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ABSTRACT

This paper examines the relative "sophistication" of China's exports to the United States along two dimensions. First, I compare China's export bundle to those of the relatively skill- and capital-abundant members of the OECD as well as to similarly endowed U.S. trading partners. Second, I examine prices within product categories to determine if China's varieties command a premium relative to its level of development.

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1. Introduction

Speculation about the impact Chinese exports will have on developed and developing countries over the coming decade varies widely. Some observers predict the imminent end of manufacturing in economies like the United States, while others believe low- and middle-income countries to be most at risk. This paper employs product-level U.S. import data to compare China's exports to the United States to those of other developed and developing economies. I find China's export bundle to be both more and less "sophisticated" than its peers. While it exports more products in common with OECD countries than would be expected given its level of development, the prices it receives for its exports compared with its per capita GDP have been declining with time.

This paper's assessment of Chinese exports is guided by the factor proportions framework. Endowment-based comparative advantage implies that extremely labor-abundant China should compete only indirectly with relatively more capital- and skill-abundant countries in world markets. Under this framework, China's export bundle should more closely resemble that of Vietnam than Germany or Japan. China's extraordinary product penetration is at odds with this implication, while the relatively low prices it receives within product markets is consistent with it.

Lacking information on export product attributes, I gauge export "sophistication" along two observable dimensions of the data. First, I compare the range of product categories China exports to the United States to the export bundles of other U.S. trading partners under the assumption that similarly developed economies export a comparable range of products (Finger and Kreinin 1979). Second, I compare Chinese export unit values within these product categories to the prices received by other U.S. trading partners. The latter comparison relies unit values being a reliable signal of endowment-driven vertical differentiation.[1]

China's export overlap with the OECD has increased dramatically over time, jumping from a rank of 21 among non-OECD U.S. trading partners

[1] Such comparisons ignore the fact that product prices might also differ due to comparative advantage, i.e., relatively low production costs due to factor abundance or greater efficiency (Hallak and Schott 2005). Schott (2004) demonstrates that within-product variation in export unit values is positively associated with exporter skill and capital abundance.

in 1972 to a rank of 3 in 2001, just behind Mexico and Taiwan. This growth is due to a very large increase in China's export product penetration, i.e., the share of all product categories with positive exports. By 2001 China's export penetration exceeded that of all of Latin America and the Caribbean combined. Within Latin America, only Mexico and Brazil achieve comparable levels of OECD export similarity and penetration. From the standpoint of product penetration, China's export mix is ahead of its peers.

Chinese export prices within product categories do not follow a similar trend. In the 1970s and 1980s, when China was present in relatively few product categories, its exports on average sold at a premium relative to its per capita GDP (but at a discount relative to its skill abundance). In the 1990s, however, this trend reversed as Chinese exports began selling at a discount with respect to its per capita GDP and its discount with respect to its skill abundance increased. I also show that Chinese exports sell for a substantial discount relative to OECD varieties over the entire sample period, and that this gap appears to be increasing in Chemicals and Machinery. Further research into the extent to which these trends are driven by quality upgrading on the part of developed economies is warranted.

The remainder of this paper is structured as follows. Section 2 provides a brief overview of the theory guiding the analysis; Section 3 summarizes China's relative endowments; and Section 4 estimates the relative sophistication of Chinese exports. Section 5 concludes.

2. Theory

The analysis in this paper is guided by the factor proportions framework, in particular the multiple cone equilibrium of the Heckscher-Ohlin model, which has country product mix varying with relative factor endowments.[2] A two-factor version of this equilibrium is displayed in the Lerner diagram in the left panel of Figure 1. This diagram features four industries – apparel, textiles, machinery and chemicals – which differ in terms of their capital intensity. Apparel is the most labor-intensive industry while chem-

[2] Leamer (1984, 1987) and Schott (2003, 2004) offer evidence in support of the idea that country product mix is a function of their relative endowments.

icals is the most capital intensive. Under standard assumptions (see Dixit and Norman 1980), the four industries' unit-value isoquants delineate three cones of diversification, where cone refers to the set of relative endowment vectors selecting a unique mix of, in this case, two industries.

Because production of an industry outside of the cone in which a country resides results in negative profit, GDP-maximizing countries specialize in the two industries anchoring their cones, i.e. the two industries whose input intensities are most closely related to their endowments.[3] The negative profits that capital-abundant United States would earn in labor-intensive apparel and textiles, for example, can be seen by comparing the amount of capital and labor that can be bought for one dollar in the United States (via the downward sloping isocost curve defined by r_{US} and w_{US}) with the amount of capital and labor needed to produce one dollar's worth of output (via the unit value isoquants). A key message of Figure 1 is that relatively high production costs drive countries out of industries at odds with their comparative advantage.

In the equilibrium depicted in the left panel of Figure 1, the United States, Latin America and China specialize in distinct bundles of industries, with the United States and China having no industries in common. If we assume the economies of Latin America occupy the middle cone of diversification, the labor-intensive portion of their product mix overlaps with that of labor-abundant China while the capital-intensive portion of its product mix overlaps with that of capital-abundant United States.[4] As indicated in the figure, the overlap of countries' product mix is a function of the relative similarity of their endowments.[5]

Substantial intra-national factor disparities within China, however, may mean that China's exports overlap with those of countries in the capital-intensive cone. Courant and Deardorff (1992) show theoretically that the uneven, or "lumpy" internal distribution of factors within China depicted in the right-hand panel of the figure can induce labor-abundant China to

[3] Leamer (1987) provides generalizations of these implications for higher dimensional settings.

[4] In a more general, three-factor setting, these overlaps might be less extreme given Latin American land abundance. For a more detailed discussion of the potential effects of Latin American resource abundance on development, see Leamer et al. (1999).

