

Measuring China's Export Sophistication

Bin Xu*

China Europe International Business School

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* Correspondence: Bin Xu, China Europe International Business School (CEIBS), 699 Hongfeng Road, Pudong, Shanghai 201206, China. Tel: 86-21-28905602. Fax: 86-21-28905620. E-mail: xubin@ceibs.edu. I would like to thank Shang-Jin Wei for useful comments, and Sally Hu, Yixin Luo, and Dafeng Xu for excellent research assistance. Financial support from CEIBS Research Fund is gratefully acknowledged. All errors are my responsibility.

ABSTRACT

Recent studies find that China is special in a cross-country relationship between level of export sophistication and level of per capita income: China's exports are found to be much more sophisticated than one would expect from its income level. In this paper we identify two measurement biases that account for the China-is-special observation. First, China's overall income level significantly underestimates the income level of its exporting regions. Using China's export-region-weighted income level, we find that the China-is-special result is weakened by about 30 to 80 percent depending on the year. Second, export sophistication indices used in existing studies overestimate the sophistication level of Chinese exports because they do not consider product quality. Using unit-value differences as a proxy for quality differences in constructing a quality-adjusted index of export sophistication, we find that the China-is-special result is weakened by another 10 to 30 percent depending on the year. After correcting the two measurement biases, the estimated China-is-special effect is statistically insignificant and its point estimates are close to zero in recent years (2001-2005).

Keywords: China; Development; Export sophistication; Export quality; Product data

JEL classification: O1; O4; F1; F4

1. Introduction

China is well-known for its rapid growth in export volume. Recent studies find, however, that China is more impressive in level of “export sophistication”. According to trade theory, a country’s export basket should reflect its endowment and technology capacity. Advanced countries, with more capital and superior technology, are expected to export more-sophisticated goods such as electronic machinery. Less-developed countries, with less capital and inferior technology, are expected to export less-sophisticated goods such as apparel. Empirically this relationship is found to exist. Figure 1 gives an illustration. In the upper graph, a country’s overall export sophistication level is measured by EXPY, an index used by Rodrik (2006) which links product sophistication level to income levels of exporting countries (detailed explanation will come later). The graph shows a positive correlation between EXPY and PCGDP (per capita GDP): low-income countries exported a basket of less-sophisticated goods, and high-income countries exported a basket of more-sophisticated goods. In the lower graph of Figure 1, a country’s export sophistication level is measured by ESI, an index used by Schott (2006) that captures the degree of similarity between a country’s exports and that of OECD countries. This graph also shows a positive correlation: low-income countries exported a basket of goods that are less similar to OECD’s, and high-income countries exported a basket of goods that are more similar to OECD’s. In both graphs, China is an outlier. China’s overall export sophistication level, measured by either EXPY or ESI, is significantly above the cross-country regression line. Quoting from Rodrik (2006)’s eye-catching title, we will refer to this observation as “China-is-special result”.¹

¹ China is not the only country that is special. In the two graphs, we see that India, Mexico, Mali, and Sierra Leone are also outliers above the regression line. There are also outliers below the regression line.

To get a more concrete picture of the China-is-special observation, we report in Table 1 some industry-level data on China's manufacturing exports to the U.S. There are 14 manufacturing industries listed in Table 1 in descending order of R&D intensity. In 1992, "Textiles, apparel, leather and footwear", the least R&D-intensive industry, accounted for more than half of China's manufacturing exports to the U.S. From 1992 to 2005, China's export structure changed dramatically. By 2005, "Textiles, apparel, leather and footwear" fell to less than one quarter in export share, and its role was replaced by two R&D-intensive industries, "Machinery and equipment; office, accounting and computing machinery" (26% of China's exports) and "Electrical machinery; radio, television and communication equipment" (24% of China's exports).

We should point out that the China-is-special observation in the aforementioned studies does *not* refer to this impressive transformation of China's export structure from labor-intensive industries towards technology-intensive industries. Rather, it refers to China's ability of exporting a large amount from technology-intensive industries. Table 1 shows that China's 1992 exports already comprise of 12% "Electrical machinery; radio, television and communication equipment" and 7.5% "Machinery and equipment; office, accounting and computing machinery". According to the studies cited above, China was special in being able to export so many goods from such technology-intensive industries, while other countries at similar development levels were not able to do so.

The purpose of this paper is not to explain the reasons behind the numbers in Table 1; we will investigate it in some other papers. Our focus in this paper is on the methodology of measuring China's export sophistication. There are two facts about China that prompt us to believe that the existing measures overestimate China's export

sophistication. First, China's exports come overwhelmingly from its more developed regions, whose income levels are significantly higher than China's average. Table 2 reports some key economic indicators of China's provinces. In 2004, 90 percent of China's exports came from the top nine provinces. As shown in the second column of Table 2, the top-nine exporting provinces had income levels 1.3 to 4.5 times that of China as a whole in 2004.² Notice also that these nine provinces accounted for 84 percent of China's inward FDI flow in 2004. It seems clear that income level of China's export regions is a more appropriate measure of China's endowment and technology capacity for producing exports. By using China's average PCGDP in the cross-country relationship between export sophistication and income, one would overestimate China's upward deviation from the estimated relationship between the two variables.

Second, China's exports are usually priced lower than the same products exported by other countries. Figure 2 gives an example of "Line Telephone Sets with Cordless Handsets" (HS code=8517110000). Variable q is relative price of a product, which equals price of the product from a country relative to export-value-weighted average price of the product from all exporting countries. In 1996, there were 26 countries exporting this product to the U.S. and the export-value-weighted average price was \$49. Among major exporters, China exported 11.3 million sets at price \$44, the Philippines exported 9.2 million sets at price \$38, Malaysia exported 5.5 million sets at price \$55, and Japan exported 463 thousand sets at price \$117 (detail of the data can be found in table 8).

² In December 2005, China revised its 2004 GDP to 15.99 trillion yuan, an increased of 16.8 percent. Over 90 percent of the newly-added 2.3 trillion yuan is from better data about the services sector. In our computation of province-country PCGDP ratios, we use the revised PCGDP of China (12336 yuan) rather than the unrevised one (10561 yuan). If the unrevised PCGDP of China were used, the ratios would be larger; for example, the ratio for Shanghai would be 5.24. China's provinces over-report their GDP. In 2004, the sum of GDP reported by provinces is 16.32 trillion yuan, while China's GDP is 13.69 trillion yuan (prior to the aforementioned revision). Thus our approach has the effect of offsetting the upward bias of province-country PCGDP ratios due to the over-reporting of GDP at the provincial level.

Figure 2 shows a positive correlation between relative price and PCGDP: for the same product, low-income countries export the low-price varieties, and high-income countries export the high-price varieties. This positive correlation is typical in the data.³ As we will discuss below, neither the measure of EXPY nor the measure of ESI considers this within-product quality difference signaled by price difference. By using such measures to evaluate overall sophistication level of a country's exports, one would overestimate the export sophistication level of less-developed countries, especially China whose exports are found to have exceedingly low prices (evidence will be reported).

We want to point out that the above two points are not our novel observations. Rodrik (2006) noted that "Chinese exports often concentrate on the more labor-intensive, less sophisticated end of the product spectrum" and provided unit-value comparisons of electrical goods and equipment exports as an illustration. Schott (2006) identified export price as a second dimension of export sophistication (called within-product sophistication) in addition to across-product sophistication measured by ESI. Schott (2006) also recognized that China's provinces vary substantially in terms of their levels of development, and noted its implications for China's export mix. What these two papers did not do however is to incorporate these considerations in an integrated evaluation of China's overall export sophistication. Rodrik (2006) discounted the importance of Chinese exports being of low quality and emphasized that what matters is China's ability to export goods in high-income categories. Implicitly he assumed that low-quality high-category goods are better for economic growth than high-quality low-category goods. Schott (2006) considered both across-product and within-product export sophistication but did not provide an assessment on the extent to which China's low within-product

³ Schott (2004) identified this pattern of within-product specialization in international trade.

export sophistication offsets its high across-product export sophistication. Note that Schott's (2006) main focus was to evaluate the degree of competition of Chinese exports to OECD exports, and the finding of China exporting low-quality varieties suffices for drawing the conclusion that increasing overlap of China's exports with OECD's exports does not imply as much a competitive threat as some might think.

The China-is-special result presents a theoretical challenge to conventional trade and development theories. Rodrik (2006) considered this result as evidence that China's export experience was neither "a simple story of specialization according to comparative advantage" nor "a straightforward story of export growth achieved through trade openness and free market forces". The China-is-special hypothesis is not just for theoretical debate; it has vital policy implications on China's growth potential and its relationship with the rest of the world. Thus, an accurate assessment of China's export sophistication level is useful both for theoretical purposes and for a better understanding of the pattern of China's export structure and its implications for China's economic growth and development. This is what the present paper aims to do.

The remainder of the paper is organized as follows. In Section 2 we introduce two export sophistication measures used in existing studies and discuss their properties. In Section 3 we evaluate China's overall export sophistication level by considering of heterogeneous income levels of China's exporting regions and low product quality of Chinese exports compared to that of other countries. In Section 4 we discuss China's export sophistication in across-product and within-product dimensions. In Section 5 we conclude. We describe details of our data in an Appendix.

2. Measurement of Export Sophistication

In this section we discuss the methods used to measure the sophistication level of a country's exports. A country's export bundle comprises thousands of products. In the international trade statistics we will use, products are classified by Harmonized System (HS). At the level of 10-digit HS codes, there are more than 20,000 products.

How to rank these products according to their level of sophistication? Apparently we do not have information on R&D content of these products. The literature provides two methods for obtaining *revealed* sophistication.

