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Is China's Export Sophistication Really Special?

Shunli Yao*

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Introduction

In 1953, Harvard economist Wassily Leontief published his finding, known as the "Leontief paradox," that United States exports were less capital intensive than its imports, which contradicted standard predictions for a capital rich country.[1] Fifty years later, another Harvard economist, Dani Rodrik, argues in a cross-country study that the technological sophistication of Chinese exports in the past decade has been so high that it can not be explained simply by the economic fundamentals of a low-income country abundant in unskilled-labour (Rodrik, 2006). This seeming anomaly, or the "Rodrik paradox", is believed to be a result of China's industrial policies that help nurture domestic capabilities in machinery and electronics.

Indeed, machinery and electronics were the single most important product category that helped reshape Chinese trade patterns, as it increased by 800 per cent in export volume and from 18 to 42 per cent in terms of its share in China's exports during the period of 1995-2004. China's export surge in this sector, often perceived as "high-tech", together with highly publicized national programmes for technological innovation, have prompted quite a few suggestions by commentators on Chinese technological upgrading. As a key finding of the first academic exposition of this topic, Rodrik's underlying methodology has been hence used in the literature as a standard formula to measure the level of sophistication or technology content in China's exports (e.g. Xu and Lu, 2009). However, like the "Leontief paradox" that has stimulated a series of empirical inquiries into United States trade patterns, the "Rodrik paradox" has also invited research to scrutinize Rodrik's methodology. While Kumakura (2007) points out the intrinsic upward bias of Rodrik's technological sophistication indexes and questions their empirical robustness, this policy brief summarizes the main points of another study that attempts to untangle the "Rodrik paradox" by examining other contributing factors for its over-estimated Chinese export sophistication (Yao, 2009).

[1] According to the Heckscher-Ohlin theorem, the United States' exports are expected to be more capital intensive than its imports.

Indexes of technological intensity: Intuition and Limitations

The intuition behind Rodrik's methodology is quite simple. A country with a higher per capita Gross Domestic Product (GDP) tends to be more capital or human capital abundant. If the country's comparative advantage is properly revealed, the products that are dominant in the country's export basket tend to be more technologically sophisticated, or have higher technological contents. The opposite holds true for a country with a lower per capita GDP.

Expressed in a mathematical notation for product *k*'s technological level $PRODY_k$ and a country *j*'s export sophistication $EXPY_j$:

Product *k*'s technological level $PRODY_k = \sum_j \frac{x_{jk}/X_j}{\sum_j (x_{jk}/X_j)} Y_j$

and

Country *j*'s export sophistication level $EXPY_j = \sum_k \frac{x_{jk}}{X_j} PRODY_k$

where $X_j = \sum_k x_{jk}$ is country *j*'s total exports summed over commodity *k*, Y_j is country *j*'s per capita GDP, and x_{jk} / X_j is the share of country *j*'s export of good *k* in its total exports.

This means that commodity *k*'s technological level is the weighted average of per capita GDP of countries exporting this commodity, with the share of commodity *k* in a country's total exports as weights. Country *j*'s export sophistication level is derived by aggregating technological levels of all goods the country exports. Intuitively, country *j*'s exports are more sophisticated if, on average, the share of technologically sophisticated products in its total exports is larger.

However, the ability of these indexes, especially the first one, to capture the true level of technological sophistication of a product or a country's export sector is conditional on the following assumptions:

First, exports only use domestic inputs in their production. The logic behind $PRODY_k$ is that only domestic factors are embodied in a country's exports, which makes it

* Shunli Yao is Director, Institute for Applied International Trade at the University of International Business and Economics, Beijing, China. He can be contacted at shunliyao@yahoo.com. The views presented are those of the author and do not necessarily reflect the views of the United Nations or other ARTNeT members and partner.

possible to infer from trade theory that rich countries with abundant capital and human capital will necessarily export skill-intensive products.

