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# AN ANATOMY OF CHINA'S EXPORT GROWTH

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# An Anatomy of China's Export Growth\*

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Preliminary and Incomplete

## Abstract

We decompose China's phenomenal export growth along various dimensions. We find that the export structure changed dramatically from 1992 to 2006, with China moving out of agriculture and apparel and into electronics and other more sophisticated manufactures. We also calculate the share of growth from new varieties (extensive margin) and from existing varieties (intensive margin). Using highly disaggregated U.S. trade data at the HS 10-digit level, we find that 5 to 15 percent of export growth was in new varieties; almost all of China's export growth to the U.S. was in the intensive margin. We also find that, excluding processing trade, the skill content of China's exports has not increased.

**Key Words:**

**JEL Classifications:**

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## 1. Introduction

China's real exports increased by more than 450 percent over the last 15 years. This paper decomposes this stunning export growth along various dimensions. In particular, how has China's export structure changed? Has the export sector become more specialized, focusing on particular types of goods, or has it diversified as it has grown? And finally, are China's exports becoming more skill intensive? The answers to these questions have important implications for the global welfare consequences of China's export expansion and for future growth of China's export sectors. In addition, countries wishing to emulate China's success may find lessons in China's experience.

We find that China's export structure has transformed dramatically since 1992. There has been a significant decline in the share of agriculture and soft manufactures, such as textiles and apparel, with growing shares in hard manufactures, such as consumer electronics, appliances, and computers. In addition, we see disproportionately high growth in many goods that were very small in 1992. Specifically, goods that accounted for less than 20 percent of exports in 1992, now account for nearly 50 percent of exports. Despite this vast reallocation, export diversification did not increase, exports remained highly concentrated in a small fraction of goods—though the particular goods have changed.

We also ask whether this growth was accomplished by expanding trade of existing goods or by developing new export varieties? Traditional theory highlights the expansion of existing products (the intensive margin) as the only source of export growth. New trade theory gives a dominant role to an expansion of the number of export varieties (the extensive margin), providing an additional channel for welfare gains from trade. China's dramatic export rise offers a unique opportunity to evaluate these predictions.

We find that most of China's export growth was in existing varieties. In particular, despite a forty percent increase in the number of varieties that China exported to the U.S. since 1992, the extensive margin accounts for at most 15 percent of China's export growth.

In sum, most of China's export growth between 1992 and 2005 occurred in products that China was already exporting in 1992.

The large growth in the intensive margin is supportive of predictions consistent with traditional theories, which place endowments, productivity, and terms of trade effects at the center of trade growth. This finding stands in contrast to other recent empirical papers, which highlight the role of the extensive margin. In seminal work, Feenstra (1994) provides insights into how to measure the intensive and extensive margin. Using the Feenstra index, Hummels and Klenow (2005) find that variation in the size of exports across countries are largely due to variation in the extensive margin, suggesting that countries expand along the extensive margin as exports grow. However, their results are not directly comparable with ours since the forces that generate product distribution across countries may be quite different from the forces at work within countries.

Also using the Feenstra index, Broda and Weinstein (2006) examine U.S. import growth from 1972-2001. They find that 30 percent of growth was the result of an expansion in the extensive margin, and that China was the largest contributor to growth in U.S. varieties. While their results are suggestive of a larger role for the extensive margin, they also find that the bulk of growth in new varieties was in the period before 1988. Overall, the extensive margin was responsible for just 5 percent of U.S. import growth from 1988-2001.

In related work, Kehoe and Ruhl (2002) explore the responses of the intensive and extensive margin to trade liberalization. They find that trade liberalization leads to a large increase in the share of trade accounted for by goods that were little traded before liberalization, and interpret this as evidence that the extensive margin has increased. We also analyze how trade shares adjust; however, we argue that it is not clear that this can be interpreted as growth of the extensive margin because the bottom 10 percent of goods cover more than half of the product categories that are exported in both periods.

Finally, we find that the skill content of China's exports has increased, but most of this is due to processing trade. That is, the skill content of imported inputs used to produce

exports has increased; however, we do not find evidence that China's production techniques have become more skill-intensive.

The rest of the paper is organized as follows. Section 2 describes the data. Section 3 examines the reallocation of exports across industries. Section 4 decomposes export growth into the intensive and extensive margins. Section 5 examines whether there has been increased diversification or specialization as exports have growth. Section 6 looks at the skill intensity of exports, and section 7 concludes.

## **2. Data**

We use bilateral trade data at HS 8-digit level in current U.S. dollars from 1992-2006, from China Customs, Beijing. We deflate the data by the U.S. CPI to generate a constant dollar series. There were changes in HS 6-digit classifications in 1996 and 2002, which we use to convert the data to HS-1992 6-digit classification. In cases where a higher level of disaggregation was needed, we use the United States (HS 10-digit) imports from China data.