[5] Under this scenario, Latin America is in the "middle" and faces direct competition from "above" and "below" from capital- and labor-abundant countries, respectively.

export relatively capital-intensive goods. Such an equilibrium is presented in the right panel of Figure 1, which distributes China's regions across the middle and labor-intensive cones of diversification to reflect their underlying heterogeneity. Shanghai, for example, is far more skill- and capital-abundant than the labor-abundant inland province of Guizhou, and therefore may produce exactly the same mix of goods as the "middle" countries of Latin America. In China's case, factor lumpiness is supported by the explicit control of factor movements exercised by the government, which, for example, dampens the movement of labor from the interior to the coasts. These restrictions may prevent the factor-price disparities illustrated in the figure (via isocost lines) from being arbitraged away inside the country, thereby reinforcing the concomitant tendency of regions to produce and export goods of different capital intensity. Regional diversity within China may help explain the extraordinary product penetration trends noted below.[6]

In this paper I make use of product-level trade data to determine the relative sophistication of China's manufacturing exports. Product-level data provide much sharper resolution of this sophistication than industry-level data for two reasons. First, while virtually all countries of the world export all industries (e.g., "electronics"), they exhibit substantial heterogeneity across products within industries. Second, product-level data permit examination of trading partner heterogeneity within product markets via unit values. Use of product-level data for these purposes requires a version of the Heckscher-Ohlin model (and Figure 1) that is based on production that is more disaggregate than industries.[7] Intuition for such a model can be found by replacing the industry identifiers on the isoquants in Figure 1 with product identifiers. Within a particular industry like Electronics, for example, labor-abundant countries might export portable black and white televisions, more capital-abundant countries might export color televisions, and the most capital-abundant countries might export plasma displays.

[6] Another contributing factor may be China's size. Hummels and Klenow (2005) find that large countries export a significantly higher number of products than small countries.

[7] Schott (2004) provides evidence that countries specialize within products according to their relative endowments.

3. China's Relative Endowments

This section compares Chinese skill, capital and land abundance to that of other U.S. trading partners. It also examines indirect evidence on the distribution of endowments across regions within China. These comparisons convey two messages. First, they show that in aggregate, China is extremely skill-, capital- and land- scarce. All else equal, this scarcity implies that China should specialize in only the most labor-intensive, i.e., least "sophisticated", exports. The second message is that regions within China exhibit substantial variation in relative development.

In comparing China to other groups of countries, I make use of the country-region assignments provided in Table 5.[8] Four aspects of how countries are assigned to regions deserve mention. First, Latin America includes all of the countries of Central and South America, plus Mexico. Second, Japan is assigned to the OECD rather than Asia. Third, I define the OECD as the 23 members in place as of 1974 in order to exclude Korea, Mexico and other, more recent entrants. The resulting set of countries captures a more uniform mix of high-wage, developed economies.[9] Finally, the actual set of countries within each region used in computing any given summary statistic may vary depending upon data availability.

Tables 1 and 2 provide complementary views of China's labor abundance relative to other countries in Asia, the Caribbean, Latin America and the OECD. Table 1 compares China's relative endowments to the mean relative endowments of other countries, by region. The first four columns of the table report Barro and Lee (2000) education attainments. These columns reveal that highly skilled workers – those with more than a secondary school education – are relatively scarce in Asia compared to Latin America, and scarcer still in China. While 13 percent of Latin America's population had attained a post-secondary education by 1999, the numbers are 8 percent and 3 percent for Asia and China, respectively. China also has a higher share of workers without any schooling than Latin America or the Caribbean: 21 percent of its population, versus 18 percent for both the Caribbean and Latin America, have never received formal schooling.

Table 2 reports the location of China in the distribution of other region's

[8] These assignments are based on United Nations country codes, except as noted below.
[9] Even so, the 1974 cohort still includes Ireland and Turkey.

relative endowments. A value of 50 in this table, for example, indicates that China's relative endowments are equal to the median of the noted region. China's skill scarcity ranks the country below the median of the Asian, Latin American and Caribbean distributions. As indicated in Table 2, China's post-secondary education attainment places it in the 32nd percentile in Asia (behind Pakistan and India), in the 5th percentile of Latin America (just behind Guyana) and in the 33rd percentile of the Caribbean (between Haiti and Jamaica). It has relatively more unschooled citizens than 58 percent of Asian countries, 68 percent of Latin American countries and 67 percent of Caribbean countries.

In addition to being relatively skill scarce, China is relatively capital and land scarce. As of 2000, it has 0.10 hectares of arable land per person versus 0.25 hectares per person in Latin America, placing it in the 19th percentile of the Latin American distribution (between El Salvador and Venezuela). It's median (Nehru and Dhareshwar 1993) capital per capita in 1990 (the latest year available) of $2,274 is also relatively low, placing it at the 21st percentile of the Latin American distribution (between Ecuador and Honduras).[10]

Comparable data on the distribution of factors within China is unavailable. In its place, Table 3 compares Chinese provinces, Autonomous Regions and Municipalities along two dimensions in 1999 using data on (non-PPP-adjusted) per capita GDP (PCGDP) and illiteracy from the Chinese government quoted in OECD (2001). Regions in the table are sorted according to PCGDP, which ranges from $3,275 (CNY 30,805) in Shanghai to $299 (CNY 2475) in the inland province of Guizhou. To put this variation in perspective, note that comparable World Bank PCGDP figures for Korea, Mexico and Brazil are $10,855, $5,934 and $3,538, respectively, and that China's aggregate PCGDP is $856. The final column of Table 3 reports Chinese regional illiteracy rates.[11] These range from a high of 66 percent in Tibet to a low of 4 in Chonqing Municipality. By comparison, World Bank illiteracy rates in the over-15-year-old population in Mexico, Brazil and China as a whole are 9, 14 and 14 percent, respectively.

[10] I compare regions' capital per capita in Tables 1 and 2 using the median rather than the mean because of significant outliers (for Mexico and Uruguay among others) in the Nehru and Dhareshwar (1993) dataset. More recent cross-national comparisons of capital abundance that include China as an observation are unavailable.

[11] Intra-national PCGDP and illiteracy in China have a correlation of -0.33.

Though these comparisons are by no means rigorous, they do suggest that some regions of China may be able to produce products with skill and capital intensity approaching that of countries with much greater skill and capital abundance than exhibited by China in aggregate. These trends provide some intuition for China's relatively high export overlap with the OECD.

4. The Relative Sophistication of Chinese Exports

This section examines product-level trade data to assess the relative sophistication of China's manufacturing exports. This analysis exploits product-level U.S. import data available from the U.S. Census Bureau and compiled by Feenstra et al. (2002). These data record the customs value of all U.S. imports by exporting country from 1972 to 2001 according to thousands of finely detailed categories, which I refer to as 'products' or 'goods'.[12] I refer to imports at higher levels of aggregation, such as the one-digit Standard International Trade Classification, Revision 3 (SITC1) system, as 'industries'. I refer to imports within product categories as country 'varieties'.

