

**Intra-Product Specialization, Sino-U.S. Trade Surplus and Trade
Benefits - from the Perspective of NB Enterprises**

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Abstract

In the last decade, trade frictions have occurred more frequently between China (Sino) and the United States (U.S). China's trade surplus against the U.S. includes approximately 6,800 different products such as notebook computers (NB) and related components. This paper analyzes the source of the Sino-U.S. trade surplus from the perspective of enterprises, and the shifting of OEM/ODM companies from Taipei to mainland China through foreign direct investment (FDI). Sino-U.S. trade surplus of NB is a result of virtual production networks controlled by global NB brands. Based on a case study of Hewlett-Packard (HP), this paper proves the disparity of economic benefits between China and the U.S. which resulted in a Sino-U.S. trade surplus.

Keywords

Intra-Product specialization; Sino-U.S. trade surplus; Trade benefits, Notebook computer (NB)

1. Introduction

Trade frictions due to a Sino-U.S. trade surplus frequently occurred in the last decade. Measures, such as quota restriction and countervailing duty are used to ease the U.S. trade deficit.

Available literature explains the causes and economic results of the Sino-U.S. trade imbalance from the perspective of international specialization, domestic, methods of trade statistics, underestimation of exchange rate, domestic savings, etc. However, the most accepted cause of trade imbalance is international specialization which occurs commonly worldwide.

Lardy (1994) was the first to research the trade imbalance from the perspective of international specialization. He argued that the industry shifts in East Asia mostly led to the increase of trade surplus of China to the U.S. Scholars have linked the cause of the Sino-U.S. trade surplus and the deficit of East Asia areas to China since the early 2000s. Xiangshuo (2004) and Li Daokui (2006) appreciated that to a certain extent, the Sino-U.S. trade surplus was due to the industry shift from East Asia to mainland China. Hualin (2007) proved the long-term relationship between trade surplus of China to the U.S and deficit of East Asia areas to China through a co-integration test. In addition, Wanqin (2009) considered that the trade surplus of China to the European Union (U.S.) was the main cause of the trade deficits of Japan, Korea and Taipei to China.

Who actually benefits from global production? Is it the home country of the MNC, the countries where the products are manufactured, or those that supply the key high value components? These questions bring to mind the debate between parent and host countries of MNCs with the rise of trade imbalance resulting from global production. With the case study of Apple's iPod, Linden et al. (2009) confirmed that while the iPod was manufactured offshore and had a global roster of suppliers, the greatest benefit from this innovation went to Apple, an American company, with predominantly American employees and stockholders who reaped the benefits. For every \$299 iPod sold in the U.S., the politically volatile U.S. trade deficit with China increased by about \$150 (the factory cost) plus the cost of shipping. Yet the value added to the product through assembly in China was at most a few dollars. To shed light on the jobs issue, Linden et al. (2011) analyzed the iPod, which was manufactured offshore and used mostly foreign-made components. In terms of headcount, they estimated that, in 2006, the iPod supported nearly twice as many jobs offshore as in the U.S. Yet the total wages paid in the U.S. amounted to more than twice as much as those paid overseas. This case provided evidence that innovation by a U.S. company at the head of a global value chain could benefit both the company and U.S. workers.

Since the early 2000s, there is evidence of international specialization. The first appearance occurred through worldwide inter-industry specialization. Secondly, global production networks form where developed countries specialize in R&D and developing ones in manufacturing. Thirdly, methods of controlling production change, which means that purchasing and sales channel, rather than ownership, becomes the major indirect way of

controlling the global production network by leading companies.

A series of problems as a result of international trade emerge drastically due to new characteristics mentioned above, especially in industries with high levels of global production such as notebook computers (NB). For example, the world market share of the Chinese NB brand Lenovo is less than 8 percent. On the contrary, American brands such as HP and Dell control 35 percent of the world market share, while Intel dominates the world CPU market share with 90 percent, and Seagate and Western Digital share the world storage market share with over 75 percent. Despite owning the highest majority of market shares, the U.S still suffers a trade deficit in the NB and related components, as 90 percent of total worldwide export value comes from China each year.

This paper explains the Sino-U.S. trade surplus of NB from the viewpoint of intra-product specialization, as well as the sources and benefits of NB exported from mainland China. The paper also explores international production and trade modes of NB and highlights a case study of HP. The second section estimates the Sino-U.S. trade surplus of NB; the third section explains the source of Sino-U.S. trade surplus with intra-product specialization; the fourth section shows the distribution of benefits in a global NB value chain with the case study of HP Pavilions DM3T; and the last section concludes the paper.