## **3. Reallocation Across Industries**

How has the composition of China's exports changed? China has moved from the first stage of agriculture and apparel to more sophisticated manufactured goods. Figure 1 shows the export share of each one digit SITC sector in 1992 and 2005. Rapid export growth has been associated with a move out of agriculture and apparel into the machinery and transport sectors. Figure 2 focuses on changes within the manufacturing sector. In particular, we look at how trade shares have adjusted in all major 2-digit SITC sectors, where major is defined as accounting for at least 3 percent of exports in 1992 and/or 2005. There is a notable move out of apparel, textiles, footwear, and toys and into electrical machinery, telecom, office machines, and to a lesser extent metals. In sum, China's export bundle is very different now from what it was in the early 1990s.

## 4. Intensive vs. Extensive Margin

Was the growth in trade due mainly from new goods or existing goods? We decompose China's manufacturing export growth from 1992 to 2005 (years for which disaggregated data are available) along various dimensions using HS 6-digit trade data (over 5,000 product codes) and HS 10-digit data on China's exports to the US (over 16,000 product codes).<sup>1</sup> One issue with the 6-digit data is that it is too aggregated to be able to identify new products: by 1992, China was exporting in over 90 percent of categories. Thus, we first split exports into deciles by value in 1992 and calculate their share of exports in 2005. If export growth is mainly from new goods, we would expect rapid growth in the bottom deciles, where trade was negligible in 1992. Figure 3 shows what share of manufacturing trade in 2005 is accounted for by the products falling into each decile. The categories that accounted for the bottom twenty percent of trade by value more than doubled, while the categories in the other deciles contracted or remained constant.

An issue with the above calculation is that exports tend to be highly skewed and the smallest two deciles account for the vast majority of product categories. We evaluate the reallocation in more detail in Figure 4 by dividing exports into deciles according to the number of categories of trade in 1992. For example, the tenth decile is the top ten percent of product categories when products are ranked by value. The distribution in 1992 is highly skewed, reflecting that only 10 percent of categories accounted for nearly 80 percent of trade. The decline in the share of the top decile shows that there was a sizeable reallocation of trade, but it was not the bottom 50 percent of products that gained. Over 75 percent of the decline in the trade share of the top decile was accounted for by an increase in the trade share of the four deciles just below the top. In sum, the results imply that there was a significant reorientation in exports, but that the reshuffling of export products during the expansion

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<sup>1</sup>In the remaining sections, we report results for manufacturing trade in order to focus on how industrial structure is changing. In addition, because of protection in the agriculture sector, it is less likely to follow a natural pattern. We have, however, calculated all of the statistics with total trade and none of the results change substantively.

was mainly in the mid-upper rank products. These are products that were in the bottom 20 percent by value but in the mid-to-high range by product rank.

To examine the importance of entirely new varieties—goods that were not exported in 1992—we use highly disaggregated data on China’s exports to the US (10-digit HS data, with over 16,000 codes). The extensive margin is more likely to be present in bilateral data, as exports can expand by entering new markets with old varieties. Trade is decomposed as follows:

Let  $V_{ti}$  be the value of trade at time  $t$  in product  $i$  ( $V_{ti} = p_{ti}q_{ti}$ ).

$I_{t0}^E$  is an indicator variable that is one if the product was exported in both period  $t$  and period  $0$  (existing products).

$I_{t0}^D$  is an indicator variable that is one if the product was exported in period  $0$  and not in period  $t$  (disappearing products).

$I_{t0}^N$  is an indicator variable that is one if the product was exported in period  $t$  but not in period  $0$ .

$$\frac{\sum_i V_{ti} - \sum_i V_{0i}}{\sum_i V_{0i}} = \frac{\sum V_{ti}(I_{t0}^E) - \sum V_{0i}(I_{t0}^E)}{\sum V_{0i}} - \frac{\sum V_{0i}(I_{t0}^D)}{\sum V_{0i}} + \frac{\sum V_{ti}(I_{t0}^N)}{\sum V_{0i}} \quad (4.1)$$

This is an identity where total growth in trade relative to the base period is decomposed into three parts: (i) the growth in products that were exported in both periods, the intensive margin; (ii) the reduction in export growth due to products no longer exported, disappearing goods; and (iii) the increase in export growth due to the export of new products, the extensive margin. The disappearing category can either be counted separately or incorporated into the intensive margin, as they are part of old categories.

The share of trade growth attributed to each margin is calculated using equation 4.1. There is, however, an intrinsic problem using 8-digit or 10-digit data, as there are numerous reclassifications over time. We follow Debaere and Mostashari (2006) and consider only categories that are permanently present in the U.S. trade data. This will reduce the problem

of product reclassifications, assuming that reclassifications do not happen among incumbent product codes. The permanent categories at the HS10-digit account for 65 percent of the total HS codes and 47 percent of total exports between 1992 and 2005; for the HS 8-digit codes, the permanent categories at the HS 8-digit account for 75 percent of the total HS codes and 63 percent of total exports. Table 1 reports the extensive margin using U.S. data. As would be expected, the extensive margin is larger when we use more disaggregated data; however, the intensive margin is quite small accounting for more than 95 percent of trade growth.

