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The Rising Sophistication of China's Exports: Assessing the Roles of Processing Trade, Foreign Invested Firms, Human Capital, and Government Policies

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As China becomes a major world exporter, there has been a rapid increase in its product sophistication - measured by increased similarity between the product structure of its exports and those of the developed countries - as well as a rapid increase in the volume of its exports. This has generated anxiety in developed countries as the competitive pressure may be increasingly felt outside labor-intensive industries. Using product-level data on exports from different cities within China, this paper investigates the roles of processing trade, foreign invested firms and government promotional policies in the form of tax-favored high-tech development zones and export processing zones in raising the country's export sophistication.

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"Everyone knew that we would lose jobs in labor-intensive industries like textiles and apparel, but we thought we could hold our own in the capital-intensive, high-tech arena. The numbers we're seeing now put the lie to that hope – as China expands its share even in core industries such as autos and aerospace."

Robert Scott, US Economic Policy Institute,
Author of a report presented to the US-China Economic and Security Review Commission,
Quoted in au.biz.yahoo.com/050111/33/2x8r.html, January 12, 2005

1. Introduction

China's rise as a trading power has taken the world by the storm. Its exports have risen from 18 billion dollars or less than 4% of its GDP in 1980 to more than 760 billion dollars or about 35% of its GDP by 2005. Besides the rapid expansion of its trade volume, researchers have noted another feature: its level of sophistication has been rising steadily. This can be seen in three ways, two from the literature, and the third provided by us. First, as Schott (2005) noted, China's export structure increasingly resembles those of high-income countries in a way that seems unusual given China's endowment and level of development. Second, as Rodrik (2006) observed, the typical level of per capita GDP associated with countries that export the basket of goods that China sells to the world is much higher than China's actual level of income. Third, as we will show, the fraction of product lines that G-3 countries (the United States, the 15-member European Union and Japan) export but China does not is shrinking steadily. Obviously, these three trends are not independent from each other[1]. Taken at their face value, they may suggest that China is competing head to head with producers from developed as well as developing nations alike. This has generated a tremendous amount of anxiety in many nations. Why would China, a country with extreme abundance in labor, but relative scarcity in capital and skilled labor as well as the capacity of technological creation and innovation, produce and export a bundle of goods that resembles those of developed countries? Schott's (2006) conjecture is that it is the result of a combination of large regional variations in factor endowment and impediments to factor mobility across regions.

Table 1 traces out the evolution of China's export sophistication during 1996-2005. It shows that the level of dissimilarity between China's export structure and that of the G-3 economies declined from 133.7 in 1996 to 121.5 by 2005[2]. During the same period, the number of HS 6-

[1] Xu (2007) noted the income level of China's exporting regions is higher than the average for the country as a whole. Furthermore, by making use of Schott (2004), he also noted the unit value of China's exports tend to be lower than that of rich countries for the same product, indicating China's variety is of lower quality and presumably of lesser sophistication. Fontagne, Gaulier and Zignago (2007, Tables 1 and 2) show that China's export structure, defined the same way as in Schott (2006) but at the HS 6-digit level, is more similar to Japan, the United States, and the European Union than to Brazil and Russia. However, judged on unit values, Chinese exports are more likely to be in the low end of the market than those of the high-income countries.

[2] This is computed at national level using equation (2) (without the region subscript).

digit product lines that G-3 exports (between 4143 and 4212 in total) but China does not fell from 101 in 1996 to 83 in 2005. As a share of the product lines that G-3 exports, that fell from 2.44% in 1996 to 1.97% in 2005. China exports a tiny bit (e.g., less than $ 1 million) in several product lines. The share of products that the G-3 exports but China does not export one million dollars or more fell from 28.7% (1189/4143) in 1996 to 13.7% (578/4212) in 2005.

How much should developed countries be concerned with the rising competitive pressure from the increased sophistication of the Chinese exports? The answer depends on the sources of the rising sophistication. On the one hand, the measured sophistication could be a statistical mirage due to processing trade. For example, both United States and China may export notebook computers, but the Chinese manufacturers may have to import the most sophisticated components of the computer, such as processors (CPU) made by Intel from the United States. In such a case, the Chinese producers may specialize in the unsophisticated stage of the production but the final product is classified as sophisticated. If one were able to classify a product further into its components, China and developed countries might be found to produce different components. That is, they do not compete directly with each other. In this scenario, there is very little for the developed countries to worry about.

As a variation of this scenario, China and the high-income economies may export the same set of product lines, but the two export very different varieties with each product line, with China exporting varieties of much lower quality. The competition between the high-income economies and China needs not be tense.

On the other hand, the Chinese authorities, including governments at the regional/local levels, have been actively promoting quality upgrading of China's product structure through tax and other policy incentives. A particular manifestation of these incentives is the proliferation of economic and technological development zones, high-tech industrial zones, and export processing zones around the country. Their collective share in China's exports has risen from less than 6% in 1995 to about 25% by 2005. These policy incentives could raise the similarity of Chinese exports with those of developed countries, although it is unlikely the most efficient thing for China to do (unless there is significant positive externality from learning by doing). If this is the primary driver for the rising sophistication rather than the mis-measurement induced by processing trade, then China may be increasingly competing directly with developed countries.

In between the two explanations is the role of foreign invested firms in China. The share in China's total exports produced by foreign wholly owned firms and Sino-foreign joint ventures has risen steadily over time, from about 31% in 1995 to more than 58% by 2005 (Table 2). These foreign invested firms may choose to produce and export products much more sophisticated than what indigenous Chinese firms would. In this scenario, while China-made products may compete with those from developed countries, at least the profits from such activities also contribute directly to the GNPs of the developed countries. Besides this direct effect of foreign invested firms on China's export upgrading, it is possible that the presence of foreign firms helps to raise indirectly the sophistication levels of Chinese exports through various spillover to domestic firms (Hale and Hong, 2006). The above three possible explanations can reinforce each other, rather than being mutually exclusive. For example, a foreign-invested firm may engage in processing trade while located in a high-tech zone.

To the best of our knowledge, direct evidence on the importance of these channels is not yet available in the literature. By using a very detailed product-level data set on Chinese exports, disaggregated by firm ownership types and across about 240 Chinese cities, this paper aims to provide some answers.

To preview some of the key findings, we will argue that it is important to look at both the export structure and the unit value of exports. We will report evidence that neither processing trade nor foreign invested firms play an important role in generating the increased overlap in the export structure between China and high-income countries. Instead, improvement in human capital and government policies in the form of tax-favored high-tech zones appear to contribute significantly to the rising sophistication of China's exports.

An analysis of unit values adds important insights. Processing trade is positively associated with higher unit values. In the absence of data on value added from imported inputs versus domestic inputs, it is difficult to say whether processing trade has generated any skill upgrading for China. However, after controlling for processing trade, exports by foreign invested firms tend to systematically have higher unit values, suggesting that they produce higher-end varieties (beyond promoting processing exports). High-tech zones and other policy zones set up by the government are also associated with higher unit values (beyond promoting processing trade). Therefore, both foreign investment and government policy zones are conducive to raising product sophistication, by increasing the overlap in export structure between China and advanced economies' export and/or by producing higher-end varieties within a given product category.

The rest of the paper is organized as follows. Section 2 explains the basic specification and the underlying data. Section 3 reports a series of statistical analyses. Section 4 concludes.

2. Specification and Data

Our strategy is to make use of variations across Chinese cities in both export sophistication and its potential determinants to study their relationship. On export sophistication, we look at two measures: (a) the similarity between local export structure to that of the G-3 economies, and (b) the unit value of local exports. We consider several categories of the determinants, including the level of human capital, the use of processing trade, and the promotion of sophistication by governments through high-tech and economic development zones.

2.1 Data and Basic Facts

Data on China's exports are obtained from China Customs General Administration's electronic trade database at the most detailed level (HS 8 digit), which the United States International Trade Commission subscribed through the China Customs Statistics Information Center in Hong Kong. The database reports exporter location (more than 400 cities in China), policy zone designation (i.e., whether an exporter is located in any type of policy zone), firm ownership, and. transaction type by customs declaration (whether an export is processing trade) for the period 1995 to 2005.

We link the database with a separate database on city information, including per capita gross city product, population, college student enrolment and FDI data, from the China-data-online databank managed by the China Data Center at University of Michigan. Unfortunately, the second database has more limited coverage (240 cities during 1996-2004). The cities in our sample are list in Appendix table 3.

The exports by the G-3 economies at HS 6 digit level come from the United Nations' COMTRADE database downloaded from the WITS. All HS Chapters 1 through 24 (agricultural products) and 25-27(mineral products) are excluded. Detailed HS codes excluded from the sample are list in Appendix table 4.

The summary statistics are reported in Tables 2-4. Table 2 reports a breakdown of the export value by the ownership of the exporters. A number of features are worth noting. First, there has been a steady decline in the share of state-owned firms in China's exports, from 66.7% in 1995 to 39.8% in 2005. This reduction in the role of state-owned firms in exports mirrors the reduction of the state in the economy in general. Second, foreign invested firms (both wholly foreign owned and sino-foreign joint ventures) play a significant role in China's exports. Their share in China's exports also increases steadily, from 31.5% in 1995 to 50.5% in 2005. The role played by foreign firms in China's exports is larger than for most other countries with more than 10 million population. Third, exports are truly private domestic firms are relatively small, though their share in China's exports also increases over time, from virtually 0% until 1997 to 17.8% by 2005. Some of the growth in exports by domestic private firms is achieved by a change in firm ownership. For example, when the laptop manufacturer Lenova was first established, it was a partly state-owned firms. By 2003, it was a privately-owned firms. By now, it has added foreign investment, acquired the original IBM PC division, and exported some of its products under the IBM brand.