Second, income is evenly distributed across exporting and non-exporting regions. This makes it possible that a country's per capita GDP and the level of abundance in physical and human capital in its exporting region can serve as a proxy for each other.

Third, the product classification scheme is detailed enough to exhaust all critical differentiations for any given type of product. For example, all products made in different parts of the world with the same identification *k*, shall not differ significantly in quality, function and other key parameters.

The first two assumptions are country-specific characteristics, whereas the third one is a general issue for all countries. Do the first two assumptions hold for China? Can China serve as a case study to shed any light on the validity of the third assumption? The answer to each of these questions is no, for the following reasons:

(a) The Chinese customs regimes can be broadly grouped into two categories: normal and processing trade regimes. The processing trade regime was set up in the early years of reform to serve as an export promotion strategy, under which imports were free of duty and value-added taxes, but products using imported inputs were required to be exported.

This institutional arrangement for export promotion is equivalent to an "export processing zone". With the development of global production fragmentation, it has led to a rapid expansion of China's trade involving processing activities, with Foreign Direct Investment (FDI) in its processing sector as the main mode of foreign outsourcing to China.

During the period of 1995-2004, China's soaring surpluses with NAFTA and the European Union (15) countries were mirrored by equally fast growing deficits with Asia and other regions. These patterns are consistent with the observation that re-organization of production and trade is accelerating and centering on China in the Pacific Rim region. This data highlights the driving force behind the trade imbalance between China and the United States: China is increasingly becoming part of the global production chain, importing parts and components from its Asian neighbours and exporting processed goods to the United States and European Union (15). On average, processing trade accounts for half of total trade (imports plus exports), with US$ 328 billion exports and US$ 222 billion imports in 2004.

Given the nature and scale of the Chinese processing trade, the first assumption does not hold true for China. For example, it is very likely that China imports high-tech components from the Republic of Korea and Japan under the processing trade regime and then exports them out of China as assembled products with local labour-intensive assembly operations as the only value added.

(b) Chinese foreign trade is unevenly distributed across regions and the inland/coast and rural/urban income divides are widening. China's foreign trade and investment reform started in the southern coastal provinces. The Pearl River Delta (Guangdong Province) was the leading region in Chinese exports in the early years of reform. In 1992, the focus of Chinese economic reform began to shift from the southeast provinces to the Yangtze Delta regions (Shanghai, Jiangsu and Zhejiang), so did FDI inflows and the gravity centre of Chinese exports.

An outcome of Chinese trade and investment development has been a high concentration of exports. While more than 80 per cent of Chinese exports were produced along the coastal region Guangdong and the Yangtze Delta alone, the two richest regions in China, accounted for 70 per cent of exports on average from 2002-2004.

For Guangdong, Shanghai, Zhejiang and Jiangsu, indicators based on adjusted regional per capita GDP are constructed with the combined output in the manufacturing and services sectors divided by total non-agricultural population, showing a huge gap between the national average and the regional per capita indicators for key export regions: the latter are roughly 3~6 times higher than the former. Those numbers suggest that if China's export sophistication index is compared with its adjusted regional, instead of the country-level per capita GDP, it would not appear to be overly high.

(c) Harmonized System (HS) codes are not sufficient for identifying products in international trade. The traditional approach of industry analysts to identify the high-tech products in international trade was to measure the industry-wide R&D to sales ratios. Industries with high R&D/sales ratios were regarded as high-tech industries and products in these industries were therefore labeled as high-tech products. The United States Bureau of Census adopted a different approach to compile its Advanced Technology Product list: it uses expert subjective judgment on individual products. This approach is susceptible to subjective errors as well as to incomplete identifications of trade products by HS codes. Rodrik's method seems to be an alternative approach that does not require direct examination of products, but it is also based on HS codes and therefore the latter problem remains. For example, a United States International Trade Commission study shows that for the same commodities in recent United States-China Advanced Technology Product trade, around 82-90 per cent of 10-digit HS codes in United States exports to China have higher unit values than its imports from China. Furthermore, the average unit value of United States Advanced Technology Product exports to China is in the range of US$ 1 million, while the average unit value of its Advanced Technology Product imports from China lies mostly below US$1,000 (and only US$ 536 in 2006) (Ferrantino et al., 2008). Huge disparities in unit values for products identified with the same HS codes signal that they should be treated as totally different products (that is, as products with different levels of quality or vertically differentiated products). If China's exports contain a large amount of products with the same HS codes as those dominant in United States exports, but are completely different in quality, China could end up with an upward biased export sophistication index.