An important concern is that using permanent trade codes will understate the extensive margin since new exports are likely to be in new classifications. The last row of Table 1 reports growth in extensive margin using a traditional Feenstra index of variety on all HS 10-digit codes on imports from China to the United States. Specifically, we calculate the expenditure share in the last period on goods available in both the first and last period relative to the expenditure share in the first period on goods available in both periods (*Feenstra index of variety* =  $\frac{\sum V_{ti}(I_{t0}^E)/\sum V_{ti}}{\sum V_{0i}(I_{t0}^E)/\sum V_{0i}}$ ). The index will be equal to one if there is no growth in varieties relative to the base period and less (greater) than one if the number of varieties has grown (declined). Variety growth is  $1/\text{Feenstra index}$ . This measure has the nice feature that if classifications are simply split, and their share of total trade remains unchanged, the index remains unchanged. However, if growth classifications tend to be split to a greater extent than shrinking classifications are merged, the index will tend to overstate the extensive margin. Alternatively, if there is a lot of churning, with an equal amount of creation and destruction, it will report variety growth of nil. Using this index we find an extensive margin of 15 percent.

Our estimates of the extensive margin in trade are considerably smaller than has been found in the previous literature. Exports of new varieties (at the HS-10 digit) from China to the U.S. accounted for 40 percent of the total number of categories in 2005; however, these new varieties account for at most 15 percent of the total value of China's exports to the U.S.



#### 4.1. Exports to New Markets

Are market discoveries important? New markets may provide an important channel for export growth. To the importing country, a good from China that had not been imported before is akin to a new variety in welfare terms. From China's perspective, to the extent that markets are segmented, expanding exports across markets may also reduce downward pressure on the terms of trade.

We calculate the share of trade growth that is accounted for by new product-market linkages. For example, in 1992 China exported window air-conditioning units (HS 841510) to Russia, but not to Ukraine. By 2005, China exported this product to both countries. Using the 6-digit HS data, which covers exports to all countries, we find that 65 percent of the total product-market pairs in 2005 were new, but because of their small size, they only accounted for 16 percent of trade growth.

In sum, the evidence shows that new products and new markets were important to China's recent export success, and that growth of a number of previously small sectors was especially important.

### 5. Diversification versus Specialization

Next, we examine whether exports became more or less specialized over the period. Figure 5a shows inverse cumulative trade shares for all products. We graph it as an inverse function, with products ranked from largest to smallest, in order to focus on the top 1000 and 500 products. Figure 5b magnifies the image, showing the cumulative trade shares when we keep only the 500 categories, which account for nearly 80 percent of trade in each period. The figure shows that concentration has increased.

To examine specialization in more detail, we calculate the Gini coefficient of export equality in each period. It is defined as

$$Gini \equiv 1 - \frac{1}{n} \sum_i (cshare_{i-1} + cshare_i),$$

where there are  $n$  products,  $i$  is a product's rank (1 is smallest and  $n$  is largest), and  $cshare_i$  is the cumulative share of exports of the  $i$ th product. The Gini coefficient uses the trapezoid approximation to calculate the area between a 45 degree line and the cumulative distribution, weighting each industry as an equal share of the population of industries ( $1/n$ ). A Gini coefficient of one reflects complete inequality and a Gini coefficient of zero reflects complete equality.

Table 2 reports the Gini coefficient for the first and last period for various different samples. When we include all products, the Gini coefficient remained constant over the period at 0.85. Ranking the goods and including only the largest 70 percent, the Gini coefficient increased from 0.46 to 0.55. Alternatively, examining the top 100 products, which account for nearly 50 percent of trade in the second period and 45 percent in the first period, the Gini coefficient increased from 0.35 to 0.50. Thus, over the period we see enhanced specialization, especially for the products that accounted for the largest export shares.

## 6. Skill Content of Export Growth

Finally, we examine whether the skill content of China's export growth has increased over the sample period. As industry skill level data for China were unavailable, we rank industries from low to high skill intensity based on information from Indonesia, another developed country that is likely to have similar technologies. We use the ratio of production workers to total employment from the Indonesian manufacturing census at the 5 digit ISIC level for 1992 to rank China's manufacturing industries from low to high skill on the horizontal axis, and then plot the cumulative export share on the vertical axis.<sup>2</sup> Figure 6a shows that in 1992, 55 percent of China's exports were accounted for by 20 percent of the least skill-intensive industries. The shift of the curve to the right indicates that the skill content of China's exports has increased over time. For example, in 1992, 20 percent of the least skill-intensive

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<sup>2</sup>Chun and Trefer (2005) measure changes in the skill content of exports for all countries using U.S. industry level skill data to rank the skill intensity of industries, assuming no factor intensity reversals. Our results also hold using U.S. skill data.

industries produced 55 percent of China's export share. By 2005, the export share that these industries produced fell to 32 percent.