Table 3a reports a breakdown of China's exports into processing trade, normal trade, and others according to exporters' customs declarations. Processing exports come in three ways: (a) from export processing zones, (b) from processing exports out of various high-tech zones, and (c) from processing exports outside any policy zones. Collectively, their share in the country's total exports has increased from 43% (=0+3.2%+39.8%) in 1995 to 52% (=4.6%+11.8%+35.6%) in 2005. As we lack information on the share of processing exports for other countries, we cannot conduct a formal international comparison. Our conjecture is that very few developing countries would have the share to be as high as China's. On the other hand, we conjecture that a portion of China's reported processing trade may be exaggerated due to some firms' to evade tariffs on imported inputs for usage in domestic production[3].

Table 3b provides a tabulation of firm ownership distribution for exports from each type of policy zones. Foreign invested firms are dominant in export processing, account 100% of the exports out of export processing zones, 95% of the processing exports out of the high-tech zones, and 67% of the processing exports from the rest of China. State-owned firms account for the bulk of the remaining processing trade. Therefore, processing exports are mostly though not fully engaged by wholly and partly foreign owned firms. The reverse is not true, that is, foreign firms

[3] Fisman and Wei (2004) provided evidence of tariff evasion in China's imports.

also engage in normal (i.e., "non-processing") exports, accounting for 40% of the non-processing exports out of the high-tech zones, and 24% of the normal trade outside the policy zones in 2004.

We can compute a breakdown of export type (processing or not) by ownership. The result is reported in Table 4b.[For both foreign wholly-owned firms and sino-foreign joint ventures, processing trade accounts for nearly 50% of their exports. For state-owned firms and collectively owned firms, the share of processing exports in their total exports is 18% and 13%, respectively. Domestic private firms engage in comparatively little processing trade, with less than 7% of their exports in this category (table 4b).]

China has established a number of special economic zones and areas where more incentive policies are applied as parts of its development strategy since 1979. Five special economic zones (SEZs) are distinguished from other special economic areas. They include entire Hainan province, three cities (Shenzhen, Zhuhai, and Shantou) in Guangdong province, and a city (Xiamen) in Fujian Province. Other special economic areas are much smaller geographically and classified as Economic and Technological Development Areas(ETDAs), Hi-Technology Industry Development Areas (HTIDA), Export Processing Zones (EPZs), etc. Some of these special economic zones and areas are within the five SEZs. A number of incentive policies have been introduced in these zones and they also enjoyed greater flexibility in utilizing foreign capital, introducing foreign technology and conducting economic cooperation overseas. We name all these special zones and areas as "policy zones".

Among these policy zones, ETDAs and HTIDAs are tax-favored enclaves established by central or local governments (and often approved by the central government) to promote development of sectors that could be said as "high and new tech" by some not-always-clearly-defined criteria. There are some differences between the two types of zones. In practice, however, the line between the two is often blurred. Which firms should go into which type of zone is somewhat arbitrary. As a result, we group them together in our subsequent discussions. Taking simple average across the years and the cities in our sample, they account 2% of total exports (Table 4b). On national aggregate, export share of these high-tech zones has increased over time from 5% in 1995 to about 14% in 2004(table 3a).

Relatively few cities have export processing zones (whose exports are exclusively processing trade), which introduced at 2001. In national aggregate, only 3.5% of exports come from the export processing zones by 2005 (table 3a). On simple average, only 0.04% of exports come from EPZs because only about 20 cities have such zones and all have less than four years in history in our sample. This means most of China's processing exports are produced outside export processing zones.

Foreign invested firms dominate exports from EPZs and processing exports from high-tech zones in our sample period (99 % and 95% respectively, table 3b), and also took a lion share in processing trade outside those policy zones (67%), while SOEs were the major players in normal exports, took 58% normal exports from High-tech zones and 63% normal exports outside policy zones during our sample period. Relative to processing trade, collectively owned and private

firms also played an important role in China's normal exports, took 8.5% of normal exports from high-tech zones and 18% exports outside policy zones (table 3b).

2.2 Basic Specification

We relate the sophistication level of local export structure to its plausible determinants including the role of processing trade, foreign investment, and local human capital. Formally, the econometric specification is given by the following equation (or some variation of it):

$$\begin{aligned} \text{Ln}(EDI_{rft}) = & \; city\_fixed + year\_fixed + \beta_1 \text{EPZ\_share}_{\text{rft}} \\ & + \beta_2 \text{High\_tech\_zone\_processing\_Share}_{\text{rft}} \\ & + \beta_3 \text{Pr}oces\sin g\_outside\_anyzone\_share_{\text{rft}} \\ & + \beta_4 High\_tech\_zone\_nonproces\sin g\_share_{rft} \\ & + \beta_5 \text{Ln}(GDP_{rt}) + \beta_6 SKILL_{rt} + other\_controls + \mu_{rft} \end{aligned} \quad (1)$$

Where Ln(EDI) is the log of a **dissimilarity index** between a Chinese city's export structure and that of the United States, Japan, and the European Union combined. $\beta_1 - \beta_6$ are the coefficients to be estimated. μ_{rft} is the error term. Other regressors and the sources of the data are explained in Appendix Table 1. Robust standard errors that are clustered around cities are reported.

We define an index for a lack of sophistication by the dissimilarity between the product structure of a region's exports and that of the G-3 economies, or the export dissimilarity index (EDI), as:

$$EDI_{rft} = 100(\sum_i abs(s_{irft} - s_{i,t}^{ref})) \quad (2)$$

where

$$S_{irft} = \frac{E_{irft}}{\sum_i E_{irft}} \quad (3)$$

Where s_{irft} is the share of HS product i at 6 digit level in Chinese city r's exports for firm type f in year t, and $s^{ref}_{i,t}$ is the share of HS product i in the 6 digit level exports of G-3 developed countries. The greater the value, the more dissimilar the two export structures are. If the two export structures are identical, then the value of the index would be zero; if the two export structures have no overlap, then the index would take the value of 200. We regard an export structure as more sophisticated if the index takes a smaller value. Alternatively, one could use a similarity index proposed by Finger and Kreinin (1979) and used by Schott (2006) (except for the scale):

$$\text{ESI}_{\text{rft}} = 100\sum_i \min(s_{irft}, s^{ref}_{it,}) \quad (4)$$

This index is bounded by zero and 100. If Chinese city r's export structure has no overlap with that of the G-3 developed countries, then ESI would be zero; if the two export structures have a perfect overlap, then the index would take the value of 100. It can be verified that there is a one-to-one, linear mapping between ESI and EDI (see the appendix for detail) :

$$ESI_{rft} = (200 - EDI_{rft})/2 \quad (5)$$

However, log(ESI) is related to log(EDI) only non-linearly. Economic theory does not give much guidance to the exact functional form. Our experimentation suggests that using log(EDI) as the dependent variable is more likely to produce robustly significant coefficients. In our subsequent analysis, we choose to use log(EDI) as the dependent variable.

3. Analysis

3.1 Basic Results

The regression results are reported in Table 5. In the first four columns, the sophistication of a city's export structure is measured by its similarity with that of the G-3 high income countries on a *year by year basis*. As a robustness check, in the last four columns, the export sophistication is measured against the export structure of the high-income countries in a fixed year (2004, the last one in our sample period). The change in the reference year for the export sophistication does not turn out to matter qualitatively.

The coefficient on "export processing zone exports as a share of total city exports" is negative and significant, implying that exports from EPZs tend to be more similar to those of high-income countries than the typical Chinese exports. However, as a majority of Chinese cities do not have EPZs, this does not contribute much to explaining cross-city differences in export sophistication.

The coefficients on the two variables describing exports from high-tech zones ("processing exports from high-tech zones" and "non-processing exports from high-tech zones") are negative and significant, implying that the high-tech zones do contribute to raising the export structure sophistication for China. Comparing the two point estimates, however, one sees that the non-processing exports from the two high-tech zones in fact contribute more to raising export sophistication than the processing exports.

The share of processing exports outside any policy zones is positive and significant: the more processing trade outside any policy zones, the less sophisticated a city's exports becomes. Taking the discussion of the last three coefficients together, we might argue that the processing trade (outside the policy zones) is unlikely to have promoted resemblance of the Chinese export structure to that of the high-income countries. It is consistent with the intuition that processing trade in many areas of China except in these policy zones is relatively labor intensive in nature.

The coefficient on student enrollment in colleges or graduate schools as a share of a city's non-agricultural population - a proxy for a city's level of human capital - is negative and significant, consistent with the notion that a city with more skilled labor tends to have a more sophisticated export structure. In column 2 of Table 5, we use a city's per capita GDP as an alternative measure of its level of human capital. This variable also produces a negative coefficient, indicating an association between more human capital and more sophisticated export structure.

In columns 3-4 of Table 5, we include measures of the presence of foreign firms in a city. The estimated coefficient for the share of exports by wholly-owned foreign firms in a city's total exports is not significantly different from zero. Interestingly, the share of exports by joint venture firms has a positive coefficient: the more a city's exports come from joint-venture firms, the less the export structure resembles those of high income countries. These results suggest that foreign invested firms in China are not likely to be directly responsible for the rising sophistication of China's export structure, or at least not in a simple linear fashion (e.g., the more FDI, the more sophisticated the China's exports structure will be).

As we explained earlier, Columns 5-8 of Table 5 replicate the first four columns except that the left-hand-side variables are re-calibrated against the 2004 export structure of the G-3 economies. The qualitative results stay essentially the same. To summarize the key findings that emerge from the series of regressions in Table 5, we find:

(a) Cross-city differences in human capital are linked to cross-city differences in the sophistication level of the export structure. A higher level of human capital, measured either by per capita GDP or by college/graduate school enrollment, is associated with a more sophisticated export structure.

(b) The high-tech zones are associated with more sophisticated export structure. The higher the share of a city's exports coming out of high-tech zones, the more likely the city's export structure resembles that of the G-3 high income economies.

