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**The People's Republic of
China's High-Tech Exports:
Myth and Reality**

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Abstract

Trade statistics portray the People's Republic of China (PRC) as the largest exporter of high-tech products. In this paper I will argue that the PRC's leading position in high-tech exports is a myth created by outdated trade statistics which are inconsistent with trade based on global supply chains. Current trade statistics mistakenly credit entire values of assembled high-tech products to the PRC, thus greatly inflating its exports. In 2009, the PRC's value-added accounted for only about 3% of the total value attributed to its exports of iPhones and laptop personal computers. Moreover, 82% of the PRC's high-tech exports were produced by foreign-invested firms, in particular Taipei,China-owned companies. In this paper I will argue that a value-added-based approach should be adopted to accurately measure high-tech exports. Furthermore, if assembly is the only source of the value-added generated by PRC workers, in terms of technological contribution these assembled high-tech exports are no different from labor-intensive products, and so they should be excluded from the high-tech classification.

JEL Classification: F1, F2

Contents

1.	Introduction.....	3
2.	Reported Growth of the PRC's High-Tech Exports	3
3.	High-Tech or Assembled High-Tech Products?	4
4.	Who Produces the PRC's High-Tech Exports?	6
5.	Concluding Remarks: Myth and Reality	9
	References	10

1. INTRODUCTION

According to a European Commission report, the People's Republic of China (PRC) surpassed the United States (US), the European Union (EU)-27, and Japan to emerge as the largest exporter of high-tech goods in 2006, when the global share of the PRC's high-tech exports surged to 16.9%, closely followed by the US at 16.8%, EU-27 at 15%, and Japan at 8% (Meri 2009). US Census Bureau data show that since 2002 the US has consistently run a trade deficit with the PRC in advanced technology products. The deficit reached a record high of US\$94 billion in 2010 (US Census Bureau 2011). Statistics from the PRC government present a similar story: high-tech exports reached US\$492 billion in 2010, accounting for over one-third of the PRC's total exports.

Until recently, the PRC had not been a major player in the global market of high-tech products. Resource- and labor-intensive products had dominated the PRC's exports. In 1995, the PRC accounted for a mere 2.1% of global high-tech exports, equivalent to only 8% of those of the US (Meri 2009). With a population of 1.3 billion, it is no surprise that the PRC dominated the global market of labor-intensive products. It is astonishing, therefore, that only a decade later the PRC was regarded as the number one exporter of high-tech products. This is even more shocking given research and development (R&D) expenditure accounted for only 1.5% of gross domestic product (GDP) (Tong and Zhu 2009). So is the PRC really a high-tech export champion, or is this just a myth?

In this paper I analyze the structure of the PRC's high-tech exports and the ownership of firms that export high-tech products, and argue that i) only a fraction of the value-added in high-tech products labeled "Made in the China" can be attributed to the PRC, and that ii) the PRC's real contribution to 80% of reported high-tech exports is labor, not technology. This reality check suggests that the PRC's leading position in high-tech exports is indeed a myth that has little to do with technology advancement of indigenous companies. In the next section I will present the official statistics on the PRC's high-tech exports before analyzing them in section 3 to understand the true nature of the PRC's high-tech exports. Section 4 will explore the role of foreign direct investment (FDI) and extension of production networks of multinational enterprises (MNEs) in establishing the PRC as the assembly hub of high-tech products.

2. REPORTED GROWTH OF THE PRC'S HIGH-TECH EXPORTS

The PRC's official statistics on high-tech trade are divided into nine product categories: computers and telecommunications, life science technologies, electronics, computer-integrated manufacturing, aerospace, optical-electronics, biotechnology, materials, and others. The classification is jointly published by the PRC's Ministry of Science and Technology and the Ministry of Commerce. The high-tech category is comparable with the US trade statistics on advanced technology products.