Income Content Index

This method assigns an income content number for each product. If a good is exported only by one country whose per capita income is \$5000, then the income content of the good is \$5000. If a good is exported by more than one country, then its income content is the trade-importance-weighted sum of income levels of all the exporting countries. Hausmann, Hwang, and Rodrik (2007) specify this measure as⁴

$$\text{PRODY}_i = \sum_{c \in C_i} \left\{ \frac{s_{ic}}{\sum_{n \in C_i} s_{in}} Y_c \right\} \quad (1)$$

In this equation, PRODY_i denotes the sophistication level of product i and is measured as the weighted average of real PCGDP (Y_c) of all countries in set C_i that export good i . The weight variable is $s_{ic}/\sum s_{in}$, where s_{ic} is the share of good i in country c 's total export value, which reflects the importance of good i in country c 's exports. Dividing s_{ic} by $\sum s_{in}$ makes the sum of weights equal to one, so the weight variable reflects the importance of good i in country c 's exports *relative to* all the other countries that export the good.

⁴ Similar measures were developed by Michaely (1984) and Lall et al. (2006).

By aggregating $PRODY_i$ of a country's all exporting goods, one obtains a measure of the country's overall level of export sophistication:

$$EXPY_c = \sum_{i \in I} s_{ic} PRODY_i \quad (2)$$

In this equation, I denotes the set of goods that country c exports. A country's overall level of export sophistication is the weighted average of the sophistication levels of all its exporting goods, with export shares as weights.

Table 3 provides a numerical example of computing $PRODY$ and $EXPY$. In this example, a low-income country (L) exports goods 1, 2, 3 (export shares: 0.5, 0.3, 0.2), a middle-income country (M) exports goods 2, 3, 4 (export shares: 0.5, 0.3, 0.2), and a high-income country (H) exports goods 3, 4, 5 (export shares: 0.5, 0.3, 0.2). PCGDP levels of the three countries are \$5,000, \$10,000, and \$20,000 respectively. We first use equation (1) to compute $PRODY$ of each good. In this example, good 1 is exported only by country L, so $PRODY_1=5,000$. Good 2 is exported by both country L and country M, so $PRODY_2=(0.3/0.8) \times 5000 + (0.5/0.8) \times 10000 = 8125$. We then use equation (2) to compute $EXPY$ for the three countries in the example.

Export Similarity Index

This method measures a country's overall level of export sophistication by computing the overlap of its exports with that of advanced countries (OECD). This measure, called Export Similarity Index (ESI), is specified as⁵

$$ESI_{cd} = \sum_{i \in I} \min(s_{ic}, s_{id}) \quad (3)$$

⁵ Export similarity index was first developed by Finger and Kreinin (1979). See Wang and Wei (2007) for an index of export dissimilarity.

In this equation, ESI_{cd} is the similarity between country c 's exports and country d 's exports. If country d is OECD, then ESI_{cd} measures the similarity of country c 's exports to OECD exports. The last row of Table 3 shows ESI with respect to country H. In this example, country L has good 3 that overlaps with country H, and the overlap is $\min(0.2, 0.5)=0.2$; hence $ESI_{LH}=0.2$. Country M has goods 3 and 4 that overlap with country H, and the overlaps are 0.3 and 0.2 respectively; hence $ESI_{MH}=0.3+0.2=0.5$.

Properties of the Two Measures

Consider ESI of a country against the OECD. ESI has the following properties. First, it accounts for a country's catch-up in export structure with the OECD, and does not account for its catch-up with non-OECD. In our example, if country L's export share of good 3 increases from 0.2 to 0.3 (catch-up with country H), its ESI would rise from 0.2 to 0.3. If country L's export share of good 2 increases from 0.3 to 0.4 (catch-up with country M) but its export share of good 3 remains 0.2, its ESI would not change. Moreover, if a country surpasses OECD in export share of a good, ESI would not change either. In our example, if country M's export share of good 4 increases from 0.2 to 0.3, its ESI would rise from 0.5 to 0.6; a further increase from 0.3 to 0.4 however would not raise its ESI. The above discussion indicates that ESI is a measure of the degree of a country's catch-up (but not overtaking) in exports overlapping with that of the OECD.

In comparison, EXPY considers a country's catch-up and overtaking in *all* goods. As equations (1) and (2) show, construction of EXPY takes two steps. First, goods are ranked by their income content (PRODY). Second, export shares are used as weights to aggregate the income content of all goods that a country exports. As a result, an increase

in a country's exports of a high- (low-) PRODY good would lead to a large (small) increase in EXPY. In our example, an increase in country M's export share of good 4 from 0.2 to 0.3 would raise its EXPY more than an increase in its export share of good 3 from 0.3 to 0.4; note that in these two cases ESI would increase by the same amount from 0.5 to 0.6. This example shows that EXPY is more responsive than ESI to product-mix changes of a country's export bundle.

Conceptually neither EXPY nor ESI necessarily measures the technology sophistication of a country's exports. A rich country may export a high-PRODY good because of its natural resource. For example, "Dungeness crabmeat, prepared, frozen" (HS=1605104015) is exported mainly by Canada and its PRODY level is computed to be about 20,000.⁶ On the other hand, a poor country may export a high-PRODY good not because it has the technology capability to produce it, but because multinational firms exporting it from the country. In today's world of global outsourcing, it is also rather possible that a country exports a highly sophisticated final good from processing imported intermediate goods that are already of high sophistication.

Accounting for these noises in measurement of product sophistication, we find that EXPY/ESI is positively correlated with R&D-GDP ratio at the country level, and PRODY/ESI is positively correlated with R&D intensity at the industry level. Using the 1996-2004 average R&D-GDP ratio as R&D variable for 2005, we find that its correlations with the 2005 EXPY and ESI indices are 0.72 and 0.46 respectively in a sample of 90 countries (both correlation estimates are statistically significant at the 0.01 percent level). Industry-level R&D data are available for OECD countries at the 2-digit

⁶ In our sample period of 1992-2005, "Dungeness crabmeat, prepared, frozen" (hs=1605104015) was exported dominantly by Canada and only occasionally and in small amount by Chile (1995-1996, 1998-1999), Ecuador (2000), Japan (1996), Korea (2004), and Thailand (1995).

ISIC level. We use industry average R&D intensity of previous five years as industry R&D variable for current year, and compute its correlation with average PRODY of the corresponding industry. Table 4 reports the results. All estimated correlations are positive, and only three resource-intensive industries (fuel, rubber, and basic metals) show estimates that are statistically insignificant.

We conclude from the above discussion that both EXPY and ESI are imperfect but useful measures of a country's level of export sophistication. ESI may be more suitable for studying the degree of direct export competition against a benchmark economy (e.g. OECD), while EXPY may be more suitable for studying a country's overall position in the ladder of export sophistication.

3. China's Level of Export Sophistication

3.1. The China-Is-Special Result

Existing studies (Rodrik, 2006; Schott, 2006) find that China is special in a cross-country relationship between export sophistication level and economic development level. This result can be obtained from the following regression:

$$\ln(\text{EXPY}_c \text{ or } \text{ESI}_c) = \alpha + \beta \ln(Y_c) + \gamma \text{CHINA} + \varepsilon, \quad (4)$$

where CHINA is a dummy variable and ε is an error term. The China-is-special result refers to the finding of a positive and large estimate of γ . That is, compared with countries at similar PCGDP levels, China is found to have a significantly higher overall export sophistication level measured by EXPY or ESI.

We replicate the China-is-special result in the upper panel of Table 5. Both EXPY and ESI have a log-linear relationship with PCGDP; the higher a country's PCGDP, the

higher the country's overall export sophistication. In this log-linear relationship between EXPY/ESI and PCGDP, China is a clear outlier. Although the estimated coefficients on the China dummy become statistically insignificant in recent years, magnitude of the estimated coefficients remains large. Notice however that in both EXPY and ESI, estimated coefficients on the China dummy fall steadily over time.

To get a direct idea about how special China is, we display in the upper panel of Table 6 the ten countries at PCGDP levels similar to China's in 1992 and in 2004. We find, as Rodrik (2006), that China and India were outliers in 1992 by EXPY; and this was also true by ESI. China's rapid GDP growth moves it to a group with higher income in 2004; in the new group China still had the highest EXPY and ESI.

3.2. Adjustment of China's Income Level

Why does China have a higher EXPY/ESI than countries with similar PCGDP? Before exploring deeper reasons, we look at some more obvious reasons for China to be found special. Our first target is uneven development of China's regions.

The estimated log-linear relationship between EXPY/ESI and PCGDP supports the hypothesis that an economy at a higher development level is able to produce and export products of higher sophistication. The more relevant development level for this relationship is that of a country's export regions. If income level of a country's export regions is similar to that of the entire country, or if the former exceeds the latter by similar margins across countries, then it should be fine to use a country's income level as a proxy for income level of its export regions. However, in the case of China, this would be a poor proxy. Recall Table 2 which displays some key statistics of China's provinces.

The second column of Table 2 shows ratio of China's provincial PCGDP to overall PCGDP. It is clear that Chinese provinces vary greatly in economic development level. The third column shows provincial export share. The top-nine export provinces account for 90 percent of China's total export value in 2004. Notice that these provinces are also the most developed (second column) and most attractive to foreign direct investment (last column). Thus we can conclude that PCGDP of China significantly underestimates the development level of China's exporting regions.

To what extent does this underestimation affect the China-is-special result? To perform estimation, we construct the following export-region-weighted PCGDP:

$$Y_E = \sum_{r \in R} s_r Y_r \quad (5)$$

In this equation, R is the set of export regions, Y_r is PCGDP of region r , and s_r is export share of region r . Table 7 reports Y_E for China in 1992-2005. We find that China's export-region-weighted PCGDP is 43 percent to 95 percent higher than China's PCGDP. Notice that Y_E/Y has increased steadily over time, implying that the income gap between China's export regions and non-export regions gets larger and larger.