2. Sino-U.S. Trade Surplus of Notebook Computers

In 2009, there were 32 kinds of products with a trade surplus of more than 1 billion USD between the U.S and China. Notebook computers accounted for the largest share of the trade surplus. In fact, with continual investments of NB companies, mainland China enjoyed an unprecedented increase in export value of NB since 2003. The Sino-U.S. trade surplus of NB in 2009 was as much as 21.74 billion USD which accounted for 15.17 percent of the Sino-U.S. total trade surplus compared to the total trade surplus in 2003 of 3.24 billion USD which was 5.53 percent of the Sino-U.S. total trade surplus. Moreover, the Sino-U.S. total trade surplus of related components of NB increased to 11.20 billion USD with 7.81 percent of Sino-U.S. total trade surplus in 2009. Therefore, NB and related components has become the major products that raise the Sino-U.S. total trade surplus in recent years.

Table 1. The Trade Value of Notebook Computers in Mainland China (2000-2009)

Billion USD (percent)

Year	NB Export Value(1)	NB Import Value(2)	Trade Surplus of NB(3)	Total Trade Surplus(4)	(3)/(4) percent
2000	0.207	0.181	0.026	24.145	0.11
2001	0.688	0.158	0.53	22.841	2.32
2002	2.202	0.268	1.935	30.339	6.38
2003	11.314	0.524	10.791	25.377	42.52
2004	20.774	0.736	20.038	32.836	61.02
2005	29.902	0.654	29.248	102.105	28.65
2006	38.522	0.597	37.925	177.53	21.36
2007	53.091	0.493	52.598	261.894	20.08
2008	65.589	0.396	65.193	297.401	21.92
2009	66.651	0.306	66.345	198.155	33.48

Source: Database of World Trade Atlas, China Customs

3. The Source of Sino-US Trade Surplus with Intra-Product Specialization

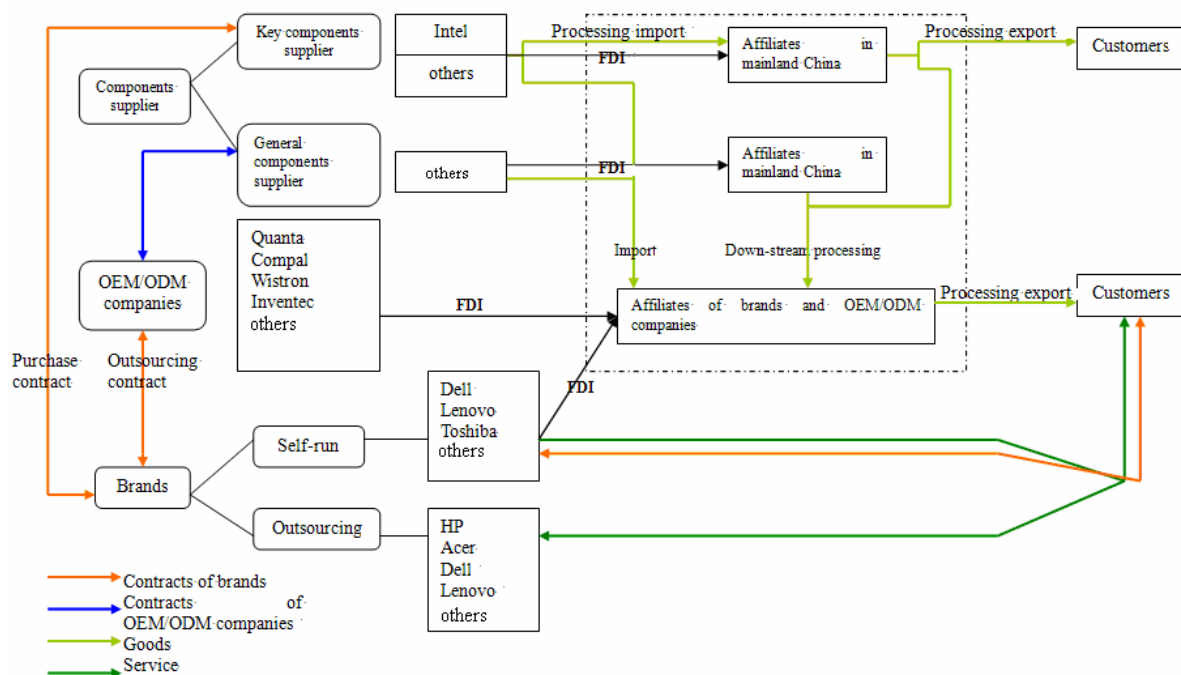
The NB production and trade network in mainland China is comprised of three key players. They are name brand companies, OEM/ODM companies, and components suppliers. Brands are the sponsors of production and trade, components suppliers are the participants, and OEM/ODM companies are the organizers and performers of this network as shown in Figure 1.