Figure 1 shows the trend in the PRC's high-tech exports and its share of total manufacturing exports from 1995 to 2010. In 1995, the value of high-tech exports amounted to US\$10.1 billion, making up about 6.8% of total exports. From 1995 to 2010, high-tech exports grew by 30% annually, much faster than the growth of overall exports. In 2010 high-tech exports totaled US\$492.4 billion, accounting for 31.2% of total manufacturing exports. Before 2004, the PRC consistently had a trade deficit in high-tech products. The rapid expansion of high-tech exports

turned the trade deficit into surplus. By 2010 the trade surplus in high-tech products had surged to US\$79.6 billion, constituting 44% of the PRC's total trade surplus.

Table 1 shows the structure of the PRC's high-tech exports in 2010. Computers and Telecommunications equipment, and Electronics made up the bulk of high-tech exports. Exports in Computers and Telecommunications totaled US\$356 billion, or about 72% of total high-tech exports; Electronics ranked second with US\$77.5 billion. Combined exports in the two categories accounted for almost 90% of total high-tech exports, suggesting that the PRC's high-tech exports were dominated by these two product categories.

Table 1: The PRC's High-Tech Trade by Categories, 2010

Technologies	Exports		Imports		Trade Balance
	Value (US\$ billion)	Share (%)	Value (US\$ billion)	Share (%)	Value (US\$ billion)
Computer and Telecommunications	356.0	72.3	93.7	22.7	262.3
Life Science technologies	13.9	2.8	11.7	2.8	2.2
Electronics	77.5	15.7	196.2	47.5	-118.7
Computer-integrated manufacturing	7.7	1.6	34.9	8.5	-27.2
Aerospace	3.5	0.7	34.9	8.5	-31.4
Optoelectronics	28.6	5.8	52.3	12.7	-23.7
Biotechnology	0.4	0.1	0.4	0.1	0
Materials	4.4	0.9	5.8	1.4	-1.4
Others	0.4	0.1	0.9	0.2	-0.5
Total	492.3	100	412.7	100	79.6

Source: Statistics on Science and Technology, PRC Ministry of Sciences and Technology.

It is worth pointing out that trade in Computers and Telecommunications generated a US\$262 billion surplus in 2010, whereas the Electronics category showed a deficit of US\$ 119 billion. These figures provide some insight into the PRC's so-called high-tech trade. Many parts and components used as intermediate inputs for products in the Computers and Telecommunications category are classified as electronics—one of the reasons for the deficit in the Electronics category. Global supply chains in Information and Communication Technologies (ICT) are distributed across countries, and the PRC is integrated in the low value-added portion of the supply chain. The large share and the surplus in the Computers and Telecommunications category is consistent with the fact that the PRC is positioned at the final stage of the ICT production chain—assembly and current trade statistics ascribe the entire value of an assembled high-tech product to the country shipping the product abroad. This, I argue, is the reason behind the myth of the PRC's number one status in high-tech exports. I will discuss these issues in more detail in the next section.