We replace China's export-region-weighted PCGDP for China's PCGDP in regression (4). The lower panel of Table 5 reports the results. Not surprisingly, the estimated effects on the China dummy decline. Notice that the rate of decline gets larger over time as implied by the increasing income gap between China's export regions and non-export regions. Using China's export-region-weighted PCGDP instead of China's PCGDP, the estimated China effect on EXPY falls by 28 percent in 1992 and 81 percent in 2005, and the estimated China effect on ESI falls by 15 percent in 1992 and 37 percent in 2005. It should be noted that these may be overestimates because we have not adjusted

income levels of other countries in the same way as we do with China; presumably income levels of other countries should also be adjusted upward since it is common for export regions to have higher income levels. We are not able to perform such an adjustment due to lack of data. Nevertheless, we believe that such an adjustment, if done, will still result in reduced estimated effects on the China dummy, as Chinese exports are more extremely concentrated in high-income regions than that of most other countries. We conclude that the China-is-special result is weakened after considering the fact that China's exports are mainly from the more developed regions of China.

We can get a direct idea of this weakening effect from the lower panel of Table 6. Using export-region-weighted PCGDP, China was in the group of Sri Lanka, Honduras, and Indonesia in 1992, and China had the highest EXPY/ESI in this group. In 2004, China moved to the group of Mexico, Russia, Malaysia, and Chile. In this group, Mexico had the highest EXPY/ESI. China was the second in ESI and third in EXPY, and its EXPY was quite similar to that of the other countries in the group.

3.3. Adjustment of China's Export Quality

In the previous subsection we introduced an adjustment to China's PCGDP. Now we turn our attention to the measurement of EXPY/ESI. Both EXPY and ESI relate export sophistication to product category. If China exports a new good that belongs to a high product category, or exports more of a good that belongs to a high product category, then China's EXPY/ESI rises. But goods in the same product category can differ greatly in quality even at the detailed 10-digit HS category. EXPY/ESI does not take such quality differences into account. If China exports low-quality varieties in many of the product categories, EXPY/ESI would overestimate China's overall export sophistication.

Tables 8A&B provide an example. In both 1996 and 2005, there are 26 countries exporting “Line telephone sets with cordless handsets” (HS=8517110000) to the U.S. market. The prices vary greatly across countries. In general, price is higher the higher is the exporting country’s PCGDP.⁷ Notice that in 1996 China sold the product at price \$44 and took 36 percent of the market in terms of quantity, and in 2005 China sold the product at price \$24 and took 83 percent of the market. In both years China’s price is lower than the export-value-share weighted average price of this good of all the 26 exporting countries, which is \$49 in 1996 and \$33 in 2005.

To measure within-product price difference, we define a relative-price index as follows:

$$q_{ic} = \frac{P_{ic}}{\sum_{n \in C_i} (\mu_{in} P_{in})} \quad (6)$$

In this equation, p_{ic} is the price (unit value) of good i exported by country c . The denominator is the weighted average of unit values of good i exported by all countries, the weight μ_{in} being country n ’s export share of good i in all countries’ exports of good i , which reflects the relative importance of country n in exporting good i .

How is China’s price compared to that of the other exporting countries at similar development levels? To get an idea, we run the following regression:

$$\ln(q_{ic}) = \alpha_i + \beta \ln(Y_c) + \gamma \text{CHINA} + \varepsilon. \quad (7)$$

In this regression, we use product fixed effects α_i to control for unobserved product characteristics. Columns 2-4 of Table 9 show results that use China’s PCGDP, and columns 5-7 show results that use China’s export-region-weighted PCGDP. The results

⁷ Using the 1996 data of this product, a regression of $\ln(\text{Price})$ against $\ln(\text{PCGDP})$ yields an estimated coefficient of 0.97 on $\ln(\text{PCGDP})$ that is statistically significant at the 1 percent level, and $R^2=0.3$. The regression line is shown in Figure 2.

indicate that China's export prices are significantly low compared to those of countries at similar development levels, and there is a clear trend that China's relative export prices get lower and lower over the period 1992-2005.

This finding of lower prices of Chinese exports is important in the evaluation of China's level of export sophistication. If price signals quality and quality is part of product sophistication, then EXPY/ESI overestimates China's export sophistication because it does not take product quality into consideration. In what follows, we view quality difference across country varieties in a given product category as another dimension of product sophistication.⁸ We assume that it is higher quality that leads a country's product to have a higher export price than the same product from other countries. With this assumption, q_{ic} becomes a quality index.⁹

How do we incorporate quality difference in the measurement of product sophistication? We propose to introduce a quality multiplier that adjusts the PRODY index. PRODY measures the *average* sophistication level of a good without considering within-product quality differences. To capture both across-product sophistication differences and within-product sophistication differences, we define an index of quality-adjusted export sophistication as

$$QPRODY_{ic} = (q_{ic})^{\theta} \times PRODY_i \quad (8)$$

In this equation, θ is a parameter that determines the degree of quality adjustment. Note that $QPRODY_{ic} = PRODY_i$ when $\theta = 0$. The usefulness of this index is that it recognizes the relatively high sophistication level of a high-quality variety (e.g. men's cotton shirts made in Italy, $q=2.91$ in 2001) that belongs to a product category of low sophistication

⁸ This dimension is termed within-product export sophistication by Schott (2006).

⁹ There may be reasons other than product quality that account for the price difference; consideration of them is beyond the scope of this paper.

(HS=6105100010, “Men’s shirts of cotton, knit”, PRODY=3,323 in 2001), and the relatively low sophistication level of a low-quality variety (e.g. video projectors made in China, $q=0.15$ in 2001) that belongs to a product category of high sophistication (HS=8528304000, “Video projectors, CLR, non-hi def”, PRODY=25,093 in 2001).

To compute QPRODY we need to choose a value for θ , the parameter for quality adjustment, so that $QPRODY = q^\theta \times PRODY$. We have experimented θ of different values, and will use as a benchmark the value $\theta = 0.2$. The quality adjustment of $\theta = 0.2$ has the following effects: for a product at the 1 percentile of q distribution, it adjusts its PRODY by about half; for a product at the 99 percentile of q distribution, it adjusts its PRODY by about doubling it. For example, in 2005, the 1-percentile product has $q=0.021$, so quality adjustment is $0.021^{0.2}=0.46$, which means $QPRODY=0.46 \times PRODY$ for the 1-percentile product. In 2005, the 99-percentile product has $q=41.77$, so quality adjustment is $41.77^{0.2}=2.11$, which means $QPRODY=2.11 \times PRODY$ for the 99-percentile product.¹⁰ For a product example, we can see the values of QPRODY for “Line telephone sets with cordless handsets” in Tables 8A&B.

China’s exports have relatively low q . If we consider this quality dimension of product sophistication, EXPY (which is based on PRODY) would overestimate China’s overall export sophistication level. Now we use QPRODY to compute China’s overall quality-adjusted export sophistication, which we call QEXPY. Table 10 reports results from using QEXPY as the dependent variable in cross-country regressions. Columns 2-4 are the results from using China’s PCGDP as the independent variable. We find that the introduction of quality adjustment does not reject the “China is special” hypothesis but

¹⁰ The adjustment is stable across years. In 1992, for example, the 1-percentile product has $q=0.022$, so quality adjustment is 0.47; the 99-percentile product has $q=29.47$, so quality adjustment is 1.97.

does weaken it in terms of the size and the statistical significance level of estimated China dummy effects. Columns 5-7 are the results from using China's export-region-weighted PCGDP as the independent variable. We find that if we introduce both adjustment of China's PCGDP to that of export regions and adjustment of quality of Chinese exports, we can reject the "China is special" hypothesis on the ground of both statistical significance level and size of estimated China dummy effects. Indeed, the size of estimated effects of the China dummy is close to zero after 2001.

3.4. Summary

Some recent studies found that China's export bundle is more sophisticated than what is compatible to its PCGDP. We investigated this mismatch between China's export sophistication level and its economic development level, and found that two measurement biases may be responsible to this mismatch. First, China's PCGDP underestimates the development level of its export regions as Chinese exports are produced mainly in its advanced provinces. Second, product-category-based measure of export sophistication overestimates China's export sophistication level because China tends to export low-quality varieties within product category. Table 11 summarizes the estimated "China effect" in cross-country regressions. By considering the fact that China's exports are produced mainly in its advanced regions (adjustment #1), and the fact that China's exports are of relatively low quality (adjustment #2), there is no mismatch between China's export sophistication and its export-related development level.

4. Further Discussions

In the previous section we examined China's overall level of export sophistication, and concluded that it is not so special after considering the fact that China's exporting regions are more developed and that China's export varieties are of lower quality. While China's overall export sophistication is not so special, its components are. Following Schott's (2006) terminology, we distinguish between across-product export sophistication and within-product export sophistication. EXPY and ESI are measures of across-product export sophistication, while q is a measure of within-product export sophistication. As we can see from the lower panel of Table 5, China's across-product export sophistication remains an outlier in international comparison after adjusting PCGDP to export-region-weighted PCGDP. As we can see from Table 9, China's within-product export sophistication is also an outlier in international comparison. Thus, China's overall level of export sophistication being "normal" is a result of two offsetting "special" components. In this section we provide some further evidence on across-product and within-product sophistication of Chinese exports.

