25$ ). The *RCA* of Iron & Steel and chemicals was being strengthened, but, the *RCA* of Office and telecom equipment and Telecommunications equipment were being weakened, seeing from the perspective of the change of the comparative advantage.

From the analysis of commodity structure between China and EU, we find out that China exported mainly low value-added products like textiles, machines and telecom apparatus but imported mainly capital-intensive and high-tech products. The products EU exported to China are primarily capital-intensive and technology-intensive, while China's exports, except machines and telecom apparatus, were mainly labor-intensive. The trade surplus we enjoyed in respect to the EU-15 was primarily on goods like clothing, textiles, office telecommunication and electrical machinery and apparatus, which also generated a revealed comparative or strong export competitive advantage. At the same time, the EU-25 enjoyed a surplus on goods like medicines, machine & vehicle, automobiles and telecom apparatus owing to his comparative advantage.

Traditional comparative advantage theory assumes that every country is inclined to export products with related higher labor productivity and import ones with related lower. Besides, H-O theory assumes that a

country intend to manufacture and export a good that uses his relatively abundant factor intensively and import a good that uses the relatively scarce factor intensively. The revealed China-EU export comparative advantage indexes and the commodity structure of those goods in trade show that the trade pattern between China and EU is exactly the same as is predicted by comparative advantage and H-O theories.

Classify the commodities into three types, namely, primary products, mineral products and fuel, finished products. Calculate the complementarity indexes of trade between China and EU15 countries from 1996 to 2003, and those of trade between China and EU25 countries from 2000 to 2005 respectively, according to Formula [3] and Formula [6]. The result is indicated with Table 5, Table 6, Table 7 and Table 8. In addition, changes in trade compensability indexes are illustrated dynamically with Graph 1, Graph 2, Graph 3 and Graph 4.

As is shown, both for complementarity indexes of synthetic trade between China and EU15 countries from 1996 to 2003, and those between China and EU25 countries from 2000 to 2005,  $C_{ij} > 1$ , which means there is complementarity of trade between China and 15 (or 25) EU countries. Furthermore, the complementarity of trade between China and EU countries is steady according to the figures and graphs. As an example of classified products, the complementarity indexes of primary products exports between China and 15 (or 25) EU countries are all bigger than

Table 4

## RCA indexes of China with respect to EU-25 2000–2005

	2000	2001	2002	2003	2004	2005
Agricultural products	0,599	0,485	0,492	0,466	0,503	0,648
food	0,510	0,436	0,448	0,375	0,362	0,490
Fuels and mining products	0,246	0,254	0,301	0,273	0,267	0,302
fuels	0,071	0,062	0,142	0,044	0,026	0,013
Manufactures	1,191	1,175	1,143	1,157	1,195	1,190
Iron & Steel	0,426	0,541	0,635	0,825	0,874	1,181
chemicals	0,717	0,692	0,740	0,788	0,804	0,859
Pharmaceuticals	3,782	3,118	3,532	3,454	3,636	3,981
Machinery and transport equipment	1,575	1,504	1,380	1,374	1,425	1,355
Office and telecom equipment	1,031	0,820	0,447	0,382	0,406	0,344
Electronic data processing and office equipment	0,449	0,491	0,360	0,267	0,281	0,305
Telecommunications equipment	2,696	2,040	1,081	0,944	1,024	0,829
Integrated circuits and electronic components	0,352	0,310	0,234	0,226	0,252	0,210
Automotive products	3,220	3,686	3,668	3,634	2,999	2,994
textiles	0,205	0,227	0,249	0,290	0,360	0,436
clothing	0,383	0,429	0,484	0,578	0,745	0,575

Source: calculations based on data from WTO statistics database and The World Trade Report in 1998–2006 published by the WTO.

those calculated by China's exports. For the dominant comparative advantage of primary products exported from 15 EU countries (1996–2003) or 25 EU countries (2000–2005) to the rest of the world,  $1.014 < RCA_{15} < 1.102$ ,  $1.047 < RCA_{25} < 1.131$ . The Agricultural products of EU are not provided with congenital comparative advantage in the world market because of EU's natural resources. However, as everybody knows, the Agricultural products receive subsidies there so that they take on a comparative advantage, but not obvious. On the other hand, China's Agricultural products exports have a discomparative advantage in the world market,  $RCA < 0.8$ , due to its natural resources. When it comes to the mineral products and fuel, both China and EU don't have revealed comparative advantages, whose complementarity is low as well. But their complementarity of Manufactures is quite

high. The exports of Manufactures accounted for more than 80% of total exports in China from 1996 to 2005. The import of them occupied more than 70% during the same time. Meanwhile, Manufactures imports and exports of EU countries (15 or 25) took up more than 70%.