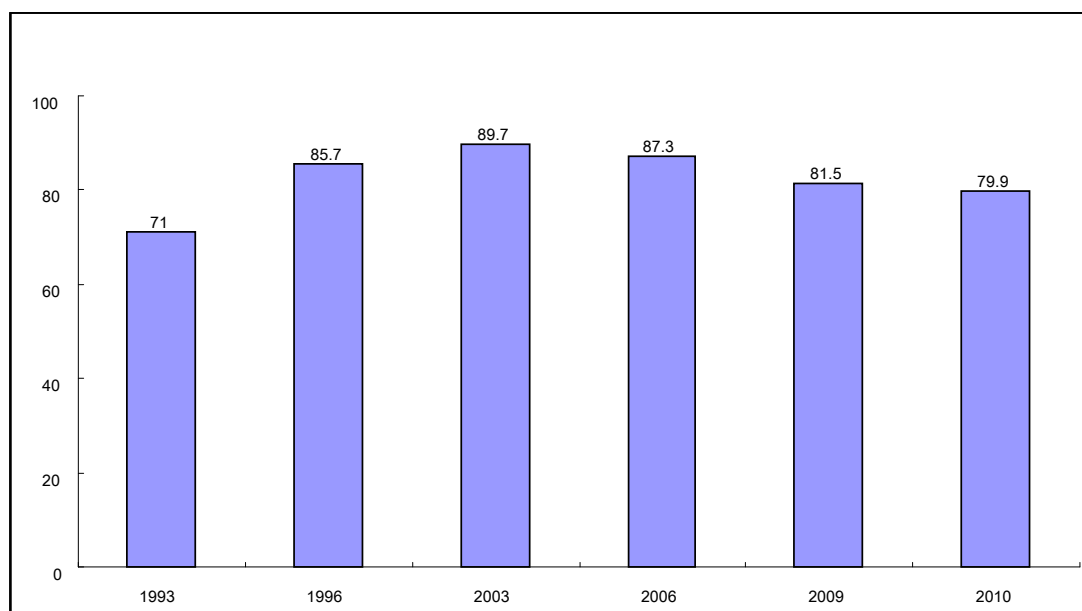
3. HIGH-TECH OR ASSEMBLED HIGH-TECH PRODUCTS?

PRC Customs classifies trade into two major categories: processing trade and ordinary trade. Processing trade involves importing parts and components as intermediate inputs, processing and assembling these intermediate inputs into finished products, and re-exporting the processed products to the global market. Processed exports use both imported and domestically-produced parts and components. The share of domestically-made content

determines the domestic value-added to exports. In 2010, processing trade accounted for over 40% of the PRC's total trade (PRC Customs data 2011).

Due to a lack of technology advantages, processing trade has been the major form of high-tech exports from the PRC since the early 1990s (Figure 2). In 1993, the PRC exported US\$4 billion in high-tech products, of which processing exports accounted for 71%. As more and more foreign firms relocated labor-intensive segments of their production-chain to the PRC and utilized the PRC as an export platform, the share of processing exports in high-tech products grew dramatically, reaching almost 90% in 2003. The share of processing exports declined slightly, to 80%, in 2010, but remained dominant in the PRC's high-tech exports.

Figure 2: Processing Exports as a Share of Total High-Tech Exports (%)



Source: Statistics on Science and Technology, the PRC's Ministry of Science and Technology.

When these assembled high-tech products are shipped abroad, PRC Customs classifies them as high-tech exports, regardless of whether the PRC's contribution is in labor or technology. The entire value of the assembled high-tech product is credited to the PRC regardless of whether most of the key parts and components are imported or domestically produced. Therefore, current trade statistics are misleading and they greatly inflate the PRC's exports in high-tech products.

The series of "i-products" designed by Apple are a typical example. All iPods, iPhones, and iPads are exclusively assembled in the PRC. The role of PRC workers in the global supply chain of i-products is simply to screw all parts together, make ready-to-use i-products, and ship them to the world market. When these ready-to-use i-products leave PRC ports, they are classified as high-tech exports and all value-added embedded is fully credited to the PRC. A false trade pattern is created by these trade statistics: the PRC—a developing country—exports high-tech products, whereas developed countries such as Japan and the US import high-tech products invented by their own companies.

Given the nature of current trade-statistics, an interesting question is: what is the value-added generated by PRC workers in high-tech exports? In other words, to what extent do current trade statistics inflate the PRC's high-tech export value? I will use the examples of the iPhone and laptop personal computers (PCs), both of which belong to the Computers and Telecommunications category, to answer these questions.

Table 2: The PRC's Exports of the iPhone and Laptop PC, 2009

	Volume (million)	Unit Price	Export Value (million US\$)	Unit Value added by PRC*	Export by value added (million US\$)
iPhone	25.7	\$179	4,600	\$6.5	167
Laptop PC	108.5	\$484	52,514	\$14.5	1,573

Source: Xing and Detert (2010); Dedrick, Kraemer, and Linden (2010); Information Industry Yearbook 2010 (MIC); and the author's estimations.