Table 12 provides data on China's across-product and within-product export sophistication. For comparison between years, we use ratio of China's EXPY to World's EXPY as measure of China's (relative) across-product export sophistication. During 1992-2005, World's EXPY grew at an average annual rate of 1.2%, while China's EXPY grew at an average annual rate of 3.6%. As a result, we observe catch-up of China's EXPY from 0.54 of the world's level in 1992 to 0.73 in 2005. In Figure 3 the upward trend shows China's across-product export sophistication relative to that of the world. As defined in the previous section, q_i is the relative price of China's good i . Using export

share as weight, we compute a weighted average of q_i for China's exports, which we display in the last column of Table 12. This number is essentially the price of China's export basket relative to that of the world of the same export basket. In 1992, China sold its export basket at 70% of the world's price. In 2005, China sold its export basket at 66% of the world's price. Given that price differences reflect quality differences, these numbers measure China's overall within-product export sophistication relative to that of the world. Figure 3 shows this downward trend.

To gain further insight into China's export sophistication, we examine China's relative export sophistication at the industry level. Is China exporting more-sophisticated goods or less-sophisticated goods within an industry relative to the international benchmark? Table 13 provides an answer. For this exercise, we use export share as weight to obtain industry-level PRODY. Running cross-country regressions with a China dummy, we find that China's industry-level export sophistication tends to be above the international benchmark in low-R&D industries (e.g. apparel, food and beverage, basic metals, and chemicals), and below the international benchmark in high-R&D industries (e.g. precision instruments, other transport equipment). This pattern suggests that in low-R&D industries China exported goods that belong to categories of high sophistication, while in high-R&D industries China exported goods that belong to categories of low sophistication. This pattern seems consistent with the prediction of conventional trade theory but further exploration will be worthwhile.

Turning to China's within-product export sophistication at the industry level, we see a pattern that is quite shocking. In Table 14 we report the estimated coefficients on the China dummy in relative-price regressions. In almost all industries, we find that

China's exports have been sold at a price below the world average price and the gap gets larger and larger over time. It is rather difficult to explain this trend with conventional trade theory. As China's technology capacity develops, one would expect a narrowing of within-product sophistication of its exports relative to that of the world. One conjecture is that advanced countries responded to competition from emerging market economies by innovating more sophisticated export varieties, which decreases the *relative* sophistication of China's exported varieties (Schott, 2006). However, this conjecture does not seem to apply to goods such as telephone sets in Table 8. In that example, China expanded its U.S. market from 36% in 1996 (measured by quantity) to 83% in 2005, suggesting that economies of scale may be an important reason for China's price to drop from \$44 in 1996 to \$24 in 2005. Thus the decline of within-product sophistication index (q) from 0.9 in 1996 to 0.73 in 2000 may not be a result of decline of China's product quality. This example shows that relative price is a noisy measure of relative product quality and within-product sophistication. While more work is needed to extract quality information from price data, the trends displayed in Table 14 are so strong that one cannot ignore them in studying the nature of Chinese exports.

5. Conclusion

Recent studies found that China is special in exporting goods that are much more sophisticated than one would expect from its per capita income level. In this paper we identify two measurement biases that can account for this China-is-special result. First, China's overall income level significantly underestimates the income level of its exporting regions. Using China's export-region-weighted income level, we find that the China-is-special result is weakened by about 30 to 80 percent depending on the year.

Second, the export sophistication indices used in existing studies overestimate the sophistication level of Chinese exports because they do not consider product quality. Using unit-value differences as a proxy for quality differences in constructing a quality-adjusted index of export sophistication, we find that the China-is-special result is weakened by another 10 to 30 percent depending on the year. After correcting the two measurement biases, the estimated China-is-special effect is statistically insignificant and its point estimates are close to zero in recent years (2001-2005).

The finding that China is not so special in the cross-country relationship between export sophistication and income does not necessarily mean that China's export experience fits the conventional theory of international trade. There are many questions that remain to be answered. For example, what has driven firms in China to expand the range of exports towards more sophisticated goods and yet specialize in low-quality varieties? If rising technology capability of Chinese firms is what drives up China's across-product export sophistication, why do we observe the decline of within-product export sophistication? What are the underlying forces that shift China's export structure from labor-intensive industries towards technology-intensive industries? What has been the role played by the Chinese government? How much of a role has foreign direct investment played? How much does export structure upgrading contribute to China's economic growth? Much research is needed to answer these questions.¹¹ We hope that the present paper has made a contribution in accounting China's export sophistication level and provided a stimulus for further research.

¹¹ Some of these questions have been explored by Alvarez and Claro (2006), Blonigen and Ma (2007), Wang and Wei (2007), and Xu and Lu (2007).

Appendix

We use U.S. merchandise import data from Feenstra, Romalis and Schott (2002) for 1992-2001 and USA Trade Online Database for 2002-2005. The data is disaggregated by Harmonized System (HS) to the 10 digit level and recorded by U.S. Customs. For each HS10 product, there is information on exporting country, value, and quantity. We use value and quantity of “general imports”, which are imports as they come off the dock. The HS10 data are distinguished by a source country sub-code that describes the trade treatment received by the import (e.g. free-trade agreements, Generalized System of Preferences), and consequently a country may have multiple observations of exports of the same good recorded by the U.S. Customs. In such cases, we aggregate the value and quantity for every country-product observation. Using 2001 as an example, there are 247,104 country-product observations in the raw data, from which we obtain 226,583 unique country-product observations that show positive import value. Among these observations, there are 36,112 observations for which the quantity units could not be measured (the dataset shows positive import value but zero import quantity), which gives rises to a sample of 190,471 observations. We use concordances from the UNCTAD to assign products to 4-digit ISIC (revision 3) industries, and use manufacturing industries (classified as 15-37 by 2-digit ISIC codes) in our study.

We use GDP per capita, PPP (constant 2000 international \$) from World Development Indicator (WDI) of the World Bank, which we call PCGDP. The compatible data for Taiwan is from IMF World Economic Outlook Database. There are 173 countries with PCGDP in some years. We drop countries with missing PCGDP in any year, which leaves us 157 countries. Because U.S. import data contains country code that is actually country group. Among the 157 countries, there are seven such country groups. We use GDP and population data from WDI to compute PCGDP for such country groups. In the end we have 141 countries (including seven country groups) that have PCGDP for every year from 1992 to 2005. We choose 1992 as the starting year mainly because it allows a maximum number of countries in our sample. All the 141 countries exported to the U.S. with only Iran and Vietnam having no recorded exports in some years. This gives us a consistent sample of countries so as to avoid the omitted country bias discussed in Hausmann, Hwang, and Rodrik (2007).

We divide value by quantity to obtain unit value for each country-product observation, and compute relative unit value as a country’s unit value divided by the export-share-weighted average unit value of the product of all its exporting countries. Relative unit values of HS10 goods vary considerably across countries. We observe that the maximum and minimum relative unit values are implausibly high and low. For example, the minimum of relative unit values in 2001 is 0.00000001, and the maximum is 37,267. U.S. General Accounting Office (1995) had an analysis of eight commodities for 1992 in this dataset and found two underlying causes for the variations in unit values. “First, there were variations that resulted from commodity classifications so broad that the same code could cover products of different types, quality, and intended use...The second cause for the variations was errors—such as misclassifying the product or entering the wrong quantity or total value—made by the filer when entering data into

Customs' Automated Commercial System" (pp. 1-2). We believe that the extremely small and large relative unit values are a result of the second reason mentioned above, i.e., errors in entering the data. To remove these erroneous values, we drop the top 1 percentile and bottom 1 percentile of the data in terms of relative unit values.

Our study also uses industry-level R&D data of 18 OECD countries and China. The OECD R&D data are from SourceOECD Science and Technology Database, and the industry gross product data are from SourceOECD STAN Structural Analysis Database. OECD data are classified in ISIC (Rev. 3) manufacturing industries. The R&D data are available for most countries when ISIC industries are grouped into 14 industries. We compute an industry's R&D intensity as the ratio of R&D spending to gross product (multiplied by 100). The Chinese R&D and gross product data are from China's national surveys of firms, which are classified in Chinese SIC which is similar to ISIC. Based on a concordance from 2-digit Chinese SIC (1994 version) to the 14 industries, we compute the R&D intensities of the 14 Chinese manufacturing industries (used in Table 1).

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Table 1: China's Manufacturing Exports to the U.S., 1992-2005

| Industries (ISIC Codes) | R&D Intensity | Export Share | | |
|---|---------------|--------------|----------|------------|
| | | 1992 (%) | 2005 (%) | Growth (%) |
| Transport equipment (34, 35) | 0.698 | 0.6 | 2.5 | 11.0 |
| Electrical machinery; radio, television and communication equipment (31, 32) | 0.690 | 12.2 | 23.5 | 5.0 |
| Medical, precision and optical Instruments; watches and clocks (33) | 0.677 | 2.1 | 1.8 | -1.2 |
| Machinery and equipment; office, accounting and computing machinery (29, 30) | 0.354 | 7.5 | 26.0 | 9.6 |
| Chemicals and chemical products (24) | 0.172 | 2.8 | 2.5 | -0.9 |
| Basic metals (27) | 0.170 | 0.8 | 1.9 | 6.7 |
| Coke, refined petroleum products, nuclear fuel (23) | 0.154 | 0.4 | 0.3 | -2.2 |
| Rubber and plastics (25) | 0.130 | 1.1 | 2.4 | 6.0 |
| Other non-metallic mineral products (26) | 0.122 | 1.3 | 1.4 | 0.6 |
| Food products, beverages and tobacco (15, 16) | 0.089 | 3.0 | 1.4 | -5.9 |
| Fabricated metal products (28) | 0.079 | 2.1 | 4.3 | 5.5 |
| Wood, paper, printing, and publishing (20, 21, 22) | 0.077 | 1.3 | 2.6 | 5.3 |
| Furniture, jewelry, musical instruments, sports goods, games and toys, and other manufacturing (36, 37) | 0.076 | 11.8 | 5.7 | -5.6 |
| Textiles, apparel, leather and footwear (17, 18, 19) | 0.053 | 53.0 | 23.7 | -6.2 |

Notes: R&D intensity is the ratio of R&D expenditure to gross output of Chinese firms in the respective industry in 2001, multiplied by 100. Export share growth is the average annual growth rate of export share of the respective industry in China from 1992 to 2005.