3.1 Brands

Some brands outsource entire manufacturing, such as Acer, but others such as Dell, Lenovo, and Toshiba practice partial outsourcing. In 2009, these companies exported 1.11 billion USD worth of NB to the U.S through “Import-and-Assembly” which accounts for 5.09 percent of total NB exports from mainland China.

As outsourcing becomes more prevalent, brands focus only on marketing while the OEM/ODM companies manufacture and deliver NB to global customers. As a result, the brands are able to control their global production network indirectly through purchasing and sales channels. The business relationship between brands and OEM/ODM companies gives the brands the right to purchase key components and collaborate with key components suppliers. However, the OEM/ODM companies are just performers of purchase, production and trade in terms of OEM/ODM contracts (Figure 1).

Figure 1. Relationship of Participants in the NB Global Production Network



3.2. OEM/ODM Companies

The major performers of Sino-U.S. NB trade are OEM/ODM companies from Taipei such as Quanta, Compal, Wistron, and Inventec. In 2009, the affiliates of the OEM/ODM companies from Taipei in mainland China exported NB in the amount of 53.21 billion USD, which accounted for 81.87 percent of total export value of NB from China to the whole world, and 20.16 billion USD, which accounted for 92.75 percent of the total export value of NB from China to the U.S, (Table 2 and 3).

Two main sources provide the components that OEM/ODM companies require. Some are imported from East Asia while others are re-imported from bonded areas in mainland China, which is home to foreign components suppliers mentioned in Section 3.3.

Table 2. The Major Players of the Sino-U.S. NB Trade (2009)

Type of Players	Export Value	Share of Total NB Export Value from Mainland China percent	Billion USD (percent)	
			Export Value from Mainland China to U.S.	Share of Total NB Export Value from Mainland China to U.S. percent
OEM/ODM Companies	53.21	81.87	20.16	92.75
Brands	9.60	14.77	1.16	5.09
Total	62.81	96.64	21.26	97.84

Notes: OEM/ODM companies include the affiliates of Quanta, Compal, Wistron, Inventec, and Foxconn in mainland China. Brands include the affiliates of Lenovo, Dell, Toshiba, Samsung and so on.

Source: Detail trade data were purchased from China Customs by the author.

Table 3. The Major Players of NB Trade in Mainland China (2009)

		Billion USD (percent)
Name of Parent Company	Name of Affiliates in Mainland China	Share of Total Export Value percent
Quanta (China, Taipei)	Tech-Trend (Shanghai) Computer Co., Ltd. (TTC)	27.02
	Tech-Giant (Shanghai) Computer Co., Ltd. (TGC)	
	Tech-Com (Shanghai) Computer Co., Ltd. (TCC)	
	Tech-Front (Shanghai) Computer Co., Ltd. (TFC)	
Compal (China, Taipei)	Compal Information (Kunshan) Co., Ltd	19.56
	Compal Information Technology (Kunshan) Co., Ltd.	
	Compal Electronics Technology (Kunshan) Co., Ltd.	
Wistron (China, Taipei)	Wistron InfoComm (Kunshan) Co., Ltd.	16.37
	WOS, China	
	WOSH, China	
Inventec (China, Taipei)	Inventec (Shanghai) Co., Ltd.	15.02
	Inventec (Pudong) Co., Ltd.	
	Inventec (Shanghai) High-Tech Co., Ltd.	
Foxconn (China, Taipei)	Foxconn (Yantai) Co., Ltd.	3.9
	Foxconn (Shenzhen) Co., Ltd.	
Asus (China, Taipei)	Asus (Shanghai) Co., Ltd.	6.56
	Asus (Suzhou) Co., Ltd.	
Lenovo (China)	Lenovo (Shenzhen) Co., Ltd.	3.59
	Lenovo (Shanghai) Co., Ltd.	
Samsung (Korea)	Samsuang (Suzhou) Co., Ltd.	2.99
Toshiba (Japan)	Toshiba (Hangzhou) Co., Ltd.	1.02
Dell (U.S.)	Dell (Xiameng) Co., Ltd.	0.61
Total		96.64

Source: China Customs.