Note: * assembling costs only

According to Xing and Detert (2010), in 2009 the PRC exported 25.7 million 3G iPhones at US\$179 per unit. Total iPhone exports are valued at US\$4.6 billion, making up 1.2% of the PRC's high-tech exports. The value-added by the PRC is only US\$6.5 per iPhone and the rest is attributed to imported parts and components from Germany, Japan, the Republic of Korea, and the US. This implies the total value-added of iPhone exports from the PRC was only US\$ 167 million, about 3.6% of the attributed US\$4.6 billion.

The PRC is the number one laptop PC maker in the world. In 2009, it exported 108.5 million laptop PCs with an average selling price of US\$484 per unit (MIC 2010). Total laptop PC exports amounted to US\$52.5 billion, contributing 14% of its total high-tech exports. Dedrick, Kraemer, and Linden (2009) estimated that assembly represents just 3% of the entire manufacturing cost of a laptop PC. Using this estimate as a reference, the value-added per laptop PC generated by PRC workers would be US\$14.5, and the PRC's total value-added exports of laptop PCs would amount to US\$1.6 billion, or just 3 % of the total attributed to the PRC.

As the iPhone and laptop PCs made up only 15% of the PRC's high-tech exports, it is not appropriate to point to the low valued-added in these two products and draw a general conclusion regarding all high-tech exports. However, given that 72% of high-tech exports belong in the category of Computers and Telecommunications and 80% are assembled with imported parts and components, there is no doubt that current trade statistics greatly exaggerate the value of high-tech exports. It is also misleading to claim that the PRC is a global leader in high-tech trade. Trade statistics fail to identify the country of origin of key technology contents and have erroneously depicted the PRC as the no.1 high-tech exporter. To accurately describe the PRC's position in global high-tech trade, a value-added approach should be employed with a detailed country distribution of the value-chain.

Even if the value-added approach were adopted, assembling high-tech products should not be considered as advanced technology. Assembling parts and components into finished products only requires low-skill labor and is no different from manufacturing of other labor-intensive goods. The contribution of PRC workers to these products is not advanced technology, but labor. High-tech products made of key imported parts and components should thus be called "assembled high-tech" and be excluded from the high-tech classification.

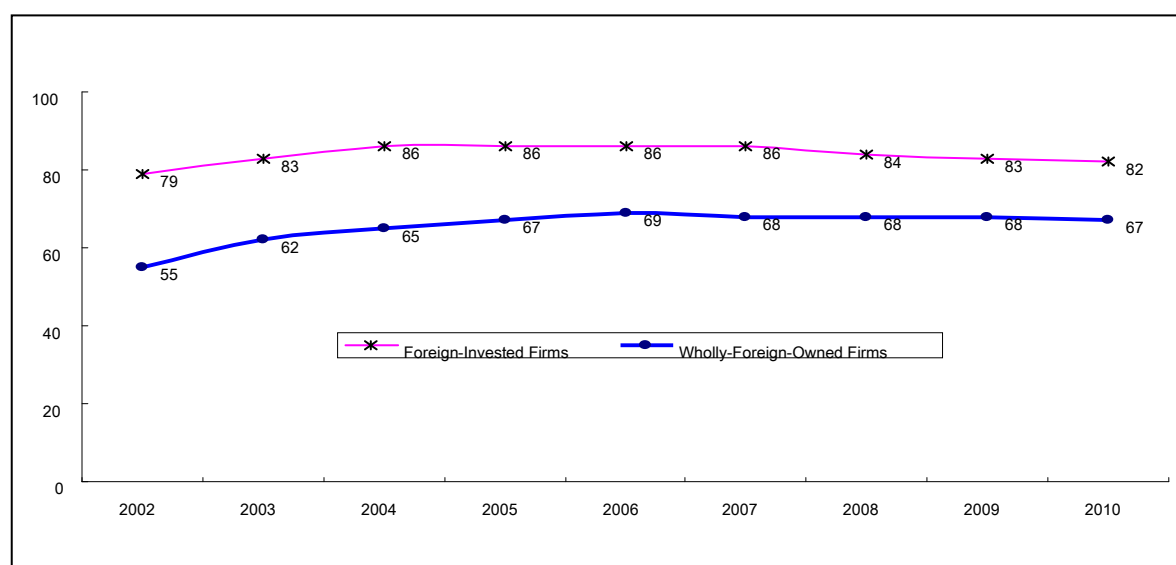
4. WHO PRODUCES THE PRC'S HIGH-TECH EXPORTS?