Using the intra-industry trade index, we figure out the intra-industry trade index between China and EU15 in the year 2003 and between China and EU25 in the year 2005 respectively. According to the results, we find that in the intra-industry trade index between China and EU15 in 2003, some merchandise of which the indexes are more than 0.9 are color-metal and other transportation vehicles. The amount of bilateral trade of these merchandise reached 6.95 billion dollars which takes up 5.5% of the total quantity. The indexes of color-metal, other transportation vehicles and

Table 5

## complementarity Indexes of Trade between China and 15 EU Countries (1996–2003) according to China statistics

	1996	1997	1998	1999	2000	2001	2002	2003
Agricultural products	0,113	0,098	0,089	0,084	0,077	0,071	0,067	0,059
Fuels and mining products	0,050	0,053	0,042	0,036	0,043	0,043	0,037	0,036
Manufactures	0,873	0,887	0,904	0,918	0,917	0,921	0,931	0,922
synthesis	1,036	1,038	1,035	1,038	1,037	1,035	1,035	1,016

Source: WTO Database; International Trade Statistics 1998–2006 published by WTO.

Table 6

**complementarity Indexes of Trade between China and 15 EU Countries (1996–2003)  
according to EU15 statistics**

	1996	1997	1998	1999	2000	2001	2002	2003
Agricultural products	0,112	0,105	0,091	0,088	0,096	0,087	0,079	0,085
Fuels and mining products	0,043	0,057	0,047	0,049	0,070	0,060	0,055	0,026
Manufactures	0,893	0,871	0,892	0,886	0,851	0,881	0,901	0,987
synthesis	1,048	1,033	1,031	1,023	1,016	1,027	1,035	1,099

Source: WTO Database; International Trade Statistics 1998–2006 published by WTO.

Table 7

**Complementarity Indexes of Trade between China and EU25 Countries (2000–2005)  
according to China statistics**

	2000	2001	2002	2003	2004	2005
Agricultural products	0,076	0,070	0,066	0,059	0,047	0,045
Fuels and mining products	0,044	0,044	0,037	0,036	0,037	0,037
Manufactures	0,920	0,923	0,936	0,945	0,956	0,965
synthesis	1,039	1,037	1,039	1,039	1,041	1,046

Source: WTO Database; International Trade Statistics 1998–2006 published by WTO.

Table 8

**Complementarity Indexes of Trade between China and 15 EU Countries (2000–2005)  
according to EU25 statistics**

	2000	2001	2002	2003	2004	2005
Agricultural products	0,095	0,087	0,078	0,080	0,082	0,077
Fuels and mining products	0,071	0,061	0,056	0,059	0,073	0,084
Manufactures	0,851	0,880	0,901	0,896	0,865	0,863
synthesis	1,017	1,027	1,035	1,035	1,020	1,025

Source: WTO Database; International Trade Statistics 1998–2006 published by WTO.

electronic mechanism facilities are more than 0.8. The amount of bilateral trade of these merchandise reached 16.89 billion dollars which takes up 13.4% of the total quantity. The amount of the bilateral trade of some merchandise of which the intra-industry trade indexes are more than 0.7 is 28.09 billion dollars, taking up 29.6% of the total quantity. The amount of the bilateral trade of some merchandise of which the intra-industry trade indexes are more than 0.6 is 32.32 billion dollars, taking up 33% of the total quantity.

According to the results of the intra-industry trade index between China and EU25 in the year 2005, the index of other vehicles is more than 0.9 and its bilateral trade amount reached 9.07 billion dollars which takes up 4.2% of the total quantity.

The amount of the bilateral trade of some merchandise of which the intra-industry trade indexes are more than 0.8 is 27.09 billion dollars, taking up 12.4% of the total quantity. The amount of the bilateral trade of some merchandise of which the intra-industry trade indexes are more than 0.7 is 34.98 billion dollars, taking up 16% of the total quantity. The amount of the bilateral trade of some merchandise of which the intra-industry trade indexes are more than 0.6 is 66.74 billion dollars, taking up 30.7% of the total quantity.

Based on the former analysis of between China and EU15 and EU25, we find that there is a stable complementary trade relation between China and EU. Whether it is complementary of inter-industry or intra-industry trade? We figure out that the amount

of the bilateral trade of merchandise of which the intra-industry trade indexes between China and EU15 and EU25 are more than 0.6 takes up 33% and 30.7% respectively of the total quantity. This demonstrates that the trade between China and EU is main complementary trade of inter-industry trade. The scale of intra-industry trade is still not big enough. The international labor division between China and EU is mainly vertical division while the horizontal division is subordinate. Considering the proportion of the direct investment from EU to China and, among the trade mode of China the amount of import and export trade of processing trade takes up more than 50% of the total trade of China, the trade between China and EU is actually driven by compared advantage.