Table 4 lists the ten mutually exclusive SITC1 industries and reports the number of product categories in each industry in both 1972 and 2001. Industries 0 through 4 comprise resource products, while industries 5 through 8 encompass manufacturing goods, which are the focus of this study. Two of the manufacturing industries, Manufactured Materials (SITC1=6) and Miscellaneous Manufactures (SITC1=8) – which include textiles and apparel, respectively – account for the largest share of products in both periods. Machinery (SITC1=7), on the other hand, experiences the largest increase in the number of product categories over the sample period. Because of their idiosyncrasy, I exclude products from industry 9 (Not Elsewhere Classified) from the analysis.

My comparison of Chinese and other countries' trade patterns proceeds under the assumption that U.S. trading partners' exports to the U.S. accurately reflects their domestic production as well as their exports to other

[12] Imports are classified according to seven-digit Tariff Schedule of the United States (TSUSA) codes from 1972 through 1988 and according to the ten-digit Harmonized System (HS10) codes from 1989 through 1994.

markets. This assumption is partially justified by the relative openness of the U.S. economy and its attractiveness as an export destination. Nevertheless, the existence of tariff and non-tariff barriers (e.g., the Multifiber Arrangement), as well as more general trade costs such as transportation, can be influential in determining which of a country's goods are exported, and to which trading partner they are sent (see, for example, Deardorff 2004). Unfortunately, comparable product-level trade data for other destination countries, such as European Union, is unavailable.

4.1. China's Export Bundle

This section assesses the relative sophistication of China's manufacturing export bundle in terms of its similarity to that of the aggregate OECD and other developing countries. Three findings stand out. First, China's export similarity with the OECD increases substantially over the sample period, far more than any other U.S. trading partner. Second, China's export similarity vis a vis the OECD generally exceeds that of countries with similar relative endowments. Third, China's "excess" similarity with the OECD increases over time. Before computing U.S. trading partners' export similarity, I briefly summarize countries' U.S. market share and product penetration. China's growth in these two components of export similarity between 1972 and 2001 has been exceptional.

Table 6 reports the U.S. manufacturing import value market share of Asia, Latin America, the OECD and China, by industry, for the first and last years of the sample.[13] The market share of region r in year t and industry i is

$$MS_{tri} = \frac{\sum_{c \in r} Imports_{tci}}{\sum_{c} Imports_{tci}}, \tag{1}$$

where c indexes countries and $c \in r$ captures the set of countries in region r. Note that results for Asia *exclude* China and that market shares across the columns of Table 6 do not sum to 100 percent because all U.S. trading partners are not represented.

The market share trends in Table 6 convey several messages. First, they show that exports from developed economies, proxied here by the

[13] As noted above, Table 5 provides a mapping of countries to regions.

OECD, dominate the U.S. market, though less so over time. While the OECD accounted for 83 percent of manufacturing imports in 1972, this share falls to 52 percent by 2001. Second, they reveal that China is the main contributor to Asia's overall growth. China's share of manufacturing imports increases steadily from just above 0 percent in 1972 to 11 percent in 2001, driven by a very large gain in Miscellaneous Manufacturing. Over the same interval, the remaining countries in Asia saw their market share increase from 11 percent to 18 percent.

China's 11 percentage point jump in market share dominates all other U.S. trading partners except for Mexico. Table 7 reports the countries with the top ten absolute (left panel) and percent growth (right panel) changes in manufacturing market share between 1972 and 2001.[14] China tops both lists, with only Mexico coming close in terms of absolute gains. Two other countries – Ireland and Indonesia – experience absolute and percent growth changes large enough to be included in both panels. For most countries, gains in market share are due to growth in Machinery or Miscellaneous Manufactures exports. Ireland's growth, driven by Chemicals (which includes pharmaceuticals), is an exception.

Manufacturing product penetration by region and industry is summarized in Table 8. Each cell in the Table 8 reports the percent of products in an industry exported by China or the group of countries in the noted region. Regional penetration is 100 percent if at least one country in the region exports each good to the United States and zero if no country exports any of the industry's products to the United States.[15] As above, results for Asia *exclude* China.

Table 8 reports several interesting trends. First, it reveals that product penetration by the OECD is virtually 100 percent throughout the sample period. Second, it shows that product penetration by Asian and Latin American countries, though substantially lower than the OECD in 1972, has increased markedly over time.[16] Finally, Table 8 reveals that China,

[14] Countries with a market share of zero in 1972 are ineligible for ranking on percent change panel of the figure.

[15] The total number of products in each industry in 1972 and 2001 is reported in the final two columns of Table 4.

[16] These two trends are puzzling from the standpoint of the factor proportions framework because they imply *declining* across-product specialization among OECD and non-OECD countries over time. Schott (2004) provides a partial resolution to this puzzle

in particular, has experienced a very large increase in product penetration, from 9 percent in 1972 to 70 percent in 2001. Table 9, which ranks countries with the biggest absolute gains in penetration between 1972 and 2001, shows that China's 61 percentage point increase is the largest of any trading partner by a factor of two.

I measure countries' or regions' export bundle overlap via Finger and Kreinin's (1979) export similarity index (ESI), which incorporates information about both market share and product penetration. For any two U.S. trading partners c and d in year t, Finger and Kreinin define their export similarity to be

$$ESI_{tcd} = \sum_{p} \min\left(s_{tpc}, s_{tpd}\right), \tag{2}$$

where s_{tpc} is the share of country c's exports in manufacturing product p in year t. This bilateral measure is computed using all manufacturing products and is bounded by zero and unity: $ESI_{tcd} = 0$ if countries c and d have no products in common in year t and $ESI_{tcd} = 1$ if their exports are distributed identically across products. To compare two regions (or to compare a region with a country), I sum exports over countries in the region and then use region-level rather than country-level export shares in equation 2.

Figure 2 displays a box-and-whisker plot of non-OECD U.S. trading partners' ESI with the OECD at ten-year intervals from 1972 to 2001. Each year's box spans the inter-quartile range of the data, while lines within the boxes record the median observation in each year. The key message of the figure, consistent with the information presented in the last section, is that non-OECD countries' overlap with the OECD is generally increasing with time.