(c) The export processing zones (EPZs) contribute to the rising sophistication of the export structure. However, since only a small fraction of the cities have any EPZs, they play a very small quantitative role in explaining the cross-city differences in export structure sophistication.

(d) Processing trade generally is not a major factor in explaining cross-city differences in export structure sophistication. This can be seen in two ways. First, for exports outside any policy zones (which is the lion share of all exports), more processing trade is in fact associated with less resemblance to the export structure of the high-income countries. Second, for exports out of the high-tech zones, those products that are classified as processing trade do not appear to overlap more with high income countries' exports than non-processing trade.

(e) After controlling for exports from major policy zones, foreign investment does not appear to play a major role in explaining cross-city differences in the sophistication level of their export structures. If anything, joint venture firms may create some divergence between a city's export structure and that of high-income economies.

These findings reject the views that the rising sophistication of China's export structure is mostly generated by processing trade and/or foreign invested firms. At the same time, it confirms the importance of human capital and governmental policies in the establishment of the high-tech zones in promoting the rising sophistication of China's export structure.

3.2 Exports by Firms of Different Ownership

As China is still making the transition from a centrally planned system to a market based economy and has become very open to foreign direct investment (being the largest developing country host to FDI since 1995), its exports are primarily generated by state-owned firms and foreign-invested firms rather than domestic privately owned firms, accounting for 40% and 51% of China's total exports during our sample period, respectively (Table 2). It is useful to check for the determinants of export structure sophistication by firms of these ownership types.

Table 6 reports a series of regressions, with specifications identical to those in Table 5, of the export structure dissimilarity of state-owned firms on various determinants. The results are qualitatively very similar to those in Table 5. In particular, the differences in the degree of processing trade (outside policy zones) are not responsible for cross-city differences in export structure sophistication. If anything, processing trade outside any policy zones may have moderated any increase in export structure resemblance with those of the high income countries. More human capital as measured by either per capita GDP or college student enrollment is associated with an increased resemblance of SOE firms' export structure to that of the high-income countries.

Columns 3-4 and 7-8 of Table 6 can be interpreted as a test of possible spillover from foreign-invested firms to local SOEs in the same city[4]. The coefficients on either wholly foreign owned firms or joint ventures as a share of a city's total exports are essentially zero statistically. Therefore, the presence of foreign firms does not appear to affect whether SOEs' exports resemble that of the high income countries.

Tables 7 and 8 report similar regressions for wholly foreign owned and Sino-foreign joint venture firms, respectively. In contrast to the previous two tables, essentially no regressor except some proxy for human capital is statistically significant. This reinforces the conclusion reached earlier that foreign invested firms do not appear to be a significant part of the story about the rising sophistication of China's export structure during our sample period. The current tables suggest that this is true whether the foreign firms are located in EPZs, high-tech zones, or elsewhere. Unfortunately, data limitations prevent us from further examining whether FDIs from different source countries have played different roles in promoting the sophistication of China's export structure.[5]

For completeness, we also examine the dissimilarity in the export structures relative to the G-3 economies for collectively and privately owned firms, respectively. These results are reported in Tables 9 and 10. For each of them, a higher level of local human capital is associated with a greater resemblance of its export structure to those of the high income countries. For collectively owned firms (only), there is evidence that processing trade both inside and outside policy zones

[4] Hale and Long (2006) suggest that foreign firms in China generate technological spillover to local firms in part through re-employment of skilled labor from foreign-invested to local firms.

[5] Xu and Lu (2007) report some differences between firms from Hong Kong, Macao and Taiwan and those from other source countries.

may have slowed down the rise in the sophistication of these firms' export structures. This is consistent with the possibility that most of these collectively owned firms are in labor-intensive industries.

For domestic private firms (but not for collectively owned firms), the EPZs promote the export structure resemblance with the rich countries. However, as EPZs do not exist in most cities, one needs to bear this in mind in interpreting the results. In contrast to the SOEs, the presence of foreign wholly owned firms or joint venture firms in the same city does show some impact on the product sophistication of private firms' export structure, both coefficients are negative (and the one for wholly foreign owned firms is statistically significant). This provides suggestive evidence that the presence of foreign invested firms in the same city may have helped Chinese domestic private firms to increase their export structure sophistication over the sample period.

3.3 Unit Value

As the recent literature has emphasized the importance of specialization across varieties within a product (Schott, 2004), we now look at cross-city differences in the unit values of the same product, where a product is defined by a pair of HS 8-digit code and physical unit code. For example, HS "94053000" refers to "lighting sets used for Christmas trees", but there are two different physical units used to measure the quantities of exports of this product: number of items and kilogram. We will define (94053000, number of items) and (94503000, kilogram) as two products in our estimation.

The maintained assumption is that different unit values for the same product reflect different varieties (plus some noise). For example, both a high-end and a low-end digital camera go into the same HS 8-digit product classification, but the high-end variety would command a higher unit value. We note, however, that differences in the unit values within a 8-digit product category may also reflect factors other than different varieties such as the differences in production costs (see Hallack, 2006; and Hallack and Schott, 2006). We will assume that these factors generate noises in equating differences in unit values with differences in variety.

We now investigate the roles of processing trade, high-tech zones, and firm ownership in explaining the differences in unit value (differences in variety) within a product category. To fix the intuition, let us look at two examples first. Color video monitor (HS code 852821) was produced and exported in 2005 by both local and foreign-invested firms, located in export processing zones, high-tech zones, as well as outside any of the policy zones. The average unit value of the product by foreign invested firms was $241.50. Even when it is all exported by foreign invested firms in China, its unit value depends very much on where the producer was located and whether the export was processing or normal trade. The unit value was $347.80 for exports from an export processing zone, $456.70 for processing exports from a high-tech zone, but $364.80 for normal exports from the same zone, only $56.80 for processing exports from outside any policy zone, and $73.60 for normal trade outside any policy zone. Ownership also matters. The unit value was $207 when exported by a state-owned firm and only $77.2 by a domestic private firm. For comparison, the average unit value of the same product when exported by producers from the United States, European Union and Japan was $467.4 (based on the information from the WITS database). Generally speaking, the unit values of the Chinese

exports are lower than those from high-income countries. In this example, among the Chinese varieties, the one produced as processing export by a foreign firm located in a high-tech zone had the highest unit value, at roughly 98% of the value of the G-3 exports, suggesting that it may be a very close substitute for the variety by producers from the rich countries.

As another example, video camera (HS code 852540) was also produced and exported by firms of various ownership and located in areas with different policy incentives. The average unit value for exports by foreign invested firms was $51.50 in 2005, compared to $30.20 for the same product by state-owned firms. Both export type and firm location matter as well. Among the processing exports by foreign-invested firms, the unit value was $154.6 for exporters from a high-tech zone, $66.30 from outside any policy zone, and $51.50 from an export processing zone. For normal exports by a foreign firm, the unit value was $21.60 from a high-tech zone, and only $13.20 from outside any policy zone. Again, the processing exports out of a high-tech zone had the highest unit value, and normal exports outside any policy had the lowest value. Foreign firms generally had higher unit values than local firms. For comparison, the average unit value by exporters from the G-3 high income regions (the United States, Japan and the European Union) was $331.50. In this example, even the most pricy variety out of China (by foreign firms producing processing exports out of a high-tech zone) had a unit value that was only 47% of that of the G-3 exports. So the Chinese varieties are unlikely to be a close substitute for that of rich country producers.

While these examples are illustrative, we now turn to a regression framework in order to summarize the data pattern more efficiently and systematically. In addition, our regression framework accounts explicitly for differences in income level across regions but otherwise treat these noises in the error term of the regression. Let ln(Unit_Value $_{rkt}$) denote the natural logarithm of the unit value of city r's export of product k in year t. Our specification relates it to city_year fixed effects, product fixed effects, the share of export processing zones in the city's export of that product, the share of high-tech zones in that city's export of that product (separated by processing and non-processing as export structure regressions), the share of processing trade in the city's export of that product outside any policy zones, plus other control variables.

$$\begin{aligned} \mathrm{Ln}\,Unit\_Value_{rkt} &= \mathrm{city\_year\_fixed} + \mathrm{product\_fixed} \\ &+ \beta_1 \mathrm{EPZ\_share}_{\mathrm{rkt}} + \beta_2 \mathrm{High\_tech\_zone\_Processing\_Share}_{\mathrm{rkt}} \\ &+ \beta_3 \mathrm{Processing\_trade\_outside\_anyzone}_{\mathrm{rkt}} \\ &+ \beta_4 High\_tech\_zone\_nonprocessing\_share_{rkt} + \mathrm{other\_controls} + \mu_{rkt} \end{aligned} \tag{6}$$

Note that the city_year fixed effects are more general than either year fixed effects or city fixed effects. The regression results are reported in Table 11. In column 1, we can see that both export processing zones and high-tech zones are associated with higher unit values. Within the exports originated from the high-tech zones, the processing trade is linked to higher unit values than non-processing trade. A 10 percentage point increase in the share of the processing exports from a high-tech zone in a city's total exports is associated with a higher unit value by 5.9%, compared with 2.1% increase in the unit value for an increase of the same magnitude in the share of non-processing trade from high-tech zones. A 10 percentage point increase in the export share from EPZs in a city's total exports is associated with an increase in the unit value by 2.1%. As far as

unit value is concerned, there is no difference between exports from an export processing zone and non-processing exports from a high-tech zone. In comparison, a 10-percentage-points increase in the share of processing exports outside any policy zones is associated with 1.2% increase in the unit value. Overall, processing trade appears to be associated with higher-quality varieties than ordinary trade.

To investigate the role of foreign investment in quality upgrading within products, Column 2 of Table 11 includes the shares of wholly foreign owned and joint venture firms in a city's total exports by HS-8, respectively, as additional regressors. Both new regressors have positive and statistically significant coefficients. A 10-percentage-points increase in the share of exports by these two types of firms in a city's total exports of a product tends to be associated with an increase in the unit value of the given product by 2.0% and 2.2%, respectively. This suggests that products from foreign-invested firms are generally of higher quality as judged by their higher unit values.