Table 2: Key Economic Indicators of China's Provinces, 2004

| Province | Provincial PCGDP /China's PCGDP | Provincial Export Share | Provincial FDI Share |
|----------------|------------------------------------|----------------------------|-------------------------|
| Shanghai* | 4.48 | 0.12 | 0.10 |
| Beijing* | 3.00 | 0.03 | 0.04 |
| Tianjin* | 2.56 | 0.04 | 0.03 |
| Zhejiang | 1.94 | 0.10 | 0.09 |
| Jiangsu | 1.68 | 0.15 | 0.15 |
| Guangdong | 1.60 | 0.32 | 0.17 |
| Fujian | 1.40 | 0.05 | 0.03 |
| Shandong | 1.37 | 0.06 | 0.14 |
| Liaoning | 1.32 | 0.03 | 0.09 |
| Heilongjiang | 1.13 | 0.01 | 0.01 |
| Hebei | 1.05 | 0.02 | 0.01 |
| Inner Mongolia | 0.92 | 0.00 | 0.01 |
| Xinjiang | 0.91 | 0.01 | 0.00 |
| Jilin | 0.89 | 0.00 | 0.00 |
| Hubei | 0.85 | 0.01 | 0.03 |
| Chongqing* | 0.78 | 0.00 | 0.00 |
| Henan | 0.77 | 0.01 | 0.01 |
| Hainan | 0.77 | 0.00 | 0.00 |
| Shanxi | 0.74 | 0.01 | 0.00 |
| Hunan | 0.74 | 0.01 | 0.02 |
| Qinghai | 0.70 | 0.00 | 0.00 |
| Jiangxi | 0.66 | 0.00 | 0.03 |
| Sichuan | 0.66 | 0.01 | 0.01 |
| Ningxia | 0.64 | 0.00 | 0.00 |
| Tibet | 0.63 | 0.00 | 0.00 |
| Anhui | 0.63 | 0.01 | 0.01 |
| Shaanxi | 0.63 | 0.00 | 0.00 |
| Guangxi | 0.58 | 0.00 | 0.00 |
| Yunnan | 0.55 | 0.00 | 0.00 |
| Gansu | 0.48 | 0.00 | 0.00 |
| Guizhou | 0.34 | 0.00 | 0.00 |

* Municipality directly under the central government (equivalent to province)

Table 3: A Numerical Example

| | Country L | Country M | Country H | PRODY _i |
|-------------------|-----------|-----------|-----------|--------------------|
| Good 1 | 0.5 | | | \$5,000 |
| Good 2 | 0.3 | 0.5 | | \$8,125 |
| Good 3 | 0.2 | 0.3 | 0.5 | \$14,000 |
| Good 4 | | 0.2 | 0.3 | \$16,000 |
| Good 5 | | | 0.2 | \$20,000 |
| Y_c | \$5,000 | \$10,000 | \$20,000 | |
| EXPY _c | \$7,738 | \$11,463 | \$15,800 | |
| ESI _{cH} | 0.2 | 0.5 | | |

Table 4: Correlation between Industry PRODY and Industry R&D Intensity

| Industries (ISIC Codes) | Correlation | Observations |
|---|-------------|--------------|
| Food products, beverages and tobacco (15, 16) | 0.25*** | 226 |
| Textiles, apparel, leather and footwear (17, 18, 19) | 0.39*** | 226 |
| Wood, paper, printing, and publishing (20, 21, 22) | 0.45*** | 226 |
| Coke, refined petroleum products, nuclear fuel (23) | 0.09 | 196 |
| Chemicals and chemical products (24) | 0.48*** | 213 |
| Rubber and plastics (25) | 0.04 | 226 |
| Other non-metallic mineral products (26) | 0.43*** | 226 |
| Basic metals (27) | 0.07 | 214 |
| Fabricated metal products (28) | 0.39*** | 214 |
| Machinery and equipment; Office, accounting and computing machinery (29, 30) | 0.43*** | 222 |
| Electrical machinery; radio, television and communication equipment (31, 32) | 0.18** | 210 |
| Medical, precision and optical Instruments; watches and clocks (33) | 0.18** | 197 |
| Transport equipment (34, 35) | 0.22*** | 226 |
| Furniture, jewelry, musical instruments, sports goods, games and toys, and other manufacturing (36, 37) | 0.11* | 226 |

Notes: The sample is 18 OECD countries in 1992-2004 (see the appendix for detail). Industry-level PRODY is a weighted average of HS10-level PRODY, the weights being export share of HS10 product in industry. R&D intensity is the average of previous five years. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels.

Table 5: Cross-Country Regressions

| Y: Per capita GDP | | | | | | |
|--------------------------|------------------------------|--------|----------------|-----------------------------|--------|----------------|
| | Dependent Variable: ln(EXPY) | | | Dependent Variable: ln(ESI) | | |
| | ln(Y) | CHINA | R ² | ln(Y) | CHINA | R ² |
| 1992 | 0.58*** | 0.75** | 0.80 | 1.40*** | 3.32* | 0.40 |
| 1993 | 0.54*** | 0.69** | 0.78 | 1.26*** | 2.87** | 0.60 |
| 1994 | 0.57*** | 0.63** | 0.82 | 1.29*** | 2.83** | 0.57 |
| 1995 | 0.58*** | 0.67** | 0.82 | 1.23*** | 2.77** | 0.57 |
| 1996 | 0.54*** | 0.57** | 0.82 | 1.15*** | 2.52** | 0.63 |
| 1997 | 0.56*** | 0.61** | 0.84 | 1.13*** | 2.51** | 0.58 |
| 1998 | 0.55*** | 0.56* | 0.83 | 1.14*** | 2.44** | 0.57 |
| 1999 | 0.57*** | 0.56* | 0.83 | 1.17*** | 2.45* | 0.55 |
| 2000 | 0.53*** | 0.56* | 0.81 | 1.01*** | 2.17** | 0.58 |
| 2001 | 0.55*** | 0.51 | 0.81 | 1.08*** | 2.18* | 0.55 |
| 2002 | 0.54*** | 0.49 | 0.77 | 1.05*** | 2.11* | 0.53 |
| 2003 | 0.51*** | 0.44 | 0.75 | 1.00*** | 2.01* | 0.52 |
| 2004 | 0.48*** | 0.47 | 0.72 | 0.97*** | 1.93 | 0.46 |
| 2005 | 0.51*** | 0.42 | 0.76 | 1.05*** | 1.87 | 0.54 |

| Y_E: Per capita GDP; China's PCGDP is weighted by export regions | | | | | | |
|---|------------------------------|-------|----------------|-----------------------------|--------|----------------|
| | Dependent Variable: ln(EXPY) | | | Dependent Variable: ln(ESI) | | |
| | ln(Y _E) | CHINA | R ² | ln(Y _E) | CHINA | R ² |
| 1992 | 0.58*** | 0.54* | 0.80 | 1.40*** | 2.81 | 0.40 |
| 1993 | 0.54*** | 0.46 | 0.78 | 1.26*** | 2.35** | 0.60 |
| 1994 | 0.57*** | 0.35 | 0.82 | 1.29*** | 2.20* | 0.57 |
| 1995 | 0.58*** | 0.40 | 0.82 | 1.23*** | 2.19* | 0.57 |
| 1996 | 0.54*** | 0.29 | 0.82 | 1.15*** | 1.92* | 0.63 |
| 1997 | 0.56*** | 0.31 | 0.84 | 1.13*** | 1.90* | 0.58 |
| 1998 | 0.55*** | 0.25 | 0.83 | 1.14*** | 1.78 | 0.57 |
| 1999 | 0.57*** | 0.21 | 0.83 | 1.17*** | 1.75 | 0.55 |
| 2000 | 0.53*** | 0.23 | 0.81 | 1.01*** | 1.55 | 0.58 |
| 2001 | 0.55*** | 0.18 | 0.81 | 1.08*** | 1.52 | 0.55 |
| 2002 | 0.54*** | 0.16 | 0.77 | 1.05*** | 1.47 | 0.53 |
| 2003 | 0.51*** | 0.10 | 0.75 | 1.00*** | 1.36 | 0.52 |
| 2004 | 0.48*** | 0.15 | 0.72 | 0.97*** | 1.26 | 0.46 |
| 2005 | 0.51*** | 0.08 | 0.76 | 1.05*** | 1.17 | 0.54 |

Notes: The number of observations in all regressions is about 140. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels.