2. Calculated from the complementary index of trade between China and EU, trade between China and EU15 and EU25 displays complementary. And the kind of complementary tends to be stable.

3. The complementary of trade between China and EU is based on inter-industry complementary, and the scale of intra-industry trade is not large enough. The international division of labor between China and EU is still based on vertical division, supplemented by horizontal division of labor. The intra-industry trade between China and EU is mainly droved by comparative advantage, taking into account the percentage of FDI from EU to China and that the ratio of processing trade to total trade exceeds 50% in the e trade pattern of China.

*Table 9*

**the indexes of intra-industry trade between China and EU15 in the year 2003 according to China statistics (Unit: billion dollars)**

	Export	Import	The amount of import and export	The proportion of total trade	Intra-industry trade index
Food	1,73	0,74	2,47	0,020	0,599
Raw materials	0,57	1,19	1,76	0,014	0,648
Ores and other minerals	0,38	0,61	0,99	0,008	0,768
Fuels	0,77	0,16	0,93	0,007	0,344
Non-ferrous minerals	0,49	0,56	1,05	0,008	0,933
Iron and Steel	0,47	2,09	2,56	0,020	0,367
chemicals	3,78	6,1	9,88	0,079	0,765
Other semi-manufactures	5,77	3,56	9,33	0,075	0,763
Power generating machinery	0,37	1,5	1,87	0,015	0,396
Other none electrical machinery	3,15	15,05	18,2	0,145	0,346
Office and telecom equipment	23,22	4,43	27,65	0,221	0,320
electrical machinery and apparatus	5,86	4,08	9,94	0,079	0,821
Automotive products	0,35	5,46	5,81	0,046	0,120
Other transport equipment	3	2,9	5,9	0,047	0,983
textiles	2,44	0,54	2,98	0,024	0,362
Clothing	6,28	0,1	6,38	0,051	0,031
Other manufactures	13,48	3,91	17,39	0,139	0,450
Total Merchandise	72,13	53,02	125,15		

Source: According to international trade statistics2004 published by WTO.

Based on the analysis above, we can come to the following conclusions:

1. The trade pattern between China and EU is consistent with the trade model forecast by the comparative advantage theory and the factor-proportions theory from the analysis of export revealed comparative advantage index and the commodity structure of imports and exports between China and EU.

Flaws of the research in this paper lies in: first, lack of analysis about the trade complementary between China and each member of EU while analyzing the trade complementary between China and EU; second, adopting the commodity classification that is used by WTO when calculating the export revealed comparative advantage index of EU and intra-industry trade index, and the result of the calculation

Table 10

**the indexes of intra-industry trade between China and EU25 in the year 2005 according to China statistics (Unit: billion dollars)**

	Export	Import	The amount of import and export	The proportion of total trade	Intra-industry trade index
Fish	1,04	0,21	1,25	0,006	0,336
Other food	1,79	1	2,79	0,013	0,717
Raw materials	1,06	2,16	3,22	0,015	0,658
Ore and minerals	0,88	1,67	2,55	0,012	0,690
Fuels	1,35	0,15	1,5	0,007	0,200
Non-ferrous minerals	1,03	1,41	2,44	0,011	0,844
Iron and Steel	1,87	3,52	5,39	0,025	0,694
pharmaceuticals	1,02	1,26	2,28	0,010	0,895
Other chemicals	5,33	7,97	13,3	0,061	0,802
Other semi- manufactures	11,76	4,52	16,28	0,075	0,555
Electronic data processing and office equipment	30,28	1,62	31,9	0,147	0,102
Telecommunications equipment	19,38	2,35	21,73	0,100	0,216
Integrated circuits	1,66	3,39	5,05	0,023	0,657
Automotive products	1,38	4,45	5,83	0,027	0,473
Other transport equipment	4,84	4,23	9,07	0,042	0,933
Power generating machinery	0,79	2,86	3,65	0,017	0,433
None electrical machinery	6,61	19,21	25,82	0,119	0,512
Electrical machinery	10,14	5,41	15,55	0,072	0,696
textiles	4,71	0,79	5,5	0,025	0,287
Clothing	13,75	0,21	13,96	0,064	0,030
Personal and household goods	8,17	0,38	8,55	0,039	0,089
Scientific and household goods	1,99	3,11	5,1	0,023	0,780
Other manufactures	12,94	1,7	14,64	0,067	0,232
Total merchandise	143,8	73,59	217,39		

Source: According to international trade statistics 2006 published by WTO.

will be more persuasive and the calculation more standardized if using SITC and HS standard classification.

#### Literature

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