It is interesting to observe that the share of EPZs is no longer statistically significant. The coefficients on the shares of processing and ordinary trade out of high-tech zones, and on the share of processing trade outside policy zones, while still positive and statistically significant, are now smaller in magnitude (by more than two standard deviations in two out of the three cases). This suggests that part of the higher-unit-value effect, previously attributed to processing trade and high-tech zones, is in fact due to the presence of foreign invested firms in these activities. As noted earlier (table 3b), more than 95% of exports from EPZs and processing trade in high-tech zones in the sample period were conducted by foreign invested firms.

Column 3 of Table 11 includes the combined share of collective and private firms in a city's total exports, and the share of state-owned firms as regressors (but leave out the shares by the two types of foreign-invested firms). Column 4 of Table 11 includes the two types of foreign-invested firms plus the combined share of the collective and domestic private firms (but leaves out the state-owned firms). The shares of exports by collective/domestic private firms and by state-owned firms have negative and statistically significant coefficients, indicating a large share of Chinese domestic firms in a city's exports is associated with a lower unit value of the city's exports. This confirms the intuition that foreign invested firms in China produces relatively higher quality varieties than Chinese domestic firms for the same HS-8 product exports.

Taking the unit value results together, we conclude that the processing trade (regardless of where it originates from), the high-tech zones, and foreign invested firms are all independently associated with higher unit values, suggesting that they all have played a role in leading China to produce and export higher-quality products that it otherwise would have.

4. Conclusion

Are China's exports competing increasingly head to head with those of high-income countries? This paper addresses this question by making use of variations in export sophistication across different cities in China. It looks at both the overlap in the product structure between a city's exports and that of the advanced economies, and the unit value of a given product.

The estimation shows that, for the country as a whole, China's export structure does increasingly resemble that of the advanced economies, and the unit values of its exports are also rising over time. If these patterns are generated entirely by the rising use of processing trade, then there may not be much genuine increase in the sophistication level of China exports. If there is increase in sophistication but the increment comes entirely from foreign-invested firms in China, then the economic profit associated with the improved sophistication accrues to foreign economies rather than to China. Of course, the increased sophistication can also come from an improved level of local human capital, or government policies such as high-tech policy zones set up specifically to promote the upgrading of the industrial structure. Regional variations in the use of processing trade, high-tech zones, and availability of skilled labor are used in this paper to assess the relative roles of these factors.

Econometric analysis conducted in this study provides the following statistical evidence on the relative importance of the three channels:

(1) Cross-city differences in human capital are linked to cross-city differences in the sophistication of export structure. A higher level of human capital is associated with more sophisticated export structure of the Chinese cities.

(2) High-tech zones are associated with both more sophisticated export structures and higher unit values. This means that the policy zones (especially ETDZs and HTIDZs) set up by the central and local governments may have worked to induce firms to upgrade their product ladder to a higher level than it otherwise would be. In other words, these policy zones not only promoted processing trade, but also promoted sophistication of China's exports.

(3) The export processing zones (EPZs) contribute to both a rising sophistication of export structure and a rising unit value. However, since only a tiny fraction of the cities have EPZs and most of its exports come from foreign invested firms, they do not contribute very much to explaining cross-city difference in export sophistication.

(4) Processing trade generally is not a major factor in explaining the cross-city differences in export structure sophistication. This can be seen in two ways. First, for exports outside any policy zones (which is the lion's share of China's total exports, about 42% during our sample period), more processing trade is in fact associated with less resemblance to the export structure of advanced countries. Second, for exports out of the high-tech zones, those products that are classified as processing trade do not appear to overlap more with advanced countries' exports than non-processing trade. However, processing trade is significantly associated with higher unit values. These seemingly contradictory findings could be easily reconciled intuitively. Because most processing exports produced outside the policy zones are labor intensive, a higher share will increase the dissimilarity of the export structure between the Chinese cities and G3 advanced economies in one hand, but it also increase the unit price of the same labor intensive products of processing exports relatively to the similar products in normal trade because of the use of imported high quality materials and technology(for example, shoes or shirts exported by a processing trade firm from a Chinese city will have a higher unit value of its exports than shoes or shirts exported by normal trade firms in the same Chinese city). Therefore, in general, processing trade has helped China to increase both its cross products and within product

sophistication in various policy zones, and also helped China's other regions increase unit value of their exports thus the within product sophistication, although it in the same time holds China's overall exports structure less sophisticate relative to the export structure of G3 advanced economies. However, there is also a possibility that processing exports' higher unit value may simply reflect the higher cost of imported inputs rather than domestically made varieties. This leaves open the question of whether processing exports could generate the same level of value added compared with normal exports that use more local/domestic inputs.

(5) The exports share of foreign invested firms in a Chinese city may not appear to play a major role in explaining cross-city differences in the sophistication level of their export structures. If anything we find, joint venture firms may create some divergence between a city's export structure and those of advanced economies. However, after controlling for processing trade, both types of foreign invested firms are found to be strongly associated with higher export unit values. Therefore, foreign investment is conducive to raising China's within product sophistication. While the limitation of our data (not able to identify the country source of FIEs) does not allow us to further evaluate the potential different roles of FDI from Western multi-nationals and from Asian countries in the sophistication of China's exports.

Proof of the linear mapping between the similarity and dissimilarity indexes (equation (4)):

Consider two economies, A and B, each having K sectors. Define A_k and B_k to be the share of sector k in the two economies' exports, respectively. The sum of A_k (or B_k) over k equals 100. Without a loss of generality, we can divide the K sectors into two subsets, N and M, where N+M = K. Let N be indexed by I, and M by j. Assuming for i € N, $A_i > B_i$, while for j € M, $A_j < B_j$.

$$EDI = \sum_k |A_k - B_k| = \sum_i (A_i - B_i) + \sum_i (B_j - A_j) = \sum_i A_i - \sum_j A_j + \sum_j B_j - \sum_i B_i$$

$$= 200 - 2\sum_j A_j - 2\sum_i B_i = 200 - 2(\sum_j A_j - \sum_i B_i) = 200 - 2ESI$$

$$\therefore \quad \sum_i A_i + \sum_j A_j = 100 \qquad \sum_j B_j + \sum_i B_i = 100$$

Therefore, $ESI = \frac{200 - EDI}{2} = \sum (A_j, B_i) = \sum_k Min(A_k, B_k)$

References

Amiti, Mary, and Caroline Freund, 2007, "An anatomy of China's trade," IMF working paper.

Finger, J. Michael, and M. E. Kreinin, 1979, "A measure of 'export similarity' and its possible uses," Economic Journal, 89: 905-912.

Hausmann, Ricardo, Jason Hwang, and Dani Rodrik, 2005, "What you export matters," NBER working paper 11905. Forthcoming, Journal of Economic Growth.

Fisman, Raymond, and Shang-Jin Wei, 2004, "Tax Rates and Tax Evasion: Evidence from 'Missing Trade' in China," Journal of Political Economy 112 (2): 471-496.

Fontagne, Lionel, Guillaume Gaulier, and Soledad Zignago, 2007, "Specialisation across varieties within products and North-South competition," CEPII Working Paper, No 2007-06, May.

Galina Hale & Cheryl Long, 2006. "What determines technological spillovers of foreign direct investment: evidence from China," Working Paper Series 2006-13, Federal Reserve Bank of San Francisco.

Hallack, Juan Carlos, 2006, "Product quality and the direction of trade," Journal of International Economics 68(1): 238-265.

Hallack, Juan Carlos, and Peter Schott, 2005, "Estimating cross-country differences in product quality," working paper, Yale University.

Hummels, David, and Peter Klenow, 2005, "The variety and quality of a nation's exports," American Economic Review, 95: 704-723.

Rodrik, Dani, 2006, "What's so special about China's exports?" NBER Working Paper 11947, forthcoming in China & World Economy.

Schott, Peter, 2004, "Across-product versus within-product specialization in international trade," Quarterly Journal of Economics, 119(2): 647-678.

Schott, Peter, 2006, "The relative sophistication of Chinese exports," NBER working paper 12173.

Xu, Bin, 2007, "Measuring China's export sophistication," China Europe International Business School.

Xu, Bin, and Jiangyong Lu, 2007, "The Impact of Foreign Firms on the Sophistication of Chinese Exports," working paper, China Europe International Business School and Tsinghua University.

Table 1. The Increasing Overlaps in the Export Structure: China Relative to the US, EU, and Japan (1996-2005). (The smaller the value, the greater the overlap)

Year	No. HS-6 digit Product Lines that the High-income Countries (G3) export (at least US$ 1 million) (1)	Of which China also exports (at least US$ 1 million) (2)	Fraction of the product lines that G-3 exports but China does not (3) = 1 – (2)/(3)	Export Dissimilarity Index (EDI)
1996	4,126	2,942	28.7	133.7
1997	4,123	3,042	26.2	132.5
1998	4,121	3,041	26.2	130.8
1999	4,120	3,024	26.6	129.2
2000	4,116	3,172	22.9	125.5
2001	4,118	3,184	22.7	124.8
2002	4,184	3,306	21.0	125.4
2003	4,182	3,408	18.5	126.1
2004	4,186	3,515	16.0	123.1
2005	4,179	3,609	13.6	121.5

Data source: Authors' computation based on trade statistics from China Customs Administration and G-3 data downloaded from the UN COMTRADE database. The EDI is computed based on Equation (2) explained in the text.