Although the skill content of China's exports has increased this does not necessarily mean that there has been any skill upgrading in China's production techniques. Instead, China could be importing intermediate inputs with higher skill content that it then assembles for exporting. We assess this possibility by plotting the cumulative of export shares against the skill intensity with non-processing manufacturing exports only. That is, we exclude any exports that have been classified by China Customs as processing trade. From Figure 6b, we see that there is hardly any shift in the curve indicating no change in the skill content of China's non-processing exports. It should be noted, however, that by excluding processing exports we are excluding around 54 percent of China's manufacturing exports. Although imported inputs account for a large share of the value of processing exports (between 52 to 76 percent of the value according to Dean, Fung and Wang, 2007), there still remains a significant amount of value added in China in processing exports and there could be skill-upgrading in that portion. There is no precise way of measuring this, but we do find a very large increase in the skill content of processed imports, using US industry skill data to rank the skill intensity of imports, which is much larger than the increase in the skill content of non-processing imports. Thus it appears that the increase in China's skill content in its exports is due to the increase in the skill content of imported inputs embodied in these exports.

## 7. Conclusions

Our analysis generates three stylized facts about China's export growth since 1992:

- Churning was important. China's exports of appliances and electronics expanded rapidly, while agriculture, textiles and apparel become less important. Much of recent export growth was driven by products that made up a small share of trade in 1992.
- Export product specialization increased marginally, though there was increased

diversification across markets.

- There is little evidence that the value added of China's exports has become more skill intensive when processing trade is excluded.

Trade reorientation, with rapid growth in a number of relatively small sectors was crucial for export growth. The development of new products and finding new markets for existing products has also played a role, though growth in existing products is far more important. In contrast, there is no evidence of increased product diversification in China's recent success. The movement of resources into their most productive uses and enhanced specialization are driving export growth. Not too surprisingly, export growth has mainly been associated with production intensive in unskilled labor, China's most abundant resource.

## References

- [1] Broda, C. and D. Weinstein (2006). "Globalization and the Gains from Variety" *Quarterly Journal of Economics*, 541-585.
- [2] Chun Zhu, S. and D. Trefler (2005). "Trade and Inequality in Developing Countries: A General Equilibrium Analysis", *Journal of International Economics* 65, 21-48.
- [3] Dean, Judy, K.C. Fung and Zhi Wang (2007) "Measuring the Vertical Specialization on Chinese Trade", unpublished mimeo.
- [4] Debaere, P. and S. Mostashari (2006?) "Do Tariffs Matter for the Extensive Margin of International Trade? An Empirical Analysis" Mimeo University of Texas, Austin.
- [5] Feenstra, R. and H.L. Kee (2006) "Trade Liberalization and Export Variety: A Comparison of Mexico and China". Mimeo World Bank.
- [6] Hillberry, R. and C. McDaniel (2002) "A Decomposition of North American Trade Growth Since NAFTA", ITC Working Paper 2002-12-A.

- [7] Hummels, D. and P. Klenow (2005). “The Variety and Quality of a Nation’s Exports”  
*American Economic Review*, 95, 704-723.
- [8] Kehoe, T. and K. Ruhl (2002) “How Important is the New Goods Margin in International Trade?” Federal Reserve Bank of Minnesota.