Table 10 reports China's export similarity with Asia (which excludes China), Latin America and the OECD at ten-year intervals from 1972 to 2001. China's overlap is greatest vis a vis aggregate Asia and lowest with the aggregate OECD. In percentage terms, overlap has grown most with the OECD, from 0.09 in 1972 to 0.75 in 2001.

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by demonstrating that specialization occurs *within* rather than across products. Further evidence of such specialization, identified via prices across country varieties within product categories, is presented below.

China's growing export overlap with the OECD is faster than that of any other individual U.S. trading partner. Table 11 reports countries with the top ten OECD manufacturing ESI at ten-year intervals over the sample period. China's rank jumps from 21 in 1972 (not shown) to 3 in 2001, just behind Mexico (the perennial leader) and Korea and ahead of Taiwan.

Regression analysis reveals that China's manufacturing export similarity with the OECD is substantially higher than that of countries with similar relative endowments, and that this premium is increasing with time. Table 13 reports coefficients from an OLS regression of trading partners' ESI with the OECD on country relative endowments and a China dummy variable,

$$ESI_{tc} = \alpha_t + \beta X_{tc} + \gamma CHINA_{tc} + \varepsilon_{tpc}, \tag{3}$$

where X_{tc} is a country characteristic, $CHINA_{tc}$ is a dummy variable equaling unity if the product is from China, and α_t is a year fixed effect. Robust standard errors adjusted for clustering at the country level are reported below coefficients, virtually all of which are statistically significant at the 1 percent level. Two country characteristics are examined. The first, World Bank PPP-adjusted per capita GDP, is a proxy for capital abundance. I use PCGDP rather than an explicit measure of capital abundance because the latter are unavailable for a large set of countries or for the full 1972 to 2001 sample period.[17] The second country characteristic is a measure of skill abundance based on Barro and Lee (2000) educational attainment data.[18] Here, I measure skill abundance as the percent of the population attaining either a secondary education or higher.

The results in Table 13 indicate that export similarity with the OECD is positively and significantly related to countries' per capita GDP and skill abundance, an outcome that is consistent with the factor proportions framework. The dummy variables for China indicate that China's ESI

[17] Results using an explicit measure of capital per worker (e.g., from the Penn World Tables), based on a shorter time period and smaller set of countries, provides similar results.

[18] Barro and Lee (2000) data are available at five-year intervals rather than annually. This feature of the data accounts for the large difference in the number of observations across the columns of Table 14. To increase the sample size, I use the 1970 value for 1972, so that there are two observations per decade.

with the OECD is on average 0.39 and 0.27 higher than for countries with similar PCGDP and skill abundance, respectively.

Table13 also contains results based on regressions which include an interaction of the $CHINA$ dummy with three decade dummies, i.e., one for the 1970s (1972-1979), one for the 1980s (1980-1989) and one for the 1990s (1990-2001).[19] The sign and significance pattern of these coefficients indicates that China's "excess" similarity has increased over time. Coefficients on the dummy variables in the PCGDP regression, for example, indicate a premium of 0.15, 0.36 and 0.57 for the 1970s, 1980s and 1990s, respectively.

4.2. Chinese Export Prices

This section exploits export prices to measure the relative sophistication of Chinese export varieties *within* products. The data indicate that Chinese varieties commanded a premium relative to countries with similar per capita GDP and skill abundance in the 1970s and 1980s, but that this trend reverses in the 1990s. They also reveal that the price premium of OECD varieties relative to Chinese varieties is widening with time in some industries.

An extremely useful feature of the Feenstra et al. (2002) data is the inclusion of both quantity and value information for a large number of goods and countries, rendering possible the calculation of unit values. I compute the unit value of product p from country c, u_{pc}, by dividing import value (V_{pc}) by import quantity (Q_{pc}), $u_{pc} = V_{pc}/Q_{pc}$.[20] Examples of the units employed to classify products include dozens of shirts in apparel, square meters of carpet in textiles and pounds of folic acid in chemicals. Because units vary by products within industries, industry-level unit values cannot be computed.[21]

[19] As noted in the previous footnote, the by-decade results for skill abundance are based on two observations per decade.

[20] For some years and products, there are multiple country observations of value and quantity. In those cases, I define the unit value to be a value-weighted average of the observations. Availability of unit values ranges from 77 percent of product-country observations in 1972 to 84 percent of observations in 2001.

[21] It is important to note that the unit values in this dataset are not perfect. A study by the U.S. General Accounting Office (1995) identified underlying product heterogeneity and classification error as two major sources of unit value error in an in-depth analysis of eight products. Identifying the results of variety heterogeneity within product categories

To identify the relative price of Chinese exports relative to similarly developed countries, I use the same methodology presented in the previous section to regress country-product unit values on country relative endowments and a China dummy variable,

$$\log(u_{tpc}) = \alpha_{tp} + \beta X_{tc} + \gamma CHINA_{tc} + \varepsilon_{tpc}, \tag{4}$$

where u_{tpc} is the unit value of product p from country c in year t, X_{tc} is a country characteristic, $CHINA_{tc}$ is a dummy variable equaling unity if the product is from China, and α_{tp} is a year-product fixed effect. To insure an appropriate range of countries in each product market, regressions are run on all manufacturing products originating in at least two countries with real PCGDP below 10% and above 90% of the U.S. level in each year, respectively. As above, I use per capita GDP and skill abundance as measures of trading partners' relative endowments.

Regression coefficients and robust standard errors, displayed in Table 14, demonstrate a positive and statistically significant relationship between countries' export prices and their per capita GDP or skill abundance. These coefficients are similar to those reported in Schott (2004) and suggest that capital- and skill-abundant countries use their endowment advantage to produce goods that are vertically superior to goods emanating from labor abundant countries.

Coefficients on the $CHINA$ dummy variable in the first and third columns of the table show that Chinese products on average sell for a discount relative to their PCGDP and skill abundance. Here, as above, results using by-decade China dummy variables in columns two and four reveal that the relative price of Chinese varieties is declining with time: the China-decade dummy flips from positive to negative over time in the PCGDP regression, while it becomes increasingly negative in the skill abundance regression.[22] The estimated 1990s discounts are 31.1 and 89.3 percent controlling for PCGDP and skill abundance, respectively. These contrast with premia of 30.4 and -42.7 percent in the 1970s, respectively.