	Year-by-year benchmark			**2004 benchmark**		
Year	No. Products	Export Dissimilarity Index	Value share of product that G-3 exports but China does not as G-3 total exports	No. Products	Export Dissimilarity Index	Value share of product that G-3 exports but China does not as G-3 total exports
1996	4143	133.7	1.26	4213	141.6	5.68
1997	4143	132.5	1.27	4213	140.4	5.65
1998	4143	130.8	1.21	4213	138.9	5.73
1999	4143	129.2	0.92	4213	136.9	5.63
2000	4143	125.5	0.97	4213	133.0	5.95
2001	4143	124.8	0.95	4213	130.9	5.77
2002	4213	125.4	0.60	4213	128.7	0.60
2003	4213	126.1	0.60	4213	127.8	0.60
2004	4213	123.1	0.77	4213	123.1	0.77
2005	4212	121.5	0.80	4213	119.5	0.80

Data source: Authors computation based on official trade statistics from the China Customs Administration and G-3 data downloaded from WITS.

Table 2: Percentage Breakdown of China's Exports by Firm Ownership, 1995-2006 (%)

Year	SOE	Joint Venture	Wholly Foreign owned	Collective	Private
1995	66.7	19.8	11.7	1.5	0.0
1996	57.0	24.9	15.7	2.0	0.0
1997	56.2	23.9	17.1	2.5	0.0
1998	52.6	24.1	20.0	2.9	0.1
1999	50.5	23.2	22.2	3.5	0.3
2000	46.7	24.2	23.8	4.2	1.0
2001	42.6	24.1	25.9	5.3	2.0
2002	37.7	22.7	29.5	5.8	4.2
2003	31.5	21.5	33.3	5.7	7.9
2004	25.9	21.0	36.1	5.4	11.7
2005	22.2	19.9	38.4	4.8	14.7
2006	19.7	18.7	39.5	4.2	17.8
Average 1996-2004	39.8	22.7	27.8	4.7	4.9

Date source: Authors' computation based on official trade statistics from the China Custom Administration.

Table 3a: Share of processing trade and policy zones in China's total exports, 1996-2005 (%

Year	Special Economic Zones	Exports Processing Zones	Processing exports in High-tech Zones	Normal exports in High-tech Zones	Processing Exports Outside Policy Zones	Normal Exports Outside Policy Zones	All Other Exports[a]
1995	10.6	0	3.2	2.1	39.8	42.1	2.2
1996	8.7	0	3.9	1.8	45.2	38.3	2.0
1997	8.8	0	4.6	1.7	43.9	39.0	1.9
1998	8.2	0	5.5	1.9	45.5	36.9	1.9
1999	7.0	0	6.4	2.2	45.5	37.0	1.9
2000	7.1	0	7.0	2.6	43.3	38.2	1.8
2001	6.8	0.1	7.4	2.8	43.0	38.0	1.9
2002	6.2	0.7	8.0	3.0	42.2	37.6	2.3
2003	5.3	2.4	9.5	3.4	39.6	37.1	2.7
2004	4.4	3.6	11.0	3.6	37.7	36.4	3.2
2005	4.3	4.6	11.8	3.6	35.6	36.8	3.5
1996-2004 average	6.3	1.3	8.0	2.8	41.7	37.4	2.4

Table 3b: Firm Structure of Table 3a (%)

	Special Economic Zones	Exports Processing Zones	Processing exports in High-tech Zones	Normal exports in High-tech Zones	Processing Exports Outside Policy Zones	Normal Exports Outside Policy Zones	All Other Exports[a]
1996-2004 average							
State Owned	23.7	0.0	4.8	58.3	28.3	62.5	44.3
Joint Venture	34.3	3.4	33.4	16.9	29.2	13.1	13.0
Wholly Foreign	36.3	96.0	61.5	16.3	38.0	6.6	24.0
Collective	1.7	0.6	0.3	1.4	3.1	8.2	4.6
Private	3.8	0.0	0.1	7.1	1.5	9.5	10.4
Total	99.9	100.0	100.0	100.0	100.0	100.0	96.3
1996							
State Owned	29.4		15.6	79.7	40.5	85.7	63.0
Joint Venture	39.5		37.8	13.3	35.2	9.4	10.3
Wholly Foreign	30.0		46.2	6.2	22.4	2.2	11.3
Collective	0.9		0.4	0.9	1.9	2.6	3.4
Private	0.0		0.0	0.0	0.0	0.0	0.2
Total	99.8		100.0	100.0	100.0	100.0	88.2
2004							
State Owned	20.5	0.0	2.5	44.0	18.3	41.8	30.3
Joint Venture	30.5	3.0	27.2	16.4	26.3	15.0	15.5
Wholly Foreign	37.9	96.5	69.8	23.2	47.9	9.4	29.8
Collective	2.2	0.4	0.2	1.4	3.4	10.3	4.0
Private	9.0	0.0	0.3	15.1	4.0	23.5	19.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	99.4

Date source: Authors computed based on official trade statistics from China Custom Administration.
Note: [a] It includes International aid, Compensation trade Goods on Consignment, Border trade Goods for foreign contracted project, goods on lease, outward processing, barter trade, warehouse trade, and entrepot trade by bonded area.

Table 4a: Summary Statistics for City-level Variables

	N	Mean	Median	Std Dev	MIN	MAX
City per capita GDP (in log)	1981	8.97	8.89	0.63	7.23	11.48
City GDP (in log)	1981	14.74	14.71	0.96	11.16	18.13
Student Enrollment in Colleges and Universities as a Share of Non-Agricultural Population	1986	0.016	0.009	0.019	0.000	0.155

Table 4b Summary Statistics: Other Key Variables in Regression Analysis

	Export Dissimilarity Index (in log)	Share of processing exports outside policy zones	Share of processing exports in the two High-tech Zones	Share of non-processing exports in Two High-tech Zones	Share of Export Processing Zone
All Firms					
N	1986	1986	1986	1986	1986
Mean	5.24	0.259	0.0144	0.0068	0.0004
Median	5.26	0.196	0.0000	0.0000	0.0000
Std Dev	0.07	0.233	0.0594	0.0253	0.0057
MIN	4.84	0.000	0.0000	0.0000	0.0000
MAX	5.30	0.996	0.5940	0.4206	0.1534
State-owned Firms					
N	1981	1981	1981	1981	1981
Mean	5.24	0.168	0.0016	0.0058	0.0000
Median	5.27	0.103	0.0000	0.0000	0.0000
Std Dev	0.06	0.200	0.0105	0.0327	0.0000
MIN	4.92	0.000	0.0000	0.0000	0.0000
MAX	5.30	0.990	0.1822	0.5102	0.0013
Joint Venture Firms					
N	1835	1835	1835	1835	1835
Mean	5.27	0.430	0.0263	0.0143	0.0004
Median	5.28	0.418	0.0000	0.0000	0.0000
Std Dev	0.04	0.321	0.0875	0.0663	0.0083
MIN	4.95	0.000	0.0000	0.0000	0.0000
MAX	5.30	1.000	0.6985	0.9543	0.3256
Wholly Foreign-owned Firms					
N	1552	1552	1552	1552	1552
Mean	5.27	0.417	0.0448	0.0132	0.0019
Median	5.29	0.378	0.0000	0.0000	0.0000
Std Dev	0.04	0.355	0.1433	0.0481	0.0214
MIN	4.99	0.000	0.0000	0.0000	0.0000
MAX	5.30	1.000	0.9470	0.9898	0.5395
Collectively-owned Firms					
N	1640	1640	1640	1640	1640
Mean	5.28	0.117	0.0021	0.0037	0.0010
Median	5.29	0.001	0.0000	0.0000	0.0000
Std Dev	0.03	0.203	0.0218	0.0228	0.0216
MIN	5.10	0.000	0.0000	0.0000	0.0000
MAX	5.30	1.000	0.5497	0.3115	0.5919
Private Firms					
N	1264	1264	1264	1264	1264
Mean	5.27	0.055	0.0025	0.0143	0.0000
Median	5.29	0.000	0.0000	0.0000	0.0000
Std Dev	0.04	0.141	0.0378	0.0692	0.0002
MIN	4.96	0.000	0.0000	0.0000	0.0000
MAX	5.30	1.000	1.0000	1.0000	0.0051

Table 5: What Explains Cross-city Export Structure? Export Structure Dissimilarity between Chinese Cities (All Firms) and the G-3

	Year-by-year benchmark				2004 benchmark			
Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Export Processing Zone Exports as a Share of Total City Exports	-0.351***	-0.382***	-0.350***	-0.384***	-0.552***	-0.594***	-0.544***	-0.591***
	(0.074)	(0.055)	(0.071)	(0.053)	(0.116)	(0.087)	(0.111)	(0.084)
Processing exports in High-tech Zones as a Share of Total City Exports	-0.065***	-0.070***	-0.067***	-0.073***	-0.083***	-0.089***	-0.082***	-0.090***
	(0.018)	(0.020)	(0.018)	(0.020)	(0.020)	(0.023)	(0.020)	(0.023)
Non-processing exports in High-tech Zones as a Share of Total City Exports	-0.087*	-0.108**	-0.093**	-0.115**	-0.087*	-0.116*	-0.092*	-0.122**
	(0.045)	(0.053)	(0.044)	(0.053)	(0.049)	(0.061)	(0.049)	(0.061)
Processing exports outside economic zones as a Share of Total City Exports	0.005*	0.004	0.004	0.002	0.006*	0.004	0.005*	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Student Enrollment in Institutions of Higher Education as a Share of the City Non-Agricultural Population	-0.225***		-0.229***		-0.309***		-0.315***	
	(0.066)		(0.066)		(0.073)		(0.072)	
City per capita GDP		-0.006**		-0.007***		-0.010***		-0.010***
		(0.002)		(0.003)		(0.003)		(0.003)
City Gross Domestic Product (GDP)	-0.003**	-0.003**	-0.003**	-0.003**	-0.003*	-0.003*	-0.003**	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Foreign-invested firms' share in city exports			0.001	0.004			-0.004	-0.000
			(0.006)	(0.006)			(0.006)	(0.007)
Joint venture firms' share in city exports			0.010***	0.010***			0.009**	0.009**
			(0.004)	(0.004)			(0.004)	(0.004)
City Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Robust, Cluster(city)	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1981	1981	1981	1981	1981	1981	1981	1981
R-squared	0.98	0.98	0.98	0.98	0.98	0.97	0.98	0.97