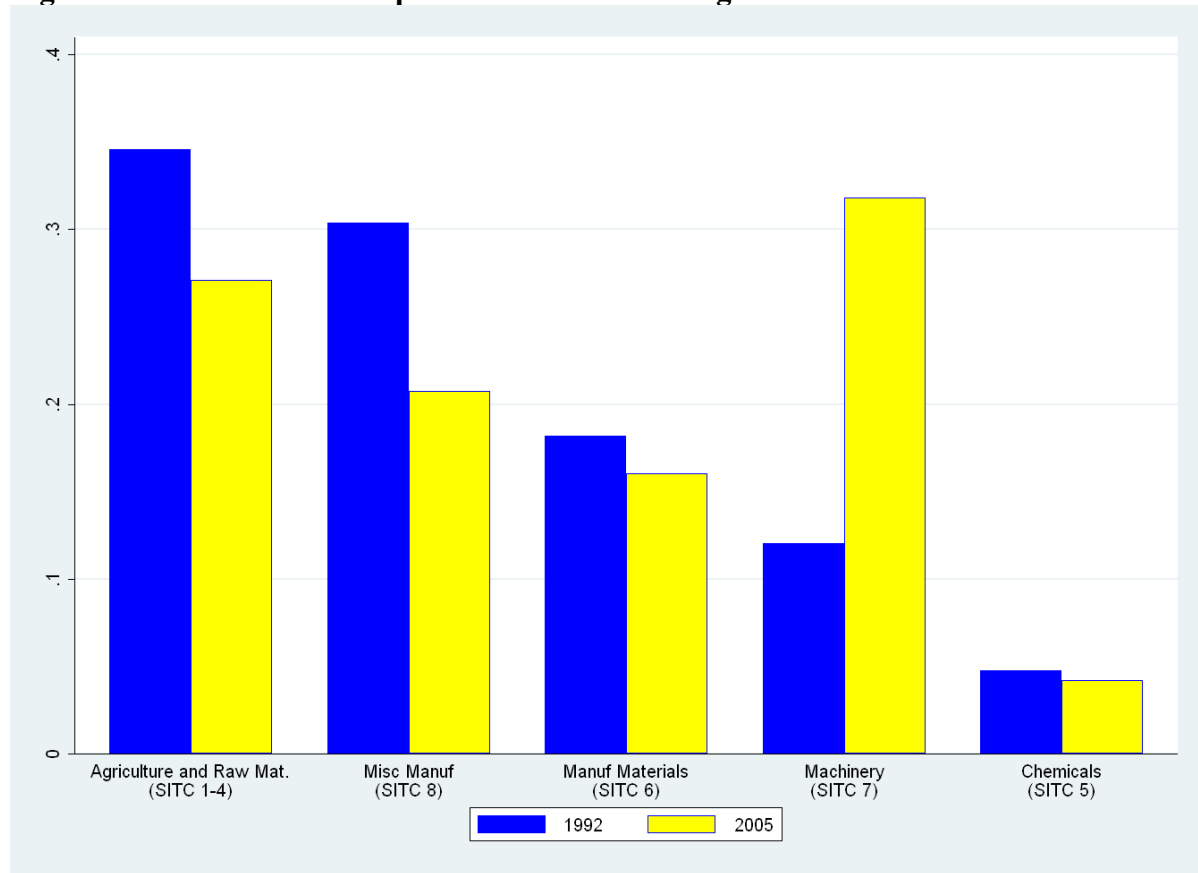
**Table 1: Extensive and Intensive Margin of China's Exports, 1992 to 2005**

<b>Extensive</b>	<b>Intensive</b>	<b>Data</b>
2.2	97.8	U.S. permanent, 8-digit HS
4.9	95.1	U.S. permanent, 10-digit HS
15.0	85.0	U.S. all codes (Feenstra Index)

**Table 2: Gini Coefficient for China's Exports**

<b>Period</b>	<b>All</b>	<b>Top 70%</b>	<b>Top 100</b>
1992	0.85	0.46	0.35
2005	0.86	0.55	0.50

**Figure 1: Reallocation of Exports Across SITC 1-Digit Industries**



Note: Column headings include the following 1-digit SITC industries:

SITC 1-4: Beverages, tobacco, raw materials, mineral fuels, oils and fats.

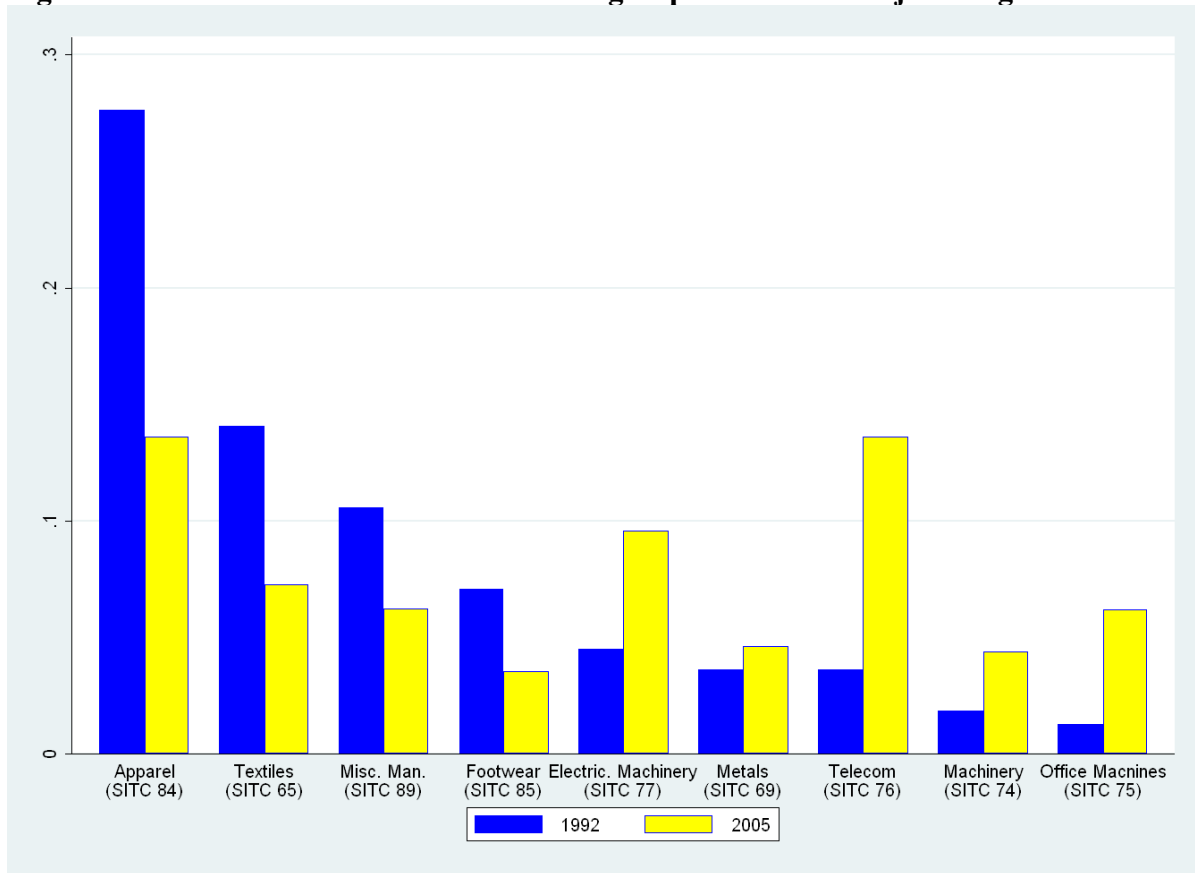
SITC 5: Chemicals, dyes, pharmaceuticals, perfumes.