Similar trends appear across manufacturing industries. Table 15 reports the results of estimating equation 4 by one-digit SITC industry. Re-

is a focus of this section.

[22] As above, the by-decade results for skill abundance are based on the two years per decade for which skill abundance data are available.

sults indicate that the trend reversal is strongest in Machinery and weaker in Chemicals and Manufactured Materials.

A comparison of Chinese prices to those of the member countries of the OECD is also instructive. I perform such a comparison via unit value ratios,

$$UVR_{tpc} = \frac{u_{tpc}}{u_{tpCHINA}}, \tag{5}$$

where in the tables below UVR_{tpc} is expressed in base two logs to preserve symmetry around zero. Table 16 reports the mean OECD country - China unit value ratio by manufacturing industry between 1991 and 2001. Two features of the data are noteworthy. First, the table illustrates that OECD exports sell for substantially more than Chinese exports in all industries across the entire period. These price premia are greatest in Machinery and lowest in Chemicals, which likely contain the highest and lowest shares of vertical differentiation within products, respectively. OECD machinery varieties, for example, command prices that are an average of 9.7 (i.e., $2^{3.28}$) times higher than Chinese machinery varieties. T-tests of these unit value ratios (not reported) indicate that all of the ratios are statistically significantly different from zero at the 10 percent level.

5. Conclusion

China's export bundle increasingly overlaps with that of more developed countries, rendering it more "sophisticated" than countries with similar relative endowments. On the other hand, its exports sell at a substantial discount relative to its level of GDP and the exports emanating from the OCED. Further research into the extent to which these trends are influenced by quality upgrading within China and the developing countries is warranted.

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Region	No Schooling (%)	Primary Attainment (%)	Secondary Attainment (%)	Post-Secondary Attainment (%)	Arable Land Per Person (Hectares)	Capital Per Capita ($)
Asia	32	32	27	8	0.14	3,339
Carribean	18	44	31	7	0.08	6,212
Latin America	18	49	20	13	0.25	5,590
OECD	5	34	40	21	0.38	67,688
China	21	42	36	3	0.10	2,274

Notes: Cells report mean (columns 2 through 5) or median (column 6) values across all countries by region for which data is available. Education measures are for 1999 and are from Barro and Lee (2000). Land abundance data are for 2000 and are from the World Bank's World Development Indicators database. Capital per population data is for 1990 and are from Nehru and Dhareshwar (1993). Per capita capital values are adjusted for purchasing power parity using World Bank PPP conversion factors; they are expressed in 1987 dollars.

Table 1: Relative Endowments by Region

Region	No Schooling	Primary Attainment	Secondary Attainment	Post-Secondary Attainment	Arable Land Per Person (Hectares)	Capital Per Capita ($)
Asia	58	84	68	32	52	27
Carribean	67	50	50	33	75	20
Latin America	68	26	89	5	19	21
OECD	95	64	41	5	26	9

Notes: Cells report the percentile of each region's distribution that would occupied by China if it were part of the region. See the notes to Table 1 for information on the source of each relative endowment variable.

Table 2: China's Percentile in the Distribution of Asian, Latin American and OECD Country Relative Endowments

Province, Region or Municipality	PCGDP ($ mill)	Illiteracy (%)
Shanghai Municipality	3,725	8.7
Beijing Municipality	2,400	6.5
Tianjin Municipality	1,932	8.0
Zhejiang	1,456	15.7
Guangdong	1,418	9.2
Fujian	1,306	18.5
Jiangsu	1,290	16.8
Liaoning	1,220	7.2
Shandong	1,049	20.2
Heilongjiang	926	9.8
Hebei	838	11.4
Hubei	788	15.0
Xinjiang Uygur Autonomous Region	782	9.8
Hainan	772	14.6
Jilin	767	6.8
Neimongu (Mongolia) Autonomous Region	647	16.4
Hunan	617	11.1
Henan	592	16.3
Chongqing Municipality	584	4.0
Shanxi	572	9.1
Anhui	569	20.3
Qinghai	564	30.5
Jiangxi	564	13.2
Ningxia Hui Autonomous Region	541	23.3
Sichuan	538	24.3
Yunnan	538	16.8
Xizang (Tibet) Autonomous Region	515	66.2
Guangxi Zhuang Autonomous Region	502	12.4
Shaanxi	496	18.3
Gansu	444	25.6
Guizhou	299	24.5
Max / Min	12.4	16.5

Notes: Source: China Statistical Yearbook (2000); quoted from OECD (2001). PCGDP figures are converted from CNY to USD using the official exchange rate of 8.27 $/CNY.

Table 3: Inter-Regional Relative Endowment Disparities within China

SITC1 Industry	SITC2 Examples	Product Examples	Number of Products (1972 / 2001)
0 Food	Meat, Dairy, Fruit	Live Sheep	703 / 1898
1 Beverage/Tobacco	Wine, Cigarettes	Carbonated softdrinks	75 / 167
2 Crude Materials	Rubber Cork, Wood, Textile Fibers	Silkworm cocoons suitable for reeling	646 / 812
3 Mineral Fuels	Coal, Coke, Petroleum	Uleaded gasoline	49 / 98
4 Animal/Vegetable Oils	Lard, Soybean Oil	Edible tallow	58 / 77
5 Chemicals	Organic Chemicals, Dyes, Medicines, Fertilizer, Plastics	Chloroform	757 / 2036
6 Manufactured Materials	Leather, Textile Yarn, Paper, Steel	Diaries and address books of paper or cardboard	2862 / 4426
7 Machinery	Generators, Computers, Autos	Ultrasonic scanning apparatus	648 / 3076
8 Misc Manufacturing	Apparel, Footwear, Scientific Equipment, Toys	Boy's shorts cotton playsuit parts, not knit	1869 / 3704
9 Not Elsewhere Classified	Special Transactions, Coins, Gold	Sound recordings for State Department use	50 / 86