Note: Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: State-owned Firms' Export Structure Dissimilarity Relative to the G-3

	Year-by-year benchmark				2004 benchmark			
Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Export Processing Zone Exports as a Share of Total City Exports	-11.88***	-13.21***	-12.16***	-13.49***	-18.84***	-20.83***	-18.97***	-20.96***
	(4.040)	(4.427)	(4.016)	(4.411)	(5.449)	(6.099)	(5.431)	(6.089)
Processing exports in High-tech Zones as a Share of Total City Exports	-0.010	-0.023	-0.013	-0.027	-0.023	-0.044	-0.025	-0.045
	(0.074)	(0.073)	(0.074)	(0.074)	(0.093)	(0.091)	(0.092)	(0.091)
Non-processing exports in High-tech Zones as a Share of Total City Exports	-0.123**	-0.136**	-0.124**	-0.138**	-0.151**	-0.171**	-0.150**	-0.170**
	(0.052)	(0.053)	(0.053)	(0.055)	(0.066)	(0.067)	(0.065)	(0.067)
Processing exports outside economic zones as a Share of Total City Exports	0.007***	0.006**	0.007***	0.007**	0.007***	0.007**	0.008***	0.007**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Student Enrollment in Institutions of Higher Education as a Share of the City Non-Agricultural Population	-0.166**		-0.170**		-0.255***		-0.258***	
	(0.069)		(0.068)		(0.075)		(0.074)	
City per capita GDP		-0.005**		-0.005**		-0.008***		-0.008***
		(0.002)		(0.002)		(0.003)		(0.003)
City Gross Domestic Product (GDP)	-0.002*	-0.003*	-0.003*	-0.003*	-0.003*	-0.003*	-0.003*	-0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Foreign-invested firms share in city exports			0.001	0.002			-0.003	-0.002
			(0.007)	(0.007)			(0.007)	(0.007)
Joint venture firms share in city exports			0.006	0.005			0.004	0.003
			(0.005)	(0.005)			(0.005)	(0.005)
	(0.023)	(0.035)	(0.023)	(0.036)	(0.023)	(0.043)	(0.023)	(0.044)
City Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Robust, Cluster(city)	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1976	1976	1976	1976	1976	1976	1976	1976
R-squared	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Wholly Foreign-owned Firms' Export Structure Dissimilarity Relative to the G-3

	Moving benchmarks		2004 Benchmark	
Explanatory Variables	(1)	(2)	(3)	(4)
Export Processing Zone Exports as a Share of Total City Exports	-0.095	-0.097*	-0.112	-0.115
	(0.059)	(0.057)	(0.073)	(0.071)
Processing exports in High-tech Zones as a Share of Total City Exports	-0.017	-0.016	-0.024*	-0.022
	(0.012)	(0.012)	(0.014)	(0.014)
Non-processing exports in High-tech Zones as a Share of Total City Exports	-0.013	-0.013	-0.019	-0.019
	(0.011)	(0.011)	(0.014)	(0.014)
Processing exports outside economic zones as a Share of Total City Exports	-0.001	-0.001	-0.007	-0.007
	(0.001)	(0.001)	(0.008)	(0.008)
Student Enrollment in Institutions of Higher Education as a Share of the City Non-Agricultural Population	-0.078		-0.080	
	(0.063)		(0.074)	
City per capita GDP		-0.012**		-0.012**
		(0.005)		(0.006)
City Gross Domestic Product (GDP)	-0.005*	-0.003	-0.005	-0.003
	(0.003)	(0.003)	(0.004)	(0.003)
City Fixed Effects	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y
Robust, Cluster(city)	Y	Y	Y	Y
Observations	1548	1548	1548	1548
R-squared	0.95	0.95	0.81	0.81

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Joint Ventures' Exports Structure Dissimilarity Relative to the G-3

	Year-by-year benchmark		2004 benchmark	
Explanatory Variables	(1)	(2)	(3)	(4)
Export Processing Zone Exports as a Share of Total City Exports	0.013	-0.002	0.000	-0.016
	(0.027)	(0.030)	(0.033)	(0.036)
Processing exports in High-tech Zones as a Share of Total City Exports	-0.005	-0.006	-0.014	-0.015*
	(0.010)	(0.009)	(0.009)	(0.009)
Non-processing exports in High-tech Zones as a Share of Total City Exports	0.001	-0.000	0.001	0.001
	(0.010)	(0.009)	(0.008)	(0.008)
Processing exports outside economic zones as a Share of Total City Exports	0.001	0.000	0.003*	0.002
	(0.001)	(0.001)	(0.002)	(0.001)
Student Enrollment in Institutions of Higher Education as a Share of the City Non-Agricultural Population	-0.094**		-0.104**	
	(0.039)		(0.035)	
City per capita GDP		-0.004*		-0.005**
		(0.002)		(0.002)
City Gross Domestic Product (GDP)	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
City Fixed Effects	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y
Robust, Cluster(city)	Y	Y	Y	Y
Observations	1831	1831	1831	1831
R-squared	0.97	0.97	0.96	0.96

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 9: Collectively-owned Firms' Export Structure Dissimilarity Relative to the G-3

	Year-by-year benchmark				2004 benchmark			
Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Export Processing Zone Exports as a Share of Total City Exports	0.003	-0.005	0.002	-0.006	-0.003	-0.010	-0.004	-0.011
	(0.005)	(0.007)	(0.005)	(0.007)	(0.006)	(0.007)	(0.005)	(0.007)
Processing exports in High-tech Zones as a Share of Total City Exports	0.028**	0.020	0.028**	0.019	0.029**	0.020*	0.028**	0.020
	(0.012)	(0.013)	(0.012)	(0.013)	(0.011)	(0.012)	(0.011)	(0.012)
Non-processing exports in High-tech Zones as a Share of Total City Exports	-0.070**	-0.089**	-0.071**	-0.089**	-0.066**	-0.084**	-0.066**	-0.084**
	(0.029)	(0.036)	(0.029)	(0.036)	(0.028)	(0.034)	(0.029)	(0.035)
Processing exports outside economic zones as a Share of Total City Exports	0.009***	0.008**	0.009***	0.007**	0.010***	0.008***	0.009***	0.008***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Student Enrollment in Institutions of Higher Education as a Share of the City Non-Agricultural Population	-0.38***		-0.39***		-0.38***		-0.38***	
	(0.075)		(0.075)		(0.078)		(0.078)	
Chinese city per capita GDP		-0.016**		-0.016**		-0.016**		-0.016**
		(0.005)		(0.005)		(0.005)		(0.005)
Chinese city Gross Domestic Product (GDP)	-0.004	-0.005*	-0.004	-0.005*	-0.004	-0.006*	-0.004	-0.006*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
FIE firms' share in city exports			-0.010	-0.011			-0.013	-0.013
			(0.008)	(0.009)			(0.008)	(0.009)
Joint venture firms' share in city exports			0.004	0.001			0.003	-0.000
			(0.005)	(0.006)			(0.005)	(0.006)
City Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Robust, Cluster(city)	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1636	1636	1636	1636	1636	1636	1636	1636
R-squared	0.89	0.87	0.89	0.88	0.87	0.86	0.87	0.86

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 10: Private Firms' Export Structure Dissimilarity Relative to the G-3

	Year-by-year benchmark				2004 benchmark			
Explanatory Variables	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Export Processing Zone Exports as a Share of Total City Exports	-14.28***	-15.86***	-14.02***	-15.51***	-14.97***	-16.68***	-14.44***	-16.00***
	(3.640)	(3.825)	(3.589)	(3.896)	(3.778)	(4.016)	(3.782)	(4.224)
Processing exports in High-tech Zones as a Share of Total City Exports	-0.006	-0.012	-0.003	-0.009	-0.005	-0.010	0.002	-0.003
	(0.014)	(0.015)	(0.014)	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)
Non-processing exports in High-tech Zones as a Share of Total City Exports	-0.100	-0.109	-0.094	-0.103	-0.096	-0.105	-0.085	-0.093
	(0.072)	(0.070)	(0.066)	(0.064)	(0.072)	(0.070)	(0.061)	(0.059)
Processing exports outside economic zones as a Share of Total City Exports	0.007	0.008	0.008	0.008	0.010	0.010	0.010	0.010*
	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.006)
Student Enrollment in Institutions of Higher Education as a Share of the City Non-Agricultural Population	-0.655***		-0.645***		-0.660***		-0.639***	
	(0.181)		(0.170)		(0.186)		(0.166)	
City per capita GDP		-0.048**		-0.050***		-0.040**		-0.043**
		(0.020)		(0.019)		(0.020)		(0.018)
City Gross Domestic Product (GDP)	-0.019	-0.024**	-0.021	-0.025**	-0.014	-0.020*	-0.017	-0.022**
	(0.015)	(0.010)	(0.015)	(0.010)	(0.014)	(0.011)	(0.013)	(0.010)
FIE firm export share			-0.086***	-0.091***			-0.179**	-0.184**
			(0.031)	(0.030)			(0.086)	(0.087)
Joint venture firm exports share			-0.003	-0.009			-0.009	-0.015
			(0.015)	(0.015)			(0.018)	(0.018)
City Fixed Effects	Y	Y	Y	Y	Y	Y	Y	y
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	y
Robust, Cluster(city)	Y	Y	Y	Y	Y	Y	Y	y
Observations	1262	1262	1262	1262	1262	1262	1262	1262
R-squared	0.75	0.74	0.76	0.76	0.63	0.62	0.68	0.67

Note: Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 11: What Explains the Cross City Difference in the Unit Values of Exports?