Further Evidence for Comparative Advantage Complying Expansion of Machinery and Electronics Exports

1. Evidence from sectoral trade balances

As shown in Figure 1, with regard to China's trade with the world, the textile and clothing (Textile Shoes etc.) sector was the leading surplus sector during 2002-2004, followed at a distance by the miscellaneous (Misc) sector (mainly toys and furniture, etc.). The machinery and electronics (Mach/Electrical) sector turned from a trade deficit during 1995-1997 to a negligible surplus during 2002-2004. In contrast, for the China-United States trade, as shown in Figure 2, it was the machinery and electronics (Mach/Electrical) sector that had the greatest surplus during 2002-2004, more than the sum of the surplus in textile and clothing, and the miscellaneous (Misc) sectors.

Figure 1. Trade Balance with Rest of the World

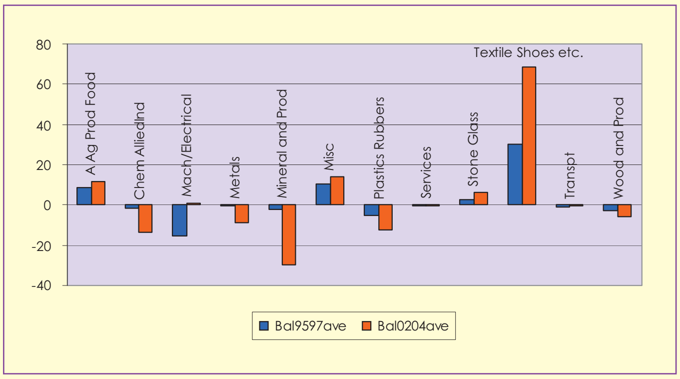
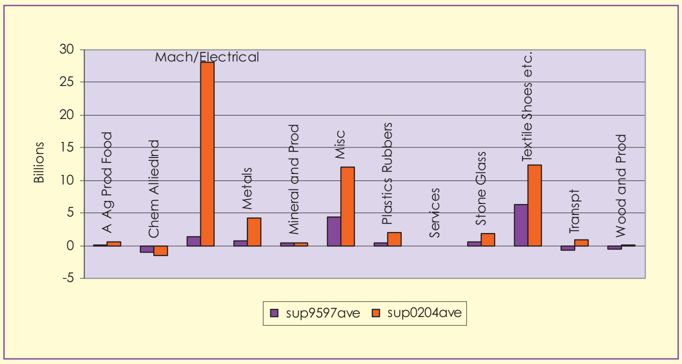


Figure 2. Trade Balance with United States



Source: Yao (2009).

Notes: Ag Food/Food stands for Agricultural Products and Food, ChemAlliedInd stands for Chemical Allied Industry, Mach/Electrical stands for Machine/Electrical, Mineral and Prod stands for Mineral and Associated Products, Misc stands for Miscellaneous, Transpt stands for Transport, and Wood and Prod stands for Wood and Associated Products.