Table 4: Products by SITC1 Industry

Country	Region	Country	Region	Country	Region
Algeria (DZA)	AF	Fiji (FJI)	AS	Guyana (GUY)	LA
Angola (AGO)	AF	Hong Kong (HKG)	AS	Honduras (HND)	LA
Benin (BEN)	AF	India (IND)	AS	Mexico (MEX)	LA
Burkina Faso (BFA)	AF	Indonesia (IDN)	AS	Nicaragua (NIC)	LA
Burundi (BDI)	AF	Kiribati (KIR)	AS	Panama (PAN)	LA
Cameroon (CMR)	AF	Korea (KOR)	AS	Paraguay (PRY)	LA
Cen Aft Rep (CAF)	AF	Lao (LAO)	AS	Peru (PER)	LA
Chad (TCD)	AF	Macao (MAC)	AS	Suriname (SUR)	LA
Congo (COG)	AF	Malaysia (MYS)	AS	Uruguay (URY)	LA
Cote d'Ivoire (CIV)	AF	Mongolia (MNG)	AS	Venezuela (VEN)	LA
Djibouti (DJI)	AF	Myanmar (MMR)	AS	Bahrain (BHR)	ME
Egypt (EGY)	AF	Nepal (NPL)	AS	Cyprus (CYP)	ME
Eq. Guinea (GNQ)	AF	New Caledonia (NCL)	AS	Iran (IRN)	ME
Ethiopia (ETH)	AF	Pakistan (PAK)	AS	Israel (ISR)	ME
Gabon (GAB)	AF	Papua New Guinea (PNG	AS	Jordan (JOR)	ME
Gambia, The (GMB)	AF	Philippines (PHL)	AS	Kuwait (KWT)	ME
Ghana (GHA)	AF	Singapore (SGP)	AS	Lebanon (LBN)	ME
Guinea (GIN)	AF	Sri Lanka (LKA)	AS	Oman (OMN)	ME
Guinea-Bissau (GNB)	AF	Taiwan (TWN)	AS	Qatar (QAT)	ME
Kenya (KEN)	AF	Thailand (THA)	AS	Saudi Arabia (SAU)	ME
Liberia (LBR)	AF	Viet Nam (VNM)	AS	Syrian (SYR)	ME
Madagascar (MDG)	AF	Bahamas (BHS)	CAR	UAE (ARE)	ME
Malawi (MWI)	AF	Barbados (BRB)	CAR	Yemen (YEM)	ME
Mali (MLI)	AF	Dom Rep (DOM)	CAR	Bermuda (BMU)	NA
Mauritania (MRT)	AF	Guadeloupe (GLP)	CAR	Greenland (GRL)	NA
Mauritius (MUS)	AF	Haiti (HTI)	CAR	Australia (AUS)	OECD
Morocco (MAR)	AF	Jamaica (JAM)	CAR	Austria (AUT)	OECD
Mozambique (MOZ)	AF	Neth Antilles (ANT)	CAR	Belgium (BEL)	OECD
Niger (NER)	AF	St. Kitts and Nevis (KNA)	CAR	Canada (CAN)	OECD
Nigeria (NGA)	AF	Trinidad (TTO)	CAR	Denmark (DNK)	OECD
Rwanda (RWA)	AF	Bulgaria (BGR)	CEU	Finland (FIN)	OECD
Senegal (SEN)	AF	Czech Republic (CZE)	CEU	France (FRA)	OECD
Seychelles (SYC)	AF	Hungary (HUN)	CEU	Germany (DEU)	OECD
Sierra Leone (SLE)	AF	Poland (POL)	CEU	Greece (GRC)	OECD
Somalia (SOM)	AF	Romania (ROM)	CEU	Iceland (ISL)	OECD
South Africa (ZAF)	AF	Yugoslavia (YUG)	CEU	Ireland (IRL)	OECD
Sudan (SDN)	AF	Albania (ALB)	EU	Italy (ITA)	OECD
Tanzania (TZA)	AF	Gibraltar (GIB)	EU	Japan (JPN)	OECD
Togo (TGO)	AF	Malta (MLT)	EU	Netherlands (NLD)	OECD
Tunisia (TUN)	AF	Argentina (ARG)	LA	New Zealand (NZL)	OECD
Uganda (UGA)	AF	Belize (BLZ)	LA	Norway (NOR)	OECD
Zaire (ZAR)	AF	Bolivia (BOL)	LA	Portugal (PRT)	OECD
Zambia (ZMB)	AF	Brazil (BRA)	LA	Spain (ESP)	OECD
Zimbabwe (ZWE)	AF	Chile (CHL)	LA	Sweden (SWE)	OECD
Afghanistan (AFG)	AS	Colombia (COL)	LA	Switzerland (CHE)	OECD
American Samoa (ASM	AS	Costa Rica (CRI)	LA	Turkey (TUR)	OECD
Bangladesh (BGD)	AS	Ecuador (ECU)	LA	UK (GBR)	OECD
Cambodia (KHM)	AS	El Salvador (SLV)	LA		
China (CHN)	AS	Guatemala (GTM)	LA		

Notes: Countries sorted alphabetically by region. Region affiliations are mutually exclusive: AF=Africa; AS=Asia; CAR=Carribean; CEU=Central Europe; LA=Latin America; ME=Middle East; NA=North America. OECD definition excludes post-1973 entrants (e.g. Mexico and Korea).

Table 5: U.S. Trading Partners by Region

	China		Asia		Latin America		OECD	
SITC1 Industry	1972	2001	1972	2001	1972	2001	1972	2001
5 Chemicals	0	3	2	5	6	5	85	80
6 Manufactured Materials	0	9	10	14	5	12	79	54
7 Machinery	0	7	5	19	2	17	93	56
8 Misc Manufacturing	0	26	29	22	4	15	63	31
Overall Manufacturing	0	11	11	18	3	15	83	52

Notes: Cells display the market share of each region's or country's exports to the U.S. Asia results exclude China.

Table 6: U.S. Import Value Market Share by Region and Year

Absolute Change				Percent Growth			
Country	1972	2001	Change	Country	1972	2001	%Change
China	0.04	10.99	10.95	China	0.04	10.99	274
Mexico	1.96	12.08	10.12	Honduras	0.01	0.29	53
Malaysia	0.42	2.35	1.93	Sri Lanka	0.01	0.22	39
Korea	1.79	3.70	1.92	Guatemala	0.01	0.20	36
Ireland	0.25	1.94	1.69	Indonesia	0.04	0.92	21
Thailand	0.19	1.34	1.15	Hungary	0.02	0.32	19
Singapore	0.58	1.51	0.93	El Salvador	0.01	0.19	17
Philippines	0.27	1.16	0.89	Dom Rep	0.03	0.40	11
Indonesia	0.04	0.92	0.88	Costa Rica	0.02	0.21	10
Israel	0.53	1.25	0.72	Bulgaria	0.00	0.03	9
Brazil	0.50	1.16	0.65	Ireland	0.25	1.94	7

Notes: Table lists U.S. trading partners with the top ten absolute and percentage changes in market share between 1972 and 2001.