3.3. Component Suppliers

Component suppliers are important participants in NB production and trade network in mainland China, as they have formed vertical specialization with OEM/ODM companies through FDI. Component suppliers in this paper are divided into key components suppliers and generic ones in terms of component value in NB. The former are suppliers of chips and central processing units, and the latter are suppliers of Printed circuit board (PCB), heat sink, and so on.

Many key component suppliers fragment their product into several parts or processes. Technical-intensive or high value-intensive ones are produced in the home country of component suppliers or other developed areas, while labor-intensive ones are located in low-cost countries such as mainland China. A good example is Intel. Intel’s total product processes of chips include wafer fabrication, packaging, and testing. Wafer fabrications are produced in the parent company located in the U.S and affiliated ones in Ireland. The packaging and testing are implemented mainly in mainland China and Malaysia. Generic components suppliers from Taipei followed OEM/ODM companies such as Quanta and Compal and shifted their production facilities to mainland China by FDI in the early 2000s.

Mainland China has been one of the most important places for key component and generic suppliers to complete their components and export them to OEM/ODM companies through down-stream processing or to re-import them from China’s bonded areas.

Therefore, from the perspective of the relationships between brands, OEM/ODM companies, and components suppliers, the cause of the Sino-U.S. NB trade surplus originates from the virtual production network of NB brands mainly from the U.S. Nonetheless, the production shift of OEM/ODM companies and components suppliers to mainland China through FDI contributes to the direct change of trade flow and the increase of the Sino-U.S. NB trade surplus.

4. Distribution of Benefits in Global NB Value Chain: Case Study of HP Pavilions DM3T

4.1 Benefits of Brands, OEM/ODM Companies, and Components Suppliers

The distribution of benefits in a global NB value chain follows the “U curve”, which means that high value-added processes of R&D and marketing are located at the endpoints of the NB value chain, and low value-added ones of manufacturing are located in the middle of the NB value chain (Table 4).

As the leaders of the NB industry, Microsoft and Intel enjoyed an average gross margin of as much as 80 percent and 50 percent, respectively, from 2001 to 2009. Meanwhile, storage suppliers achieved an average gross margin of 25 percent; LCD suppliers of 15 percent; and NB brands of 15 percent. On the contrary, OEM/ODM companies reside at the bottom of the NB value chain with the lowest average gross margin of less than 5 percent during this period.

Table4: Gross Margin of Major NB Brands and Components Suppliers (percent)

Product	Name	2001	2002	2003	2004	2005	2006	2007	2008	2009
Operating System	Microsoft	85.69	85.57	84.52	81.98	84.71	84.31	82.51	80.56	81.09
Processor	Intel	46.2	49.8	56.7	59	59.4	51.5	51.9	55.5	55.7
	AMD	NA	NA	34	39.4	40.9	37.8	37.4	40	42.1

	VIA	33.9	28.2	27	28	24	26	24	36	36.7
	SIS	21	28	28	26	27	28	NA	30	NA
Storage	Seagate	NA	NA	NA	22.2	23.2	19.2	25.2	14.4	14.4
	WDC	10.7	13.1	16.3	15.1	16.2	19.1	16.5	21.5	NA
	Hynix	NA	NA	NA	39	36	NA	19	NA	NA
	Infineon	NA	NA	NA	38	30	31	34	35	35.2
LCD	Samsung	NA	NA	NA	24	7	8	12	11	10
	CHIMEI	NA	NA	13.9	-1.4	4.8	7.2	12.9	5.7	0.1
OEM/ODM	Quanta	11	NA	5.2	5.9	4.6	3.7	4.2	4.5	5.4
	Inventec	NA	9	8	NA	5	5	5	3	4
	Wistron	12	7.2	6.4	5.2	6	6.7	6.4	5.6	4
	Compal	NA	6.8	7	3.1	3.8	2.9	4.8	5	4.6
Brand Marking	HP	25.4	26.1	26.3	23.9	23.4	24.3	24.4	24	25
	Acer	NA	NA	NA	12.1	10.7	10.9	10.3	10.5	10.2
	Dell	20.2	17.6	17.9	18.2	18.4	17.7	16.5	19.9	17.9

Source: Company annual reports.