Another relevant question concerning the PRC's high tech exports is: what are the major reasons for such a dramatic surge in high-tech exports from US\$10 billion to US\$492.4 billion in less than two decades? The simple answer is the FDI and the extension of the production networks of MNEs from Japan; the Republic of Korea; Taipei,China; Singapore; and other economies to the PRC.

It is well-known that foreign-invested firms have been driving the rapid growth and producing more than half of the PRC's exports. The advancement of production technology and transportation has greatly facilitated the spread of MNE production chains across borders. Conventional specialization of products has been replaced by specialization in parts, components, and production procedures. In computer and telecommunications, and electronics industries, specialization in parts and production procedures, and global production networks have been well developed by MNEs, especially those from Japan; the Republic of Korea; and Taipei, China. The PRC's openness to FDI and its rich endowment of labor has attracted MNEs seeking to relocate their product capacities, outsource labor-intensive components, and integrate the PRC into their global production networks.

In high-tech products, foreign-invested firms have been playing an even more crucial role, dominating the PRC's high-tech exports. Figure 3 shows the contribution of foreign-invested firms to high-tech exports. In 2002, foreign-invested firms produced 79% of high-tech exports and wholly-foreign-owned firms produced 55% of high-tech exports. Since then, the dominance of foreign-invested firms has further strengthened as more and more FDI moved into the PRC. In 2004, the share of foreign-invested firms grew to 86%; and in 2006 the share of wholly foreign-owned firms rose to 69%.

Figure 3: Foreign-Invested Firms' Contribution to the PRC's High-Tech Exports (%)



Source: Statistics on Science and Technology. Various issues. PRC Ministry of Science and Technology.

High-tech exports of Sino-foreign joint-ventures may represent the technology advancement of PRC partners in these ventures. However, technology and production know-how used to produce exports of wholly-foreign-owned firms belong to foreign investors and have nothing to do with PRC indigenous firms. Technological spillover effects might lead to technology progress of local firms, but it is ambiguous to what extent they have benefited from the presence of foreign investors in the high-tech sector. The share of indigenous firms in high-tech exports had been small; furthermore, in 2010 it slipped to 17%, 4 percentage points lower than in 1995. The relatively small share implies that there are only very limited spillover effects, if any, and that indigenous firms hardly pose a competitive threat to multinational firms in industrialized countries.

Of the foreign investors, Taipei,China Information Technology (IT) companies made a major contribution to the rapid expansion of the PRC's high-tech exports in the ICT sector. As indicated in Table 1, Computers and Telecommunications, and Electronics products represented the largest categories in high-tech exports—close to 90% of the PRC's high-tech exports fell into this category. Relocation of production facilities from Taipei,China to the PRC has helped the PRC emerge as a leading IT exporter in the world. The relocation simply transplanted the success of Taipei,China's semiconductor industry to mainland PRC.

Since 1980, Taipei,China has developed technology and production capacities in the semiconductor industry and the information technology industry. Taipei,China companies have become the largest original equipment manufacturers (OEM) and original design manufacturers (ODM) for leading international IT firms such as IBM, DELL, Intel, SONY, etc. OEM and ODM are the major forms of production fragmentation in the information and telecommunications industry. As production technologies in IT industries gradually mature and production processes are standardized, IT products become commodities rather than high-tech goods. It is then easy to divide production into segments and locate those in different countries.