Explanatory Variables	(1)	(2)	(3)	(4)
Export Processing Zone Exports as a Share of Total City Exports	0.209**	0.068	0.050	0.064
	(0.058)	(0.058)	(0.058)	(0.058)
Processing exports in High-tech Zones as a Share of Total City Exports	0.589**	0.429**	0.428**	0.434**
	(0.012)	(0.013)	(0.013)	(0.013)
Non-processing exports in High-tech Zones as a Share of Total City Exports	0.206**	0.171**	0.172**	0.173**
	(0.008)	(0.008)	(0.008)	(0.008)
Processing exports outside economic zones as a Share of Total City Exports	0.119**	0.117**	0.117**	0.119**
	(0.004)	(0.005)	(0.005)	(0.005)
FIE firm export share		0.198**		0.179**
		(0.005)		(0.005)
Joint venture firm exports share		0.222**		0.207**
		(0.004)		(0.004)
Collective and Private firm export share			-0.290**	-0.094**
			(0.005)	(0.004)
SOE firm export share			-0.196**	
			(0.004)	
Product Fixed Effects	Yes	Yes	Yes	Yes
City_Year Fixed Effects	Yes	Yes	Yes	Yes
Number of Unique Cities	238	238	238	238
Number of Unique products	6,473	6,473	6,473	6,473
Observations	1,256,999	1,256,999	1,256,999	1,256,999
Adjusted R square	0.794	0.794	0.794	0.794

Notes: The dependent variable = natural log of Unit Value of HS 6-digit product, 1996 to 2004. The regressions include city_year fixed effects and product fixed effects. Standard errors are in parentheses. ** and * indicate statistically significant at the 1% and 5% levels, respectively.

Appendix Table 1. Definition of Key Variables and their data sources

Dependent variables	Description	Data Sources
$EDI_{rft} = (\sum_i abs(s_{irft} - s_{i,t}^{ref}))$	Absolute export structure dissimilarity index	Calculated by the authors from 6 digit HS level. Chinese City exports based on official China Custom Statistics. Data on US, EU15 and Japan exports download from WITS
Explanatory variables		
GDP_{rt}	City Gross Domestic Product (10,000 yuan)	China City data, China data online
$PCGDP_{rt} = 100\ GDP_r / POP_r$	Chinese city per capita GDP (yuan)	China City data, China data online
$SKILL_{rt}$ = 100 (No. of College Students)rt /(non-agricultural population)$_{rt}$	Student Enrollment in Institutions of Higher Education as a Share of the City Non-Agricultural Population	China City data, China data online
EPZ_share_{rft}	Export Processing Zone Exports as a Share of Total City Exports	China Custom Statistics.
$High\_tech\_zone\_processing\_share_{rft}$	Processing exports in the two High-tech Zones as a Share of Total City Exports	China Custom Statistics
$High\_tech\_zone\_nonprocessing\_share_{rft}$	Non-processing exports in the two High-tech Zones as a Share of Total City Exports	China Custom Statistics
$Processing\_outside\_anyzone\_share_{rft}$	Processing exports outside policy zones as a Share of Total City Exports	China Custom Statistics
$Expfiesh_{rft}$	FIE firm exports as share of Total City Exports	China Custom Statistics.
$Expjonsh_{rft}$	Joint venture firm exports as Share of Total City Exports	China Custom Statistics
$expothsh_{rft}$	Collective and Private firm exports as Share of Total City Exports	China Custom Statistics
$expsoesh_{rft}$	SOE firm exports as Share of Total City Exports	China Custom Statistics

Appendix Table 2. Starting Years of Various Economic Zones with Policy Incentives

City Code	City Name	Special Economic Zone	Economic & Technological Development Area	Hi-Technology Industry Development Area	Export Processing Zone
1100	Beijing CY		1996	1996	2001
1200	Tianjin CY		1996	1996	2001
1301	Shijiazhuang			1996	
1303	Qinhuangdao		1996		2005
1306	Baoding			1996	
1401	Taiyuan		2003	1996	
1502	Baotou			1997	
2101	Shenyang		1996	1996	
2102	Dalian		1996	1996	2001
2103	Anshan			1996	
2201	Changchun		1996	1996	
2202	Jilin			1996	
2301	Harbin		1996	1996	
2306	Daqing			1996	
3100	Shanghai CY		1996	1996	2001
3201	Nanjing			1996	2004
3202	Wuxi			1997	2003
3204	Changzhou			1997	
3205	Suzhou		1996	1997	2001
3206	Nantong		1996		2003
3207	Lianyungang		1996		2004
3211	Zhenjiang				2004
3301	Hangzhou		1996	1996	2001
3302	Ningbo		1996		2004
3303	Wenzhou		1996		
3401	Hefei		2005	1996	
3402	Wuhu		1996		2003
3501	Fuzhou		1996	1996	
3502	Xiamen	1995		1996	2002
3601	Nanchang			1996	
3701	Jinan			1996	
3702	Qingdao		1996	1997	2004
3703	Zibo			1999	
3706	Yantai		1996		2001
3707	Weifang			1996	
3710	Weihai			1996	2001
4101	Zhengzhou			1996	2005
4103	Luoyang			1997	

4201	Wuhan		1996	1996	2001
4206	Xiangfan			1997	
4301	Changsha			1996	
4302	Zhuzhou			2000	
4401	Guangzhou		1996	1996	2001
4403	Shenzhen	1995		1996	2002
4404	Zhuhai	1995		1996	
4405	Shantou	1995			
4406	Foshan			1998	
4408	Zhanjiang		1996		
4413	Huizhou			1996	
4420	Zhongshan			1996	
4501	Nanning			1996	
4503	Guilin			1996	
4505	Beihai				2005
4601	Haikou	1995		1996	
4602	Sanya	1995			
5000	Chongqing		2002	2002	2002
5101	Chengdu		2001	1996	2001
5107	Mianyan			1996	
5201	Guiyang			1996	
5301	Kunming			1996	
6101	Xi'an			1996	2004
6103	Baoji			1997	
6104	Xianyang			2002	
6201	Lanzhou			1996	
6301	Xining		2005		
6501	Urumqi		1996	1997	

Note: Cities that do not have any of the policy zones during 1996-2005 are not on the list.

Apendex Table 3. Chinese Cities Included the Sample used in regressions (238 Total)

Code	City Name	Province	Code	City Name	Province	Code	City Name	Province
1100	BeijingCY	Beijing CY	3404	Huainan	Anhui	4313	Huaihua	Hunan
1200	TianjinCY	Tianjin CY	3405	Maanshang	Anhui	4401	Guangzhou	Guangdong
1301	Shijiazhuang	Hebei	3406	Huaibei	Anhui	4402	Shaoguan	Guangdong
1302	Tangshan	Hebei	3407	Tongling	Anhui	4403	Shenzhen	Guangdong
1303	Qinhuangdao	Hebei	3408	Anqing	Anhui	4404	Zhuhai	Guangdong
1304	Handan	Hebei	3409	Huangshan	Anhui	4405	Shantou	Guangdong
1305	Xingtai	Hebei	3410	Fuyang	Anhui	4406	Foshan	Guangdong
1306	Baoding	Hebei	3411	Suxian	Anhui	4407	Jiangmen	Guangdong
1307	Zhangjiakou	Hebei	3412	Chuxian	Anhui	4408	Zhanjiang	Guangdong
1308	Chongde	Hebei	3413	Liuan	Anhui	4409	Maoming	Guangdong
1309	Changzhou	Hebei	3414	Xuancheng	Anhui	4412	Zhaoqing	Guangdong
1310	Langfang	Hebei	3415	Chaohu	Anhui	4413	Huizhou	Guangdong
1401	Taiyuan	Shanxi	3416	Chizhou	Anhui	4414	Meizhou	Guangdong
1402	Datong	Shanxi	3502	Xiamen	Fujian	4415	Shanwei	Guangdong
1403	Yangquan	Shanxi	3503	Putian	Fujian	4416	Heyuan	Guangdong
1404	Changzhi	Shanxi	3504	Sanming	Fujian	4417	Yangjiang	Guangdong
1405	Jincheng	Shanxi	3505	Quanzhou	Fujian	4418	Qingyuan	Guangdong
1406	Suozhou	Shanxi	3506	Zhangzhou	Fujian	4419	Dongguan	Guangdong
1410	Jinzhong	Shanxi	3507	Nanpin	Fujian	4420	Zhongshan	Guangdong
1501	Hohhot	Inner Mongolia AR	3509	Longyian	Fujian	4421	Chaozhou	Guangdong
1502	Baotou	Inner Mongolia AR	3601	Nanchang	Jiangxi	4424	Jieyang	Guangdong
1503	Wuhai	Inner Mongolia AR	3602	Jingdezhen	Jiangxi	4501	Nanning	Guangxi Zhuan AR
1504	Chifeng	Inner Mongolia AR	3603	Pingxiang	Jiangxi	4502	Liuzhou	Guangxi Zhuan AR
1507	Holunbeir	Inner Mongolia AR	3604	Jiujiang	Jiangxi	4503	Guilin	Guangxi Zhuan AR
2101	Shenyang	Liaoning	3605	Xingyu	Jiangxi	4504	Wuzhou	Guangxi Zhuan AR
2102	Dalian	Liaoning	3606	Yingtan	Jiangxi	4505	Beihai	Guangxi Zhuan AR
2103	Anshan	Liaoning	3607	Ganzhou	Jiangxi	4507	Baise	Guangxi Zhuan AR
2104	Fushen	Liaoning	3611	Fuzhou	Jiangxi	4508	Hechi	Guangxi Zhuan AR
2105	Benxi	Liaoning	3701	Jinan	Shandong	4509	Qinzhou	Guangxi Zhuan AR
2106	Dandong	Liaoning	3702	Qingdao	Shandong	4516	Hezhou Area	Guangxi Zhuan AR
2107	Jinzhou	Liaoning	3703	Zibo	Shandong	4601	Haikou	Hainan
2108	Yingkou	Liaoning	3704	Zaozhuang	Shandong	4602	Sanya	Hainan
2109	Fuxin	Liaoning	3705	Dongying	Shandong	5000	Chongqing	Chongqing
2110	Liaoyang	Liaoning	3706	Yantai	Shandong	5101	Chengdu	Sichuan
2111	Panjin	Liaoning	3707	Weifang	Shandong	5103	Zigong	Sichuan
2112	Tieling	Liaoning	3708	Jining	Shandong	5104	Panzhihua	Sichuan
2113	Chaoyang	Liaoning	3709	Taian	Shandong	5105	Luzhou	Sichuan
2201	Changchun	JiLin	3710	Weihai	Shandong	5106	Deyang	Sichuan
2202	Jilin	JiLin	3711	Rizhao	Shandong	5107	Mianyan	Sichuan
2203	Sipin	JiLin	3713	Dezhou	Shandong	5108	Guangyuan	Sichuan