Table 6: Countries in China's Income Group

| Y: Per capita GDP | | | | | | | |
|--------------------------|-------------|--------------|-------------|--------------|-------------|--------------|--------------|
| 1992 | | | | 2004 | | | |
| COUNTRY | Y | ESI | EXPY | COUNTRY | Y | ESI | EXPY |
| Pakistan | 1734 | 0.012 | 4977 | Jordan | 4442 | 0.015 | 5233 |
| India | 1742 | 0.059 | 7358 | Albania | 4511 | 0.016 | 5998 |
| Guinea | 1791 | 0.003 | 2086 | El Salvador | 4673 | 0.016 | 4895 |
| Comoros | 1886 | 0.000 | 2186 | Peru | 5219 | 0.029 | 5958 |
| Kyrgyzstan | 1887 | 0.003 | 2757 | Lebanon | 5400 | 0.050 | 8534 |
| China | 1944 | 0.104 | 7756 | China | 5419 | 0.161 | 12524 |
| Armenia | 2014 | 0.006 | 4446 | Fiji | 5470 | 0.008 | 4828 |
| Georgia | 2017 | 0.006 | 3039 | Samoa | 5539 | 0.003 | 5781 |
| Haiti | 2091 | 0.009 | 4415 | Venezuela | 5553 | 0.076 | 10985 |
| Bolivia | 2126 | 0.010 | 3776 | Ukraine | 5876 | 0.031 | 9178 |
| Albania | 2186 | 0.002 | 3954 | Gabon | 6088 | 0.003 | 5566 |

| Y_E: Per capita GDP; China's PCGDP is weighted by export regions | | | | | | | |
|---|----------------|--------------|-------------|-------------------|----------------|--------------|--------------|
| 1992 | | | | 2004 | | | |
| COUNTRY | Y _E | ESI | EXPY | COUNTRY | Y _E | ESI | EXPY |
| Sri Lanka | 2522 | 0.011 | 5821 | Mexico | 8985 | 0.294 | 14811 |
| Honduras | 2524 | 0.017 | 5226 | Russia | 9098 | 0.080 | 10541 |
| Angola | 2540 | 0.008 | 3708 | Malaysia | 9444 | 0.084 | 12203 |
| Azerbaijan | 2570 | 0.005 | 6945 | South Africa | 9881 | 0.095 | 11273 |
| Solomon Islands | 2574 | 0.005 | 3918 | Chile | 10646 | 0.055 | 11298 |
| China | 2788 | 0.104 | 7756 | China | 10694 | 0.161 | 12524 |
| Indonesia | 2790 | 0.056 | 5799 | Mauritius | 10840 | 0.021 | 6185 |
| Samoa | 2874 | 0.001 | 3092 | Latvia | 11101 | 0.029 | 9313 |
| Egypt | 2886 | 0.015 | 5487 | Croatia | 11204 | 0.033 | 12008 |
| Syria | 2988 | 0.007 | 5355 | Trinidad & Tobago | 11492 | 0.031 | 10331 |
| Morocco | 3291 | 0.015 | 5161 | Lithuania | 12117 | 0.036 | 14351 |

Table 7: China's Export-Region-Weighted PCGDP

| | Y | Y _E | Ratio of Y _E / Y |
|------|------|----------------|-----------------------------|
| 1992 | 1944 | 2788 | 1.43 |
| 1993 | 2199 | 3327 | 1.51 |
| 1994 | 2457 | 4019 | 1.64 |
| 1995 | 2734 | 4366 | 1.60 |
| 1996 | 2971 | 5030 | 1.69 |
| 1997 | 3204 | 5487 | 1.71 |
| 1998 | 3438 | 6113 | 1.78 |
| 1999 | 3666 | 6689 | 1.82 |
| 2000 | 3928 | 7278 | 1.85 |
| 2001 | 4233 | 7769 | 1.84 |
| 2002 | 4568 | 8387 | 1.84 |
| 2003 | 4966 | 9547 | 1.92 |
| 2004 | 5419 | 10694 | 1.97 |
| 2005 | 5878 | 11461 | 1.95 |

Notes: Y is PPP-adjusted per capita GDP of China. Y_E is a weighted average of PPP-adjusted per capita GDP of China's exporting provinces, where the weight is export share of province.

Table 8A: Line Telephone Sets with Cordless Handsets (HS=8517110000), 1996

| Country | Quantity | Share | Price | Average Price | q | PRODY | QPRODY |
|---------|----------|-------|-------|---------------|-------|-------|--------|
| CHN | 11300000 | 0.36 | 44 | 49 | 0.90 | 5634 | 5513 |
| PHL | 9183924 | 0.29 | 38 | 49 | 0.77 | 5634 | 5351 |
| MYS | 5510509 | 0.17 | 55 | 49 | 1.14 | 5634 | 5784 |
| MEX | 2457304 | 0.08 | 46 | 49 | 0.95 | 5634 | 5573 |
| IDN | 1210257 | 0.04 | 42 | 49 | 0.87 | 5634 | 5474 |
| TWN | 976943 | 0.03 | 50 | 49 | 1.03 | 5634 | 5663 |
| JPN | 463274 | 0.01 | 117 | 49 | 2.41 | 5634 | 6715 |
| HKG | 337764 | 0.01 | 28 | 49 | 0.58 | 5634 | 5047 |
| KOR | 114344 | 0 | 71 | 49 | 1.46 | 5634 | 6079 |
| THA | 51828 | 0 | 53 | 49 | 1.10 | 5634 | 5741 |
| SGP | 24318 | 0 | 66 | 49 | 1.35 | 5634 | 5986 |
| CAN | 18198 | 0 | 109 | 49 | 2.25 | 5634 | 6628 |
| CHE | 11334 | 0 | 47 | 49 | 0.96 | 5634 | 5589 |
| DEU | 4331 | 0 | 283 | 49 | 5.82 | 5634 | 8013 |
| CRI | 4130 | 0 | 4 | 49 | 0.08 | 5634 | 3405 |
| AUT | 3300 | 0 | 292 | 49 | 6.02 | 5634 | 8067 |
| HUN | 1800 | 0 | 273 | 49 | 5.62 | 5634 | 7957 |
| PAN | 982 | 0 | 97 | 49 | 2.00 | 5634 | 6469 |
| GBR | 496 | 0 | 635 | 49 | 13.08 | 5634 | 9421 |
| ISR | 291 | 0 | 325 | 49 | 6.70 | 5634 | 8242 |
| SWE | 70 | 0 | 283 | 49 | 5.83 | 5634 | 8016 |
| FIN | 50 | 0 | 201 | 49 | 4.15 | 5634 | 7487 |
| ITA | 32 | 0 | 156 | 49 | 3.22 | 5634 | 7116 |
| ARG | 27 | 0 | 111 | 49 | 2.29 | 5634 | 6648 |
| FRA | 10 | 0 | 1555 | 49 | 32.03 | 5634 | 11269 |
| NOR | 1 | 0 | 1508 | 49 | 31.06 | 5634 | 11200 |

Notes: Quantity is country export quantity. Share is country export quantity over total export quantity. Price is country export value over country export quantity. Average price is export-share weighted sum of prices. q is country price over average price.

Table 8B: Line Telephone Sets with Cordless Handsets (HS=8517110000), 2005

| Country | Quantity | Share | Price | Average Price | q | PRODY | QPRODY |
|---------|----------|-------|-------|---------------|-------|-------|--------|
| CHN | 43400000 | 0.83 | 24 | 33 | 0.73 | 8568 | 8053 |
| MEX | 3111431 | 0.06 | 33 | 33 | 0.98 | 8568 | 8539 |
| MYS | 3104138 | 0.06 | 61 | 33 | 1.84 | 8568 | 9680 |
| JPN | 953491 | 0.02 | 63 | 33 | 1.89 | 8568 | 9730 |
| PHL | 846212 | 0.02 | 37 | 33 | 1.12 | 8568 | 8772 |
| IDN | 389619 | 0.01 | 70 | 33 | 2.12 | 8568 | 9961 |
| HKG | 132323 | 0 | 28 | 33 | 0.83 | 8568 | 8256 |
| TWN | 26698 | 0 | 97 | 33 | 2.94 | 8568 | 10630 |
| DNK | 22019 | 0 | 114 | 33 | 3.42 | 8568 | 10959 |
| THA | 9006 | 0 | 99 | 33 | 2.98 | 8568 | 10657 |
| KOR | 8434 | 0 | 76 | 33 | 2.30 | 8568 | 10117 |
| GBR | 7261 | 0 | 114 | 33 | 3.44 | 8568 | 10970 |
| FRA | 5323 | 0 | 133 | 33 | 4.01 | 8568 | 11314 |
| CAN | 2635 | 0 | 87 | 33 | 2.62 | 8568 | 10388 |
| DEU | 2296 | 0 | 500 | 33 | 15.08 | 8568 | 14741 |
| IND | 503 | 0 | 119 | 33 | 3.60 | 8568 | 11070 |
| POL | 302 | 0 | 52 | 33 | 1.58 | 8568 | 9386 |
| PER | 300 | 0 | 27 | 33 | 0.81 | 8568 | 8223 |
| ZAFG | 150 | 0 | 86 | 33 | 2.59 | 8568 | 10368 |
| NOR | 80 | 0 | 147 | 33 | 4.42 | 8568 | 11536 |
| AUS | 63 | 0 | 189 | 33 | 5.69 | 8568 | 12130 |
| ARE | 37 | 0 | 440 | 33 | 13.27 | 8568 | 14369 |
| ECU | 35 | 0 | 320 | 33 | 9.66 | 8568 | 13485 |
| SWE | 29 | 0 | 213 | 33 | 6.41 | 8568 | 12425 |
| ISR | 8 | 0 | 2268 | 33 | 68.4 | 8568 | 19948 |
| ESP | 4 | 0 | 599 | 33 | 18.07 | 8568 | 15286 |

Table 9: Cross-Product Regressions

| | Dependent Variable: $\ln(q)$ | | | | | |
|------|------------------------------|----------|-------|------------|----------|-------|
| | $\ln(Y)$ | CHINA | R^2 | $\ln(Y_E)$ | CHINA | R^2 |
| 1992 | 0.45*** | -0.00 | 0.28 | 0.45*** | -0.16*** | 0.28 |
| 1993 | 0.42*** | -0.09** | 0.28 | 0.42*** | -0.26*** | 0.28 |
| 1994 | 0.41*** | -0.15*** | 0.27 | 0.41*** | -0.36*** | 0.27 |
| 1995 | 0.41*** | -0.21*** | 0.28 | 0.41*** | -0.40*** | 0.28 |
| 1996 | 0.40*** | -0.24*** | 0.27 | 0.40*** | -0.45*** | 0.27 |
| 1997 | 0.37*** | -0.30*** | 0.27 | 0.37*** | -0.50*** | 0.27 |
| 1998 | 0.37*** | -0.32*** | 0.26 | 0.37*** | -0.54*** | 0.26 |
| 1999 | 0.36*** | -0.34*** | 0.26 | 0.36*** | -0.56*** | 0.26 |
| 2000 | 0.33*** | -0.39*** | 0.25 | 0.33*** | -0.59*** | 0.25 |
| 2001 | 0.33*** | -0.41*** | 0.25 | 0.33*** | -0.62*** | 0.25 |
| 2002 | 0.35*** | -0.45*** | 0.26 | 0.35*** | -0.67*** | 0.26 |
| 2003 | 0.36*** | -0.53*** | 0.26 | 0.36*** | -0.77*** | 0.26 |
| 2004 | 0.36*** | -0.56*** | 0.26 | 0.36*** | -0.81*** | 0.26 |
| 2005 | 0.35*** | -0.68*** | 0.27 | 0.35*** | -0.91*** | 0.27 |

Notes: All regressions include 10-digit HS product-specific fixed effects. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels.