SITC 6: Leather, rubber, cork and wood products, textiles, metallic and non-metallic manufactures

SITC 7: Industrial machinery, office machinery, telecommunications equipment, electrical machinery, transportation equipment

SITC 8: Prefabricated buildings, furniture, travel goods, clothing, footwear, professional and scientific equipment

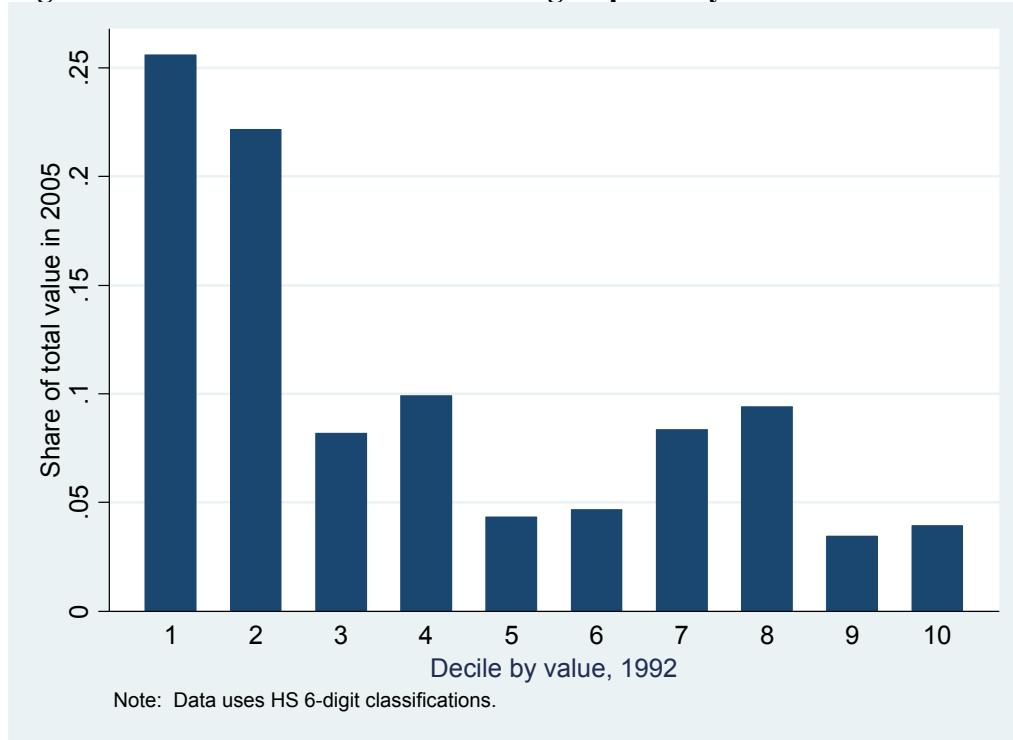
**Figure 2: The Reallocation of Manufacturing Exports Across Major 2-digit SITC Sectors\***