2204	Liaoyuan	JiLin	3714	Liaochen	Shandong	5109	Suining	Sichuan
2205	Tonghua	JiLin	3715	Linyi	Shandong	5110	Neijiang	Sichuan
2209	Baicheng	JiLin	3720	Laiwu	Shandong	5111	Leshan	Sichuan
2301	Harbin	Heilongjing	4101	Zhengzhou	Henan	5114	Yibin	Sichuan
2302	Qiqihar	Heilongjing	4102	Kaifeng	Henan	5115	Nanchong	Sichuan
2303	Jixi	Heilongjing	4103	Luoyang	Henan	5116	Daxian	Sichuan
2304	Hegang	Heilongjing	4104	Pindinshan	Henan	5201	Guiyang	Guizhou
2305	Shuangyashan	Heilongjing	4105	Anyang	Henan	5202	Liupanshan	Guizhou
2306	Daqing	Heilongjing	4106	Hebi	Henan	5203	Zunyi	Guizhou
2307	Yichun	Heilongjing	4107	Xinxiang	Henan	5301	Kunming	Yunnan
2308	Jiamusi	Heilongjing	4108	Jiaozhuo	Henan	5303	Zhaotong	Yunnan
2309	Qitaiher	Heilongjing	4109	Puyang	Henan	5304	Qujing	Yunnan
2310	Mudanjiang	Heilongjing	4110	Xuchang	Henan	5306	Yuxi	Yunnan
2311	Heihe	Heilongjing	4111	Luohe	Henan	5314	Lijiang	Yunnan
3100	ShanghaiCY	Shanghai CY	4112	Sanmenxia	Henan	6101	Xi'an	Shanxi
3201	Nanjing	Jiangsu	4113	Shangqiu	Henan	6102	Tongzhou	Shanxi
3202	Wuxi	Jiangsu	4116	Nanyang	Henan	6103	Baoji	Shanxi
3203	Xuzhou	Jiangsu	4117	Xinyang	Henan	6104	Xianyang	Shanxi
3204	Changzhou	Jiangsu	4201	Wuhan	Hubei	6105	Weinan	Shanxi
3206	Nantong	Jiangsu	4202	Huangshi	Hubei	6106	Hanzhong	Shanxi
3207	Lianyungang	Jiangsu	4203	Shiyan	Hubei	6108	Shangluo	Shanxi
3208	Huaiyin	Jiangsu	4205	Yichang	Hubei	6109	Yanan	Shanxi
3209	Yancheng	Jiangsu	4206	Xiangfan	Hubei	6110	Yulin	Shanxi
3210	Yangzhou	Jiangsu	4207	Ezhou	Hubei	6201	Lanzhou	Gansu
3211	Zhenjiang	Jiangsu	4208	Jingmen	Hubei	6202	Jiayuguan	Gansu
3217	Suqian	Jiangsu	4209	Huanggang	Hubei	6203	Jinchang	Gansu
3301	Hangzhou	Zhejiang	4210	Xiaogan	Hubei	6204	Baiyin	Gansu
3302	Ningbo	Zhejiang	4211	Xianning	Hubei	6205	Tianshiu	Gansu
3303	Wenzhou	Zhejiang	4212	Jingzhou	Hubei	6206	Jiuquan	Gansu
3304	Jiaxing	Zhejiang	4301	Changsha	Hunan	6207	Zhangye	Gansu
3305	Huzhou	Zhejiang	4302	Zhuzhou	Hunan	6208	Wuwei	Gansu
3306	Shaoxing	Zhejiang	4303	Xiangtan	Hunan	6211	Pinliang	Gansu
3307	Jinhua	Zhejiang	4304	Hengyang	Hunan	6212	Qingyang	Gansu
3308	Quzhou	Zhejiang	4305	Shaoyang	Hunan	6301	Xining	Qinghai
3309	Zhoushan	Zhejiang	4306	Yueyang	Hunan	6401	Yinchuan	Ningxia Hui AR
3311	Taizhou	Zhejiang	4307	Changde	Hunan	6402	Shizuishan	Ningxia Hui AR
3401	Hefei	Anhui	4309	Yiyang	Hunan	6501	Urumqi	Xinjiang AR
3402	Wuhu	Anhui	4310	Loudi	Hunan	6502	Kelamayi	Xinjiang AR
3403	Bangbu	Anhui	4311	Chenzhou	Hunan			

Appendix Table 4. HS Products Excluded from the Export Data

HS Code	Description	HS Code	Description
01-24	Agricultural products	25-27	Mineral products
4103	Other raw hides and skins (fresh, o	8002	Tin waste and scrap.
4104	Tanned or crust hides and skins of	8101	Tungsten (wolfram) and articles the
4105	Tanned or crust skins of sheep or l	8102	Molybdenum and articles thereof, in
4106	Tanned or crust hides and skins of	8103	Tantalum and articles thereof, incl
4402	Wood charcoal (including shell or n	8104	Magnesium and articles thereof, inc
4403	Wood in the rough, whether or not s	8105	Cobalt mattes and other intermediat
7201	Pig iron and spiegeleisen in pigs,	8106	Bismuth and articles thereof, inclu
7202	Ferro-alloys.	8107	Cadmium and articles thereof, inclu
7204	Ferrous waste and scrap; remelting	8108	Titanium and articles thereof, incl
7404	Copper waste and scrap.	8109	Zirconium and articles thereof, inc
7501	Nickel mattes, nickel oxide sinters	8110	Antimony and articles thereof, incl
7502	Unwrought nickel.	8111	Manganese and articles thereof, inc
7503	Nickel waste and scrap.	8112	Beryllium, chromium, germanium, van
7601	Unwrought aluminium.	8113	Cermets and articles thereof, inclu
7602	Aluminium waste and scrap.	9701	Paintings, drawings and pastels, ex
7801	Unwrought lead.	9702	Original engravings, prints and lit
7802	Lead waste and scrap.	9703	Original sculptures and statuary, i
7901	Unwrought zinc.	9704	Postage or revenue stamps, stamp-po
7902	Zinc waste and scrap.	9705	Collections and collectors' pieces
8001	Unwrought tin.	9706	Antiques of an age exceeding one hundred years
530521	Coconut, abaca (Manila hemp or Musa	811252	Beryllium, chromium, germanium, van

Appendix Table 5. Correlation Matrix for Key Variables, All Firms

	Export Dissimilarity Index (in log)	City per capita GDP (in log)	City GDP (in log)	Share of joint venture firm exports	Share of FIE firm exports	Student Enrollment in Colleges and Universities as a Share of Non-Agricultural Population	Share of processing exports outside policy zones	Share of processing exports in the two High-tech Zones	Share of non-processing exports in the two High-tech Zones	Share of Export Processing Zone
Export Dissimilarity Index (in log)	1.00									
City per capita GDP (in log)	-0.61	1.00								
City GDP (in log)	-0.72	0.62	1.00							
Share of joint venture firm exports	-0.13	0.09	0.12	1.00						
Share of FIE firm exports	-0.35	0.26	0.23	0.05	1.00					
Student Enrollment in Colleges and Universities as a Share of Non-Agricultural Population	-0.47	0.41	0.49	-0.06	0.03	1.00				
Share of processing exports outside policy zones	-0.20	0.08	0.05	0.40	0.33	-0.12	1.00			
Share of processing exports in the two High-tech Zones	-0.47	0.32	0.34	0.09	0.43	0.19	0.03	1.00		
Share of non-processing exports in the two High-tech Zones	-0.40	0.30	0.35	0.05	0.14	0.30	-0.03	0.42	1.00	
Share of Export Processing Zone	-0.27	0.18	0.19	0.02	0.14	0.16	0.00	0.19	0.27	1.00

Appendix Table 6. Correlation Matrix for Key Variables, Unit Value, All Firms

	Unit Value of City Exports (in log)	Share of Joint Venture firm exports	Share of FIE firm exports	Share of processing exports outside policy zones	Share of processing exports in the two High-tech Zones	Share of non-processing exports in the two High-tech Zones	Share of Export Processing Zone	Share of SOE exports	Share of Collective and Private firm exports
Unit Value of City Exports (in log)	1.00								
Share of Joint Venture firm exports	0.03	1.00							
Share of FIE firm exports	0.01	-0.07	1.00						
Share of processing exports outside policy zones	0.01	**0.29**	**0.30**	1.00					
Share of processing exports in the two High-tech Zones	0.05	0.10	0.19	-0.01	1.00				
Share of non-processing exports in the two High-tech Zones	0.05	0.04	0.05	-0.06	0.02	1.00			
Share of Export Processing Zone	0.01	0.00	0.06	0.00	0.00	0.00	1.00		
Share of SOE exports	-0.01	**-0.52**	**-0.43**	**-0.30**	-0.14	-0.05	-0.03	1.00	
Share of Collective and Private firm exports	-0.03	-0.13	-0.11	-0.10	-0.04	-0.01	0.00	**-0.57**	1.00