In terms of global market shares, in 2007 Taipei,China companies ranked first in laptop PCs with more than 90 million units, LCD monitors for PCs with 117.5 million units, and motherboards with 149 million units; it also ranked second in desktop PCs, servers, and digital cameras (Table 3). Most of these IT products are sold in markets outside Taipei,China and mainland PRC. For instance, 95% of digital cameras, 92% of laptops, and 89% of servers are exported to overseas markets.

Table 3: Key Facts of Taipei,China-owned Information Technology Companies, 2007

	Laptop PC	Desktop PC	Motherboard	LCD Monitor for PC	Servers	Digital Camera
Rank in Market Share	1	2	1	1	2	2
Annual Output (1,000 unit)	90,165	46,055	149,097	117,539	2,950	49,896
Global Market Share (%)	92.8	32.6	97.2	70.2	35.2	42.2
*Exports as a Share of Output (%)	91.5	82.8	73.7	80.5	89.4	95

*: Exports consist of all sales outside mainland PRC and Taipei,China.

Source: Taipei,China's Information Industry Yearbook 2008 (MIC).

To strengthen their competitiveness and lower production costs, companies from Taipei,China have gradually relocated their production to mainland PRC. This at once increased the PRC's output in IT products and created an ICT growth myth. Specifically, by 2007, 98% of digital cameras, 97.8% of laptop computers, 57% of servers, and close to 92% of LCD monitors for PCs made by Taipei,China companies were produced in their mainland PRC factories (Table 4). All iPhones and iPads sold in the global market are assembled by Foxconn, a Taipei,China-owned firm located in the PRC. By 2009 Taipei,China IT companies had relocated 95% of their assembling capacities in ICT to mainland PRC (Market Intelligence Center 2010).

Table 4: Shares of Major IT Products by Taipei,China and Made in Mainland PRC (%)

	Laptop PC	Desktop PC	Motherboard	Server	LCD Monitor for PC	Digital Camera
2003	54.3	51.7	73.9	21.3	79.1	89.2
2004	77.8	54.1	86.2	25	84.6	98
2005	92.8	57.5	91.6	42.2	88.7	98.5
2006	96.9	63.9	94	53.4	90.6	99
2007	97.8	71.7	96.4	57.5	91.5	98

Source: Taipei,China's Information Industry Yearbook. Various issues.

Therefore, it is the FDI and outsourcing activities of MNEs that transformed the PRC into a world high-tech assembling factory. Taipei,China IT companies, the leading global makers of ICT products, performed the most critical role in this transition. The abundant labor resources in mainland PRC in conjunction with the direct investment from Taipei,China has made the PRC a top producer of various ICT products, such as laptop PCs, digital cameras, and trendy i-products.

5. CONCLUDING REMARKS: MYTH AND REALITY

Trade statistics portray that in just a decade the PRC transformed itself from being an exporter of labor- and resource-intensive products to become the number one exporter of high-tech products. I argue that the PRC as the champion of high-tech products is a myth created by outdated trade statistics and incorrect product classification. The prevailing trade statistics are inconsistent with trade based on global supply chains and mistakenly credit entire values of assembled high-tech products to the PRC. The PRC's real contribution to 82% of reported high-tech exports is labor, not technology. High-tech products, mainly made of imported parts and components, should be called "Assembled High-tech". To accurately measure high-tech exports, a value-added approach should be employed, providing detailed analysis of the value chain distributions across countries. Furthermore, if assembly is the only source of value-added generated by PRC workers, in terms of technological contribution these assembled high-tech exports are no different from labor intensive products, so they should be excluded from the high-tech classification.

MNEs, in particular Taipei,China IT firms in the PRC, have performed an important role in the rapid expansion of high-tech exports. The trend of production fragmentation and outsourcing activities of MNEs in information and communications technology has benefited the PRC significantly. The small share of indigenous firms in high-tech exports implies that the PRC has yet to become a real competitor of the US, the EU, and Japan. That the PRC is the number one high-tech exporter is thus a myth rather than a reality.

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