What can we learn about the debate on China's trade with the United States from the difference in the machinery and electronics sector in the two figures? In light of the export surge of Chinese machinery and electronics, some observers argue that China's expansion of export of sophisticated products has gone beyond the level justified by its comparative advantage and therefore constitutes a challenge to the United States in the global high-tech market. Others believe that these exports, though increasingly sophisticated, mainly consist of labour-intensive low-tech products in traditional high-tech industries and that they therefore fit squarely within China's comparative advantage in labour-intensive production. A simple comparison of Figures 1 and 2 tends to support the latter argument, because, if China's trade surplus with the United States in the machinery and electronics sector is a reflection of its comparative advantage defying technological advancement, the surplus with the rest of the world should have been even larger!

2. Evidence from tariff structures in the machinery and electronics sector

As part of China's industrial policy to promote high-tech industry, tariff structures are designed to provide protection for its domestic industries. As a result, tariffs reflect China's perceived technological content for given products, though in practice information technology products are normally exempted from tariff duties. In other words, the tariff level for a product can serve as a proxy for its level of technological content. Using Most-favoured Nation (MFN) tariffs which China applied in 2004 and import values of the same year, simple averages of tariffs for normal and processing trade are calculated.

Specifically, China's tariffs on imports from ASEAN (1.2 to 1.6 per cent) are lower than those from the Republic of Korea (2.0 to 3.3 per cent), which again are lower than those from Japan (2.4 to 5.5 per cent). Imports from the Republic of Korea and Japan also carry higher tariffs for normal trade. China's exports to NAFTA (mainly the United States) and European Union (15) have lower technological contents than its exports to Latin America, Africa and the Middle East. Among the two categories of trade with NAFTA and the European Union (15) countries, technological contents of processing exports are lower than those of normal exports, while for trade with the other three developing regions, technological contents of normal exports are generally lower than those of processing exports.

Hence, for the machinery and electronics sector, the numbers and comparisons suggest that: (1) Chinese imports from ASEAN are more labour-intensive than imports from Japan and the Republic of Korea; (2) Chinese exports to NAFTA and the European Union (15) countries are more labour-intensive than exports to the three developing regions; and (3) Chinese processing exports to NAFTA and the European Union (15) are more labour-intensive than its normal exports to the same regions, while the opposite is true for Chinese processing exports to the three developing regions.

3. Evidence from sub-arrangements of processing exports

Foreign companies' outsourcing of labour-intensive operations to China in the machinery and electronics sector is part of the vertical specialization of global production that has been increasingly prevalent in the past decade. Given that these products typically have low transportation margins and are most suitable for production fragmentation, it is not a surprise that China's trade surplus in this sector only appears in its processing trade.

If further breakdown is made to the sectoral trade balances under the processing trade into two sub-arrangements, processing and assembly (P&A) and processing with imported materials (PWIM), the 2002-2004 average surplus (and its increase from the 1995-1997 average) in the machinery and electronics sector under PWIM is almost five to six times as much as that under P&A.

The key distinction between P&A and PWIM lies in the fact that P&A firms are fairly passive in taking orders and receiving materials from foreign trading companies, whereas the PWIM firms take full control of production, trading, as well as financing. Huang (2003) argues that lending preferences by Chinese banks against its non-state firms has prompted the formation of PWIM joint ventures. By so doing, the labour intensive processing operations by local Chinese firms are able to expand with the infusion of working capital from their foreign partners, and that is the very reason PWIM exports have become the driving force behind the growing machinery and electronics surplus with the world under the processing trade regime. In light of this argument, the surge of Chinese machinery and electronics exports due to credit constraint can be anything but capital or technology-intensive.

A Note of Caution

There is no doubt that China's exports are becoming more sophisticated over time, but the argument that the level of sophistication defies the country's comparative advantage has gone too far. By untangling the "Rodrik paradox", this brief suggests that one has to be careful with the research findings based on Rodrik's methodology. In addition, it should be kept in mind that efforts to improve these indexes could be futile, because some emerging economies and developed countries are exporting increasingly similar baskets of goods in terms of HS codes due to production fragmentation and intra-industry trade, while the ability of the research community to further refine product identification is limited. This calls for a better approach to measure the quality of a country's exports.

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