Table 10: Cross-Country Regressions of Quality-Adjusted Export Sophistication Index

| | Dependent Variable: $\ln(QEXPY)$ | | | | | |
|------|----------------------------------|--------|-------|------------|-------|-------|
| | $\ln(Y)$ | CHINA | R^2 | $\ln(Y_E)$ | CHINA | R^2 |
| 1992 | 0.59*** | 0.67** | 0.80 | 0.59*** | 0.45 | 0.80 |
| 1993 | 0.55*** | 0.60* | 0.78 | 0.55*** | 0.37 | 0.78 |
| 1994 | 0.57*** | 0.53* | 0.82 | 0.57*** | 0.25 | 0.82 |
| 1995 | 0.59*** | 0.57* | 0.82 | 0.59*** | 0.30 | 0.82 |
| 1996 | 0.53*** | 0.46 | 0.78 | 0.53*** | 0.18 | 0.78 |
| 1997 | 0.57*** | 0.51* | 0.84 | 0.57*** | 0.20 | 0.84 |
| 1998 | 0.54*** | 0.44 | 0.83 | 0.54*** | 0.13 | 0.83 |
| 1999 | 0.56*** | 0.43 | 0.82 | 0.56*** | 0.09 | 0.82 |
| 2000 | 0.53*** | 0.44 | 0.80 | 0.53*** | 0.12 | 0.80 |
| 2001 | 0.56*** | 0.40 | 0.79 | 0.56*** | 0.06 | 0.79 |
| 2002 | 0.54*** | 0.38 | 0.77 | 0.54*** | 0.05 | 0.77 |
| 2003 | 0.50*** | 0.31 | 0.74 | 0.50*** | -0.02 | 0.74 |
| 2004 | 0.47*** | 0.36 | 0.67 | 0.47*** | 0.04 | 0.67 |
| 2005 | 0.50*** | 0.29 | 0.76 | 0.50*** | -0.04 | 0.76 |

Notes: The number of observations in all regressions is about 140. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels.

Table 11: Summary of the Estimated “China Effect”

| | Without Adjustment | With Only Adjustment #1 | With Only Adjustment #2 | With Both Adjustments |
|------|--------------------|-------------------------|-------------------------|-----------------------|
| 1992 | 0.75** | 0.54* | 0.67** | 0.45 |
| 1993 | 0.69** | 0.46 | 0.60* | 0.37 |
| 1994 | 0.63** | 0.35 | 0.53* | 0.25 |
| 1995 | 0.67** | 0.40 | 0.57* | 0.30 |
| 1996 | 0.57** | 0.29 | 0.46 | 0.18 |
| 1997 | 0.61** | 0.31 | 0.51* | 0.20 |
| 1998 | 0.56* | 0.25 | 0.44 | 0.13 |
| 1999 | 0.56* | 0.21 | 0.43 | 0.09 |
| 2000 | 0.56* | 0.23 | 0.44 | 0.12 |
| 2001 | 0.51 | 0.18 | 0.40 | 0.06 |
| 2002 | 0.49 | 0.16 | 0.38 | 0.05 |
| 2003 | 0.44 | 0.10 | 0.31 | -0.02 |
| 2004 | 0.47 | 0.15 | 0.36 | 0.04 |
| 2005 | 0.42 | 0.08 | 0.29 | -0.04 |

Notes: Adjustment #1 refers to the use of China’s export-region-weighted PCGDP instead of China’s PCGDP. Adjustment #2 refers to the use of quality-adjusted product sophistication measure QPRODY instead of PRODY in computing country-level export sophistication.

Table 12: China’s Export Sophistication, Across Product and Within Product

| | China’s PCGDP | China’s EXPY | World’s EXPY | China’s Across-Product Sophistication | China’s Within-Product Sophistication |
|-----------|---------------|--------------|--------------|---------------------------------------|---------------------------------------|
| 1992 | 1944 | 7756 | 14493 | 0.54 | 0.70 |
| 1993 | 2199 | 8183 | 14404 | 0.57 | 0.69 |
| 1994 | 2457 | 8116 | 14713 | 0.55 | 0.68 |
| 1995 | 2734 | 8935 | 14968 | 0.60 | 0.68 |
| 1996 | 2971 | 9015 | 15022 | 0.60 | 0.68 |
| 1997 | 3204 | 9723 | 15523 | 0.63 | 0.69 |
| 1998 | 3438 | 9790 | 15549 | 0.63 | 0.70 |
| 1999 | 3666 | 9989 | 16233 | 0.62 | 0.68 |
| 2000 | 3928 | 10952 | 16522 | 0.66 | 0.67 |
| 2001 | 4233 | 10753 | 16548 | 0.65 | 0.65 |
| 2002 | 4568 | 11120 | 16734 | 0.66 | 0.65 |
| 2003 | 4966 | 11255 | 16572 | 0.68 | 0.64 |
| 2004 | 5419 | 12524 | 16992 | 0.74 | 0.66 |
| 2005 | 5878 | 12419 | 16967 | 0.73 | 0.66 |
| 1992-2005 | 8.5% | 3.6% | 1.2% | 2.4% | -0.5% |

Notes: China’s across-product sophistication is the ratio of China’s EXPY to World’s EXPY. China’s within-product sophistication is the export-share-weighted average of the relative prices of Chinese exported products. Last row shows average annual growth rates over 1992-2005.

Table 13: Regressions of Industry-Level PRODY

| ISIC | Industry | $\ln(Y_E)$ | China | Obs. | R^2 |
|------|---------------------------------|------------|---------|------|-------|
| 15 | Food and Beverages | 0.53*** | 0.30** | 1810 | 0.63 |
| 16 | Tobacco | 0.23*** | 0.12 | 720 | 0.27 |
| 17 | Textiles | 0.42*** | 0.12 | 1812 | 0.61 |
| 18 | Apparel | 0.22*** | 0.14** | 1805 | 0.48 |
| 19 | Leather and Footwear | 0.23*** | -0.07 | 1587 | 0.31 |
| 20 | Wood except Furniture | 0.48*** | 0.01 | 1480 | 0.57 |
| 21 | Paper | 0.26*** | -0.11 | 1225 | 0.36 |
| 22 | Publishing and Printing | 0.19*** | 0.11 | 1513 | 0.20 |
| 23 | Petroleum and Nuclear Fuel | 0.28*** | 0.45*** | 1098 | 0.37 |
| 24 | Chemicals | 0.45*** | 0.36*** | 1627 | 0.52 |
| 25 | Rubber and Plastics | 0.23*** | -0.12 | 1412 | 0.35 |
| 26 | Non-metal Minerals | 0.20*** | -0.02 | 1382 | 0.36 |
| 27 | Basic Metals | 0.45*** | 0.25** | 1461 | 0.56 |
| 28 | Fabricated Metals | 0.28*** | 0.12 | 1496 | 0.42 |
| 29 | Machinery and Equipment, n.e.c. | 0.25*** | -0.09 | 1481 | 0.29 |
| 30 | Computing Machinery | 0.11*** | -0.08 | 1432 | 0.16 |
| 31 | Electrical Machinery | 0.18*** | -0.03 | 1418 | 0.28 |
| 32 | Communication Equipment | 0.20*** | -0.14 | 1473 | 0.26 |
| 33 | Precision Instruments | 0.17*** | -0.18* | 1380 | 0.22 |
| 34 | Vehicles and Trailers | 0.15*** | 0.00 | 1236 | 0.29 |
| 35 | Other Transport Equipment | 0.14*** | -0.16* | 1148 | 0.24 |
| 36 | Furniture and Miscellaneous | 0.29*** | -0.04 | 1642 | 0.37 |

Notes: Data are pooled over the period 1992-2005. Year Dummies are included.