4.2. Benefits Distribution between the U.S. and Mainland China

Estimating the trade benefits of countries with the prevalence of global production and outsourcing of MNCs can be challenging. The following section analyzes the HP Pavilions DM3T which launched in the fourth quarter of 2009, and the gross margin of suppliers of their benefits in the NB value chain. Considering outsourcing and global production of MNCs, we treat the parent country of MNCs as the country of benefits attribution.

HP Pavilions DM3T consists of 500 kinds of components, 80 percent of which are mainly from the U.S., Taipei and Korea (Table 5). The value of components from U.S. suppliers share 51.09 percent of the total, those from Taipei share 16.02 percent, and those from Korea share 8.74 percent.

Table 5. Component Value of HP Pavilions DM3T

Home Country of Component Suppliers	Share of total PC value (percent)
U.S.	51.09
China Taipei	16.02
Korea	8.74
Japan	0.52
Switzerland	0.19
China Hong Kong	0.07
Netherland	0.04

Other	23.34
Total	100

Source: iSuppli database

The NB components with high technology and value are supplied by U.S suppliers, such as CPU, Northbridge chip, Southbridge chip, chip of input-output, storage, WLAN and so on, with an average gross margin of more than 40 percent. Meanwhile, the average gross margin of suppliers from Korea and Taipei are 20 percent and 10 percent, respectively (Table 6).

Table 6. Gross Profit Margin of Major Suppliers - 2009 (percent)

Home Country of Component Supplier	Name of Component Suppliers	Gross Profit Margin (percent)
US	Intel	55
	Broadcom	50
	Atheros	49
	TI	48
	IDT	41
	Reltek	41
	Parada	38
	HP	21
Korea	Seagate	14
	Samsung	20
China Taipei	Delta	21
	Novatek	20
	AUO	11
	TRIPOD	8
	Quanta, Compal, Inventek	5

Source: Company annual reports.

However, few components suppliers from mainland China have been key members of HP global production until now, in terms of the HP teardown dataset. Therefore, we cannot estimate benefits of mainland China through Chinese NB suppliers.

Since China is one of the largest NB assembler in the world, the benefits of ODM/OEM company's affiliates, establish the position of mainland China in the NB global value chain. Table 7 shows the benefit distribution of four major OEM/ODM companies between their parent companies and affiliates in mainland China from 2003 to 2009. Two characteristics are apparent from the data. Firstly, the share of total revenue of affiliates in mainland China has experienced a significant increase since 2003, which resulted in the large-scale production shift to mainland China of OEM/ODM companies in the early 2000s. Secondly, the ratio of

profit margin of affiliates in mainland China to that of OEM/ODM parent companies lies in the low level of 10 percent to 20 percent, which implies mainland China gains few benefits from assembling and lies in the bottom of NB value chain.

Evidently, there has been a large gap between the benefits from the NB global production network gained by the U.S and mainland China. The U.S enjoys generous profits but mainland China suffers meager ones. NB and components suppliers from the U.S are the leaders of this industry but few key suppliers from mainland China participate in the NB global production. The benefits of the U.S stem from high technologies and global sales channels, while mainland China resorts to a low-cost labor force.

Table 7. Distribution of Benefits of Major OEM/ODM Parent Companies and Affiliates in Mainland China (2003-2009)