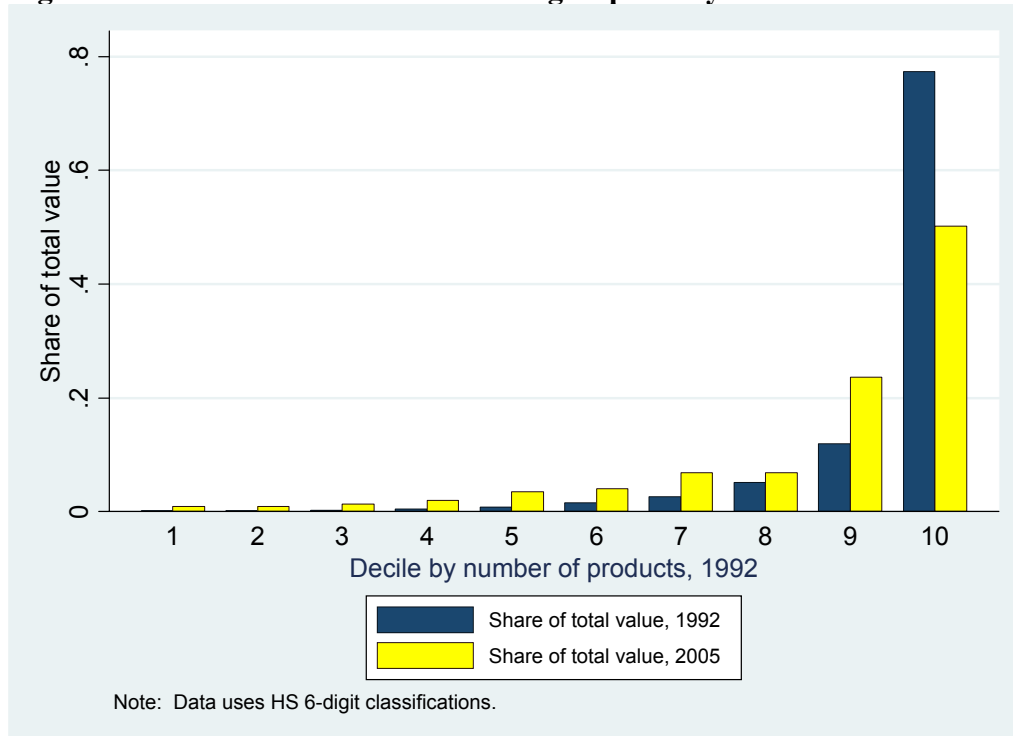
\* A sector is defined as major if the sector's share of total trade is above 3% in 1992 and/or 2005. These sectors account for about 70 percent of manufacturing exports.



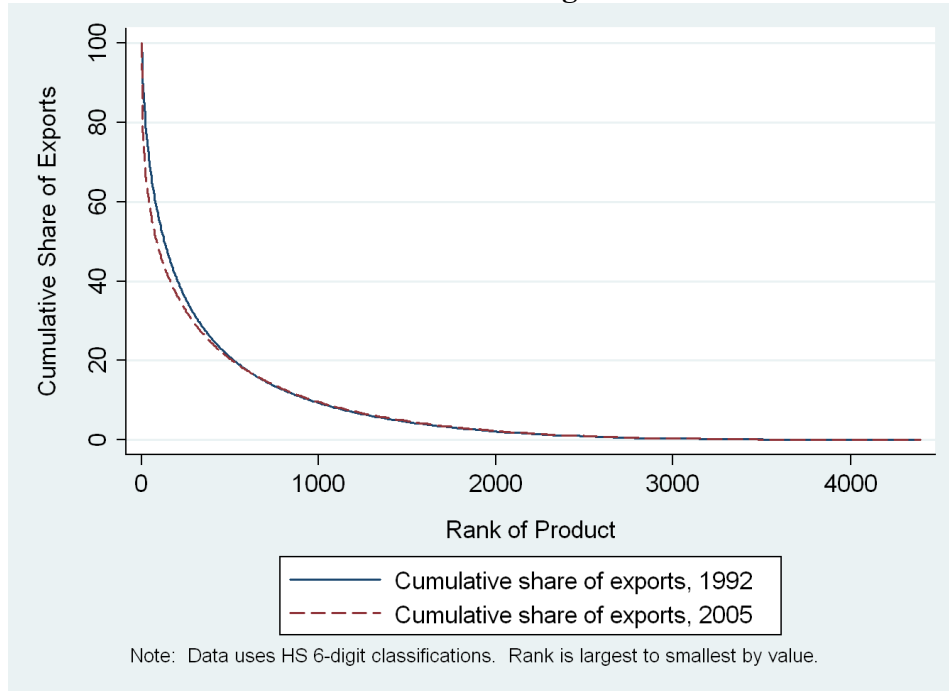
**Figure 3: Reallocation of Manufacturing Exports By Value**