Table 14: Relative-Price Regressions, Estimated Coefficients on China Dummy, Selected Years

| ISIC | Industry | 1992 | 1996 | 2000 | 2004 |
|------|---------------------------------|----------|----------|----------|----------|
| 15 | Food and Beverages | 0.15*** | -0.11*** | -0.15*** | -0.24*** |
| 16 | Tobacco | -1.77 | -0.55 | -0.16 | -0.55 |
| 17 | Textiles | -0.10** | -0.23*** | -0.41*** | -0.72*** |
| 18 | Apparel | 0.13*** | -0.08*** | -0.15*** | -0.56*** |
| 19 | Leather and Footwear | -0.20*** | -0.40*** | -0.61*** | -0.75*** |
| 20 | Wood except Furniture | -0.04 | -0.25** | -0.48*** | -0.46*** |
| 21 | Paper | 0.09 | 0.01 | -0.10 | -0.34*** |
| 22 | Publishing and Printing | -0.61*** | -0.88*** | -0.88*** | -1.20*** |
| 23 | Petroleum and Nuclear Fuel | -0.01 | 0.45 | 0.15 | 0.38** |
| 24 | Chemicals | 0.05 | -0.22*** | -0.42*** | -0.59*** |
| 25 | Rubber and Plastics | -0.00 | -0.34*** | -0.80*** | -1.02*** |
| 26 | Non-metal Minerals | -0.37*** | -0.46*** | -0.77*** | -0.93*** |
| 27 | Basic Metals | 0.13* | 0.04 | -0.11** | -0.28*** |
| 28 | Fabricated Metals | -0.34*** | -0.71*** | -0.92*** | -1.11*** |
| 29 | Machinery and Equipment, n.e.c. | -0.67*** | -0.99*** | -1.19*** | -1.40*** |
| 30 | Computing Machinery | -1.11*** | -1.49*** | -1.60*** | -1.69*** |
| 31 | Electrical Machinery | -0.62*** | -1.33*** | -1.33*** | -1.65*** |
| 32 | Communication Equipment | -0.06 | -0.82*** | -1.07*** | -1.40*** |
| 33 | Precision Instruments | -0.29** | -1.15*** | -1.38*** | -1.63*** |
| 34 | Vehicles and Trailers | -0.16 | -0.45*** | -1.23*** | -1.27*** |
| 35 | Other Transport Equipment | -0.34 | -0.58*** | -0.99*** | -1.05*** |
| 36 | Furniture and Miscellaneous | -0.58*** | -0.86*** | -0.92*** | -1.13*** |

Figure 1: Illustration of the China-Is-Special Result, 1996

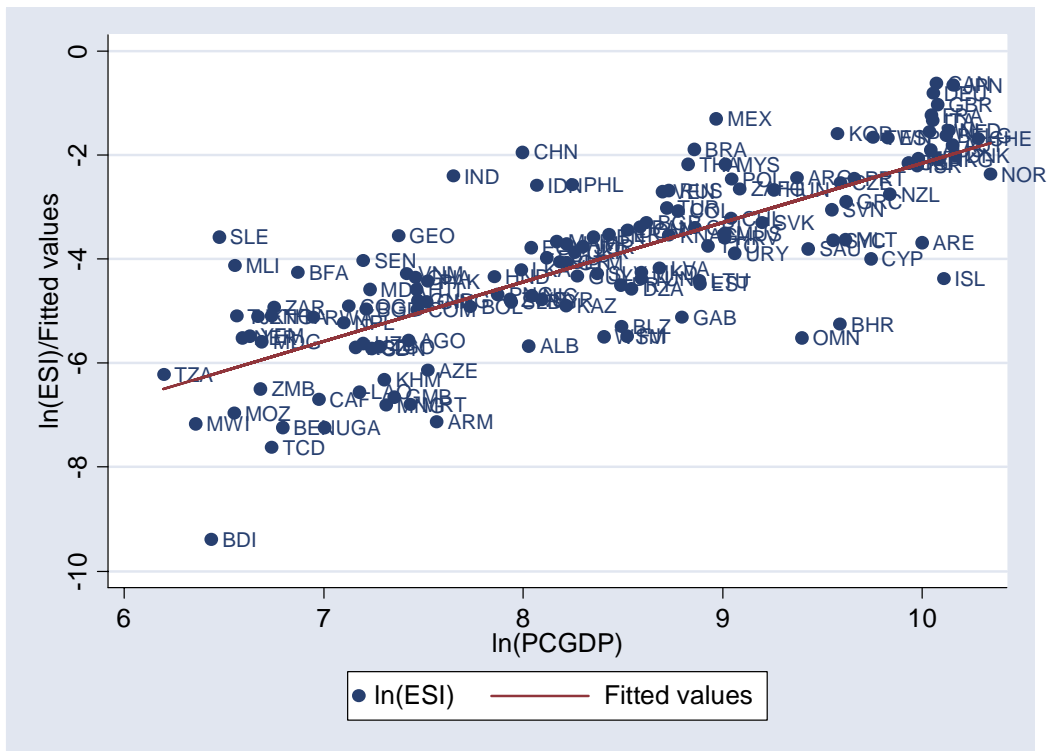
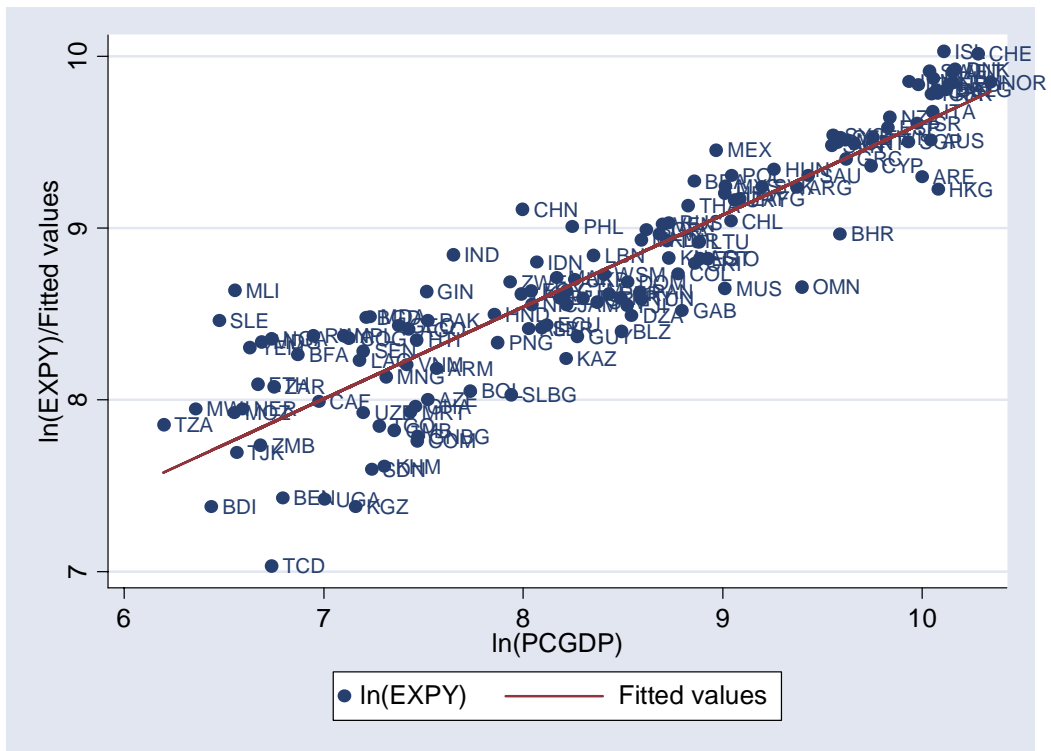


Figure 2: Relative Prices of U.S. Imported “Line Telephone Sets with Cordless Handsets”, 1996

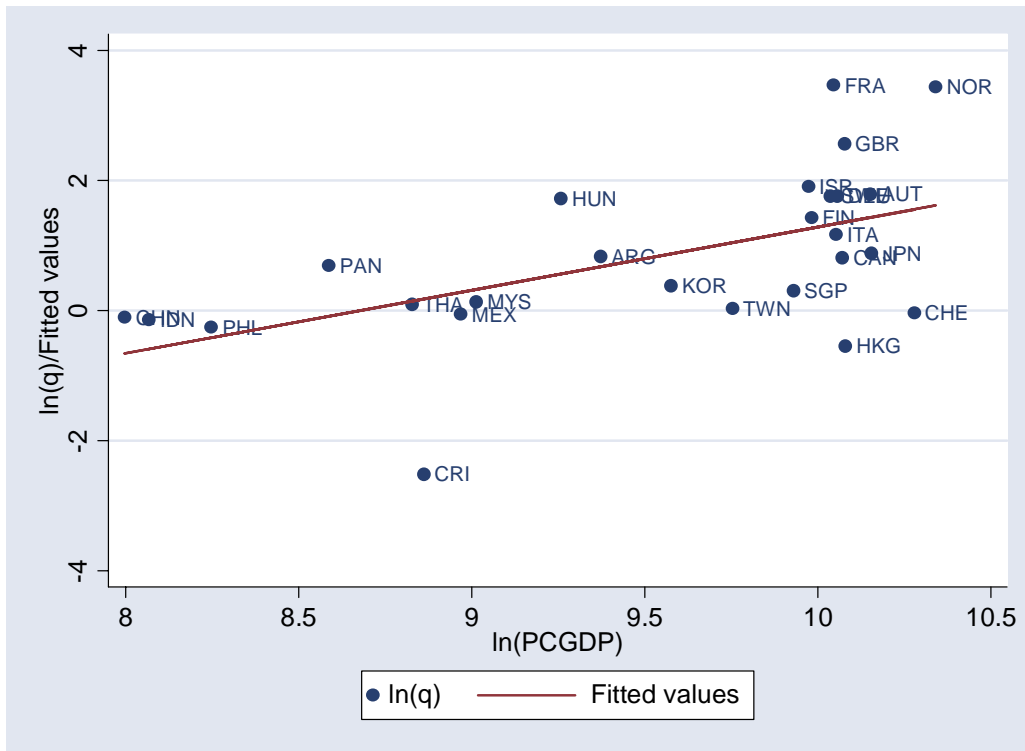


Figure 3: Trends of China’s Export Characteristics