Table 7: U.S. Trading Partners with the Largest Gains in Market Share (Absolute and Percent Growth), 1972 to 2001

	China		Asia		Latin America		OECD	
SITC1 Industry	1972	2001	1972	2001	1972	2001	1972	2001
5 Chemicals	4	62	16	63	22	49	98	98
6 Manufactured Materials	7	63	45	79	34	68	96	98
7 Machinery	1	72	56	85	51	73	100	99
8 Misc Manufacturing	16	81	72	87	45	70	98	96
Overall Manufacturing	9	70	51	80	38	67	97	98

Notes: Cells display share of products in the industry that are exported to the U.S. by at least one country from the region. Asia results exclude China.

Table 8: Product Penetration by Region and Year

Country	1972	2001	Difference
China	9	70	61
Korea	19	51	32
Mexico	26	56	29
Thailand	6	32	26
India	19	43	25
Taiwan	30	54	24
Indonesia	2	25	23
Canada	52	73	21
Malaysia	3	23	19
Italy	51	69	18
Brazil	14	31	17

Notes: Table lists U.S. trading partners with the top ten absolute changes in product penetration between 1972 and 2001.

Table 9: U.S. Trading Partners with the Largest Gains in Manufacturing Product Penetration, 1972 to 2001

	Export Similarity with China			
Region	1972	1981	1991	2001
Asia	0.40	0.70	0.91	0.97
Latin America	0.16	0.48	0.70	0.86
OECD	0.09	0.28	0.55	0.75

Notes: Table displays each region's export similarity index (see text) with China. Asia excludes China.

Table 10: Regions' Export Similarity with China

Top 10 Manufacturing Export Similarity Indexes with the OECD

1972		1981		1991		2001	
Mexico	0.53	Brazil	0.54	Mexico	0.72	Mexico	0.80
Brazil	0.41	Korea	0.49	Korea	0.66	Korea	0.78
Taiwan	0.40	Taiwan	0.48	Taiwan	0.63	China	0.75
Hong Kong	0.35	Mexico	0.48	China	0.55	Taiwan	0.64
Korea	0.35	Israel	0.46	Hong Kong	0.50	Brazil	0.60
South Africa	0.30	Hong Kong	0.39	Brazil	0.50	India	0.54
Israel	0.25	Singapore	0.33	Singapore	0.41	Israel	0.51
Colombia	0.24	Philippines	0.31	Israel	0.40	Hong Kong	0.46
Argentina	0.23	South Africa	0.30	Thailand	0.36	Thailand	0.45
India	0.22	China	0.28	India	0.35	Singapore	0.44

Notes: Table lists non-OECD countries with the highest export similarity index (ESI) with the OECD at ten-year intervals from 1972 to 2001. Second column of each panel notes the countries ESI. ESI ranges from zero (no overlap) to unity (total ovelap). The total number of non-OECD U.S. trading partners in the sample increases from 131 in 1972 to 152 in 2001.

Table 11: Countries with the Highest Export Similarity to the OECD

Export Similarity with OECD

Region	1972	1981	1991	2001
Asia	0.16	0.20	0.26	0.27
China	0.09	0.28	0.55	0.75
Latin America	0.22	0.22	0.31	0.34

Notes: Table displays each region's export similarity index (see text) with the aggregate OECD. Asia excludes China.

Table 12: Regional Export Similarity with the OECD

	ESI_{ct}	ESI_{ct}	ESI_{ct}	ESI_{ct}
Log (Real $PCGDP_{ct}$)	0.050	0.050		
	0.011	0.011		
Log (Skill $Abundance_{ct}$)			0.069	0.070
			0.014	0.014
China Dummy	0.387		0.273	
	0.010		0.023	
China 70s		0.149		-0.020
		0.016		0.023
China 80s		0.355		0.130
		0.011		0.022
China 90s		0.569		0.466
		0.010		0.025
Constant	-0.287	-0.280	-0.056	-0.060
	0.066	0.066	0.035	0.035
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	3,006	3,006	533	533
Unique Countries	110	110	79	79
R^2	0.25	0.27	0.24	0.25

Notes: Table reports OLS regression results of country-year manufacturing export similarity index with the OECD on country real per capita GDP and skill abundance from 1972 to 2001. Explanatory variables include an aggregate China dummy as well as this dummy interacted with dummies for the 1970s (i.e.,1972-1979), 1980s (i.e.,1980-1989)) and 1990s (i.e.,1990-2001). Robust standard errors adjusted for clustering at the country level reported below each coefficient. All coefficients except the China70 dummy in column 4 are statistically significant at the 1% level. The p-value for the insignificant dummy is 0.39.

Table 13: China's Relative Export Similarity Index with the OECD

	Log(uv_{pct})	Log(uv_{pct})	Log(uv_{pct})	Log(uv_{pct})
Log (Real $PCGDP_{ct}$)	0.254	0.256		
	0.029	0.029		
Log (Skill $Abundance_{ct}$)			0.481	0.483
			0.078	0.079
China Dummy	-0.166		-0.780	
	0.079		0.068	
China 70s		0.304		-0.427
		0.087		0.073
China 80s		0.168		-0.383
		0.083		0.058
China 90s		-0.311		-0.893
		0.078		0.072
Constant	0.911	0.924	1.410	1.405
	0.129	0.240	0.256	0.257
Product-Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	2,037,991	2,037,991	411,710	411,710
Unique Products	20,660	20,660	14,052	14,052
Unique Countries	155	155	101	101
Adj R^2	0.72	0.72	0.71	0.71

Notes: Table reports OLS regression results of country-product unit values on country real per capita GDP and skill abundance from 1972 to 2001. Sample restricted to products originating in at least two countries with real PCGDP below 10% and above 90% of the U.S. level in that year, respectively. Explanatory variables include an aggregate China dummy as well as this dummy interacted with dummies for the 1970s (i.e.,1972-1979), 1980s (i.e.,1980-1989)) and 1990s (i.e.,1990-2001). Robust standard errors adjusted for clustering at the country level reported below each coefficient. All coefficients (except constant) are statistically significant at the 5% level.