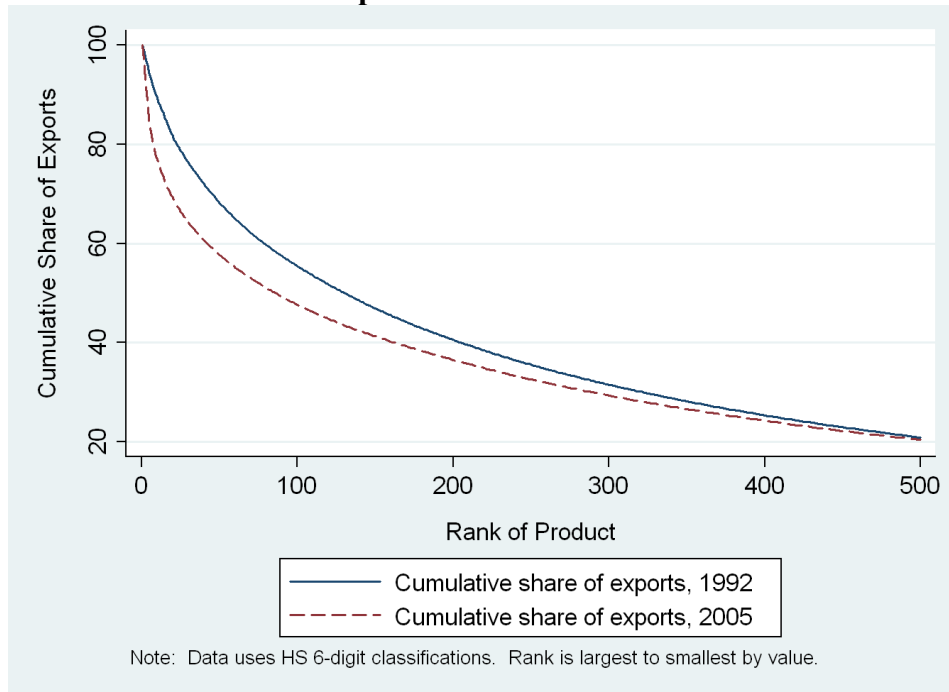
**Figure 4: Reallocation of Manufacturing Exports by Product Shares**



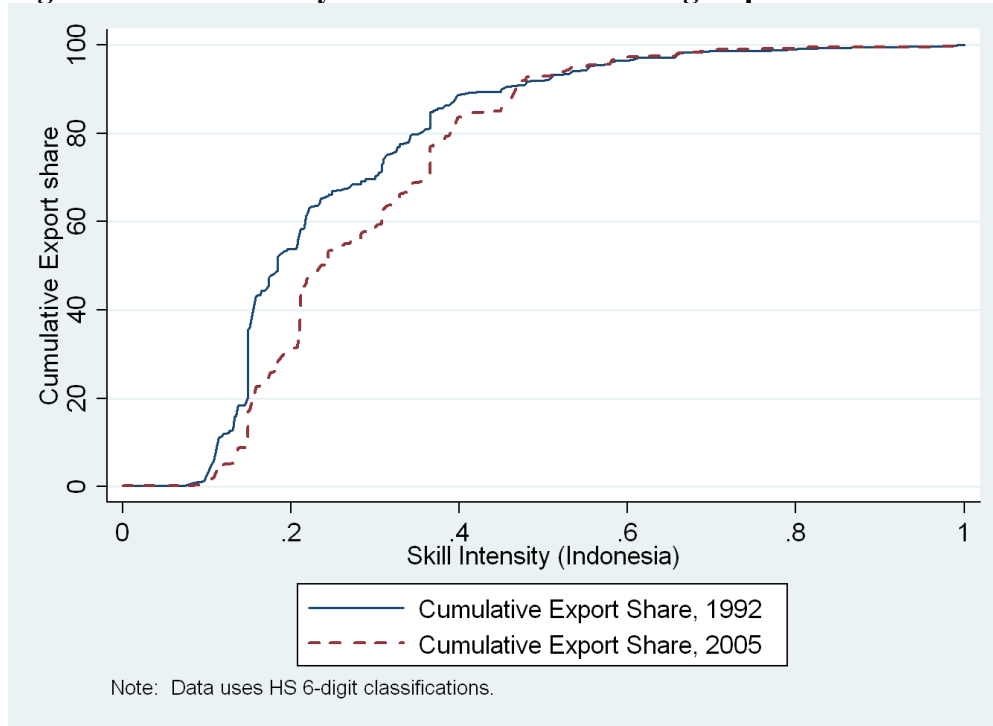
**Figure 5a: Cumulative Share of Manufacturing Exports by Rank  
All Manufacturing**



**Figure 5b: Cumulative Share of Manufacturing Exports by Rank  
Top 500 Products**



**Figure 6: Skill Intensity of China's Manufacturing Exports**



**Figure 7: Skill Intensity of China's Manufacturing Exports Excluding Processing Trade**