NT \$

Name	Year	Revenue of Parent Companies (1)	Revenue of Affiliates in Mainland China (2)	(2)/(1) percent	Net Income of Parent Companies (3)	Net Income of Affiliates in Mainland China (4)	(4)/(3) percent	Profit Margin of Parent Companies(5)	Profit Margin of Affiliates in Mainland China (6)	(6)/(5) percent
Quanta	2003	1,123	60	5.34	119	-1	——	10.62	-2.16	——
	2004	1,422	NA	NA	109	5	4.59	7.63	NA	NA
	2005	2,923	NA	NA	133	11	8.27	4.53	0.29	6.4
	2006	3,245	2,980	91.83	120	13	10.83	3.69	0.42	11.38
	2007	4,031	4,143	100	109	15	13.76	2.71	0.36	13.28
	2008	7,324	8,844	100	184	44	23.91	2.52	0.49	19.44
	2009	7,631	8,008	100	202	23	11.39	2.65	0.29	10.94
Compal	2003	772	116	15.03	54	2	3.7	7	1.3	18.57
	2004	1,165	692	59.4	79	-2	——	6.8	-0.27	——
	2005	1,622	1,197	73.8	113	-2	——	6.97	-0.14	——
	2006	2,114	818	38.69	66	-3	——	3.11	-0.34	——
	2007	2,209	581	26.3	84	0	0	3.81	-0.01	——
	2008	4,275	1,092	25.54	137	6	4.38	3.2	0.57	17.81
Wistron	2004	767	92	11.99	17	-4	——	2.22	-4.45	——
	2005	777	119	15.32	16	-4	——	2.07	-3.12	——
	2006	1,166	634	54.37	-8	-4	——	-0.71	-0.64	——
	2007	1,549	1,276	82.38	32	1	3.13	2.05	0.05	2.44
	2008	2,769	2,452	88.55	66	13	19.7	2.39	0.55	23.01
	2009	4,223	3,869	91.62	69	27	39.13	1.63	0.7	42.94
Inventec	2004	683	261	38.21	33	2	6.06	4.9	0.65	13.27
	2005	816	851	100	42	7	16.67	5.21	0.85	16.31

	2006	1,314	1,767	100	24	-4	—	1.85	-0.21	—
	2007	1,626	2,600	100	33	4	12.12	2	0.15	7.5
	2008	2,392	3,248	100	—	29	51.79	2.36	0.89	—
	2009	3,507	4,248	100	53	4	7.55	1.52	0.1	6.58

Source: Company annual reports.

5. Conclusion

The series of international trade issues triggered by the increase of the Sino-U.S. trade surplus draws common concerns in the world. In fact, international specializations dominated by MNCs are closely related to vertical trades with the boom of economic globalization. In the last ten years, MNCs increasingly outsourced their manufacturing and performed their production through virtual production networks. The higher the standardization of the industry, the more prevalent outsourcing was used, of which the NB industry was distinctive.

The prevalence of global production and outsourcing of MNCs changes the NB trade modes and the distribution pattern of benefits. We find that the Sino-U.S. NB trade surplus originates from the virtual production network controlled by NB brands mainly from the U.S. Take the HP Pavilions DM3T (launched in the fourth quarter of 2009) for example, and regard the gross margin of production suppliers as their benefits in the NB value chain. We learned that the U.S. enjoys generous profits but mainland China suffers meager ones in the NB and components trade. Today, few components suppliers from mainland China have been the key member of HP global production in terms of the HP teardown dataset. Mainland China still mainly resorts to low-cost labor for benefits. Despite the gains in the NB industry, the U.S. still suffers trade deficits from China. Nonetheless, China bears the same consequence, but in a different way.

References

- Daokui, Li; Ning, Dan (2006). The Sino-US Trade Imbalance: What Are the Fundamental Causes? *International Economic Review*, 5.
- Dedrick, Jason; Kraemer, Kenneth L.; Linden, Greg (2010). Who Profits from Innovation in Global Value Chains?: A Study of the iPod and Notebook PCs. *Industrial and Corporate Change*, 19(1):81-116.
- Lardy, Nicholas R. (1994). China in the World Economy. *Institute for International Studies: Peterson Institute*.
- Linden, Greg; Dedrick, Jason; Kraemer, Kenneth L. (2007). Innovation and Job Creation in a Global Economy: The Case of Apple's iPod. *Journal of International Commerce and Economics*, 223-240.
- Linden, Greg; Kraemer, Kenneth L.; Dedrick, Jason. (2009). Who Captures Value in a Global Innovation Network? The Case of Apple's iPod. *Communications of the ACM*, 52(3):140-144.
- Wanqin, Lu. (2009). Chinese Current Trade Surplus is Aroused by the Intra-product Specialization in East Asia. *Journal of International Trade*, 7.
- Xiangshuo, Yin; Wang, Lin (2004). The East Asia Factors in the Imbalance of Sino-U.S. Trade. *Asia-Pacific Economic Review*, 1.
- Zhangjie, Pu Hualin (2007). Intraproduct Trade and the Structural Sino-USA Trade Surplus. *World Economy Study*, (2).