Table 14: China's Relative Export Prices 1972-2001

	5 Chemicals	6 Manuf Mat	7 Machinery	8 Misc Manuf
	Log(uv_{pct})	Log(uv_{pct})	Log(uv_{pct})	Log(uv_{pct})
Log (Real $PCGDP_{ct}$)	0.17	0.22	0.28	0.28
	0.04	0.02	0.06	0.03
China 70s	0.12	0.37	0.27	0.22
	0.15	0.08	0.24	0.07
China 80s	0.07	0.15	0.05	0.17
	0.14	0.08	0.22	0.06
China 90s	-0.21	-0.20	-0.88	-0.17
	0.12	0.07	0.19	0.06
Constant	0.61	-0.05	1.94	1.24
	0.37	0.21	0.56	0.22
Product-Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	172,350	582,799	387,808	895,034
Unique Countries	2,700	6,294	3,866	7,820
Uniique Products	153	155	155	155
Adj R^2	0.54	0.62	0.70	0.68

Notes: Table reports OLS regression results of country-product unit values on country real per capita GDP and skill abundance from 1972 to 2001. Sample restricted to products originating in at least two countries with real PCGDP below 10% and above 90% of the U.S. level in that year, respectively. Explanatory variables include an aggregate China dummy interacted with dummies for the 1970s (i.e.,1972-1979), 1980s (i.e.,1980-1989)) and 1990s (i.e.,1990-2001). Robust standard errors adjusted for clustering at the country level reported below each coefficient.

Table 15: China's Relative Export Prices 1972-2001, by Industry

Industry	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5 Chemicals	1.01	1.13	1.19	1.18	1.10	1.14	1.15	1.28	1.28	1.29	1.37
6 Manuf Mat	1.75	1.86	1.75	1.67	1.75	1.66	1.70	1.66	1.66	1.56	1.57
7 Machinery	3.20	3.30	3.36	3.43	3.24	3.36	3.27	3.20	3.20	3.22	3.28
8 Misc Manuf	2.14	2.13	2.11	2.11	2.16	2.13	2.09	2.11	2.03	1.96	2.01

Notes: Table displays mean log base 2 unit value ratios for OECD countries versus China across noted one-digit SITC manufacturing industries from 1991 and 2001. All ratios are statistically different from zero in a one-sided t-test at the 1% level. Observations for each industry range from 3,789 to 23,910.

Table 16: Mean OECD/China Manufacturing Unit Value Ratios

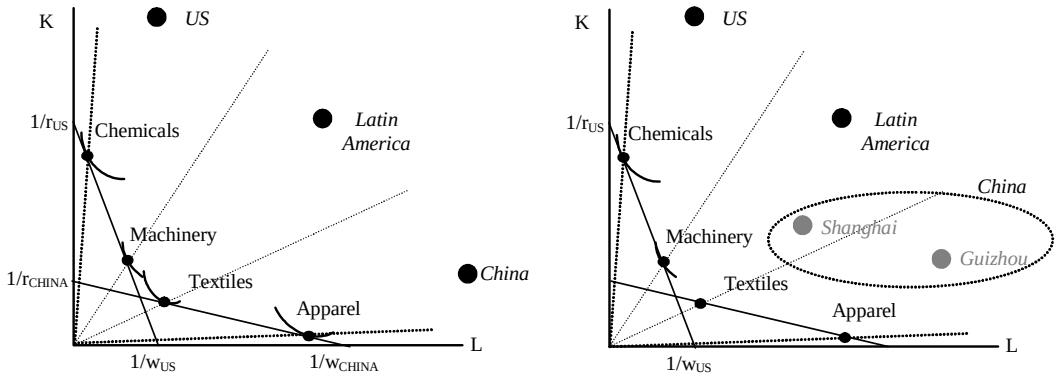

Figure 1: Inter- and Intra-National Specialization in a Multiple Cone Equilibrium

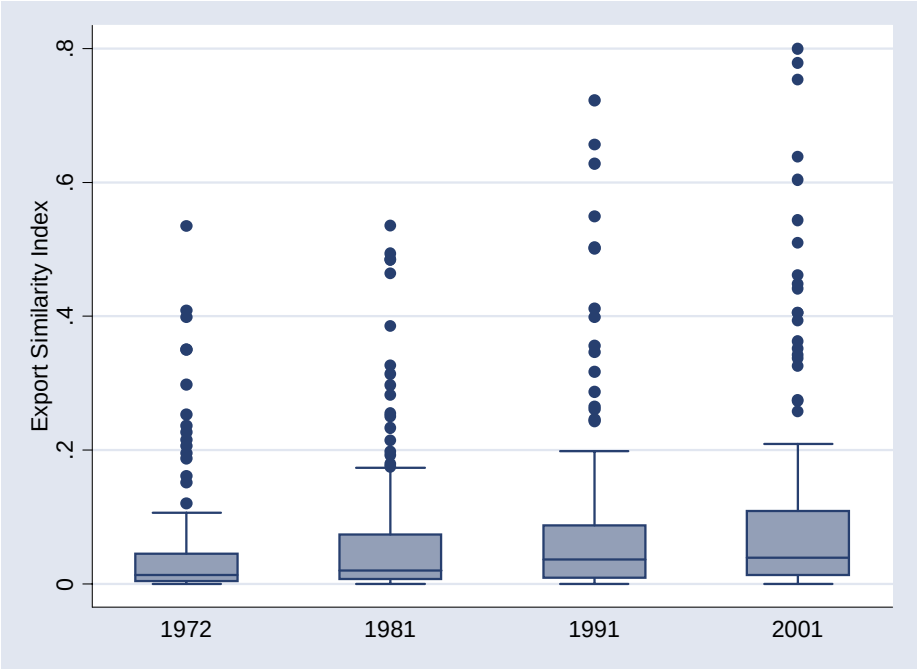

Figure 2: Distribution of U.S. Trading Partners' *ESI* with the OECD, 1972 to 2001