Chinese exports

SUMMARY

China's exports have grown dramatically over the last three decades in large part due to its rapid penetration of new product markets. To help address the implications of this growth for developed economies, this paper gauges the relative sophistication of Chinese exports along two dimensions. First, I measure China's export overlap with developed countries by comparing the set of products China exports to the United States with the bundle of products exported by the OECD. Second, I compare Chinese and other countries' exports within product markets in terms of the price they receive in the US market. While China's export overlap with the OECD is much greater than one would predict given its low wages, the prices that US consumers are willing to pay for China's exports are substantially lower than the prices they are willing to pay for OECD exports. This fact, as well as the increase in the 'OECD premium' over time, suggests that competition between China and the world's most developed economies may be less direct than their product-mix overlap implies. It may also reflect efforts by developed-country firms to compete with China by dropping their least sophisticated offerings and moving up the quality ladder.

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The relative sophistication of Chinese exports

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1. INTRODUCTION

Speculation about the impact Chinese growth will have on developed and developing countries over the coming decade varies widely. Some observers predict the imminent end of manufacturing in developed economies like the United States and Europe, while others believe low- and middle-income countries are most at risk.

This paper analyzes very detailed information about countries' international trade with the United States to gain a better understanding of developed countries' susceptibility to competition from China. It considers both the breadth of product markets China has entered over the last three decades as well as changes in the relative prices of Chinese products within these product markets. The data show that China's penetration of the US market has been substantial and that its export bundle overlaps significantly with that of developed economies. On the other hand, Chinese

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exports sell at a discount relative to other countries, particularly the advanced economies that are members of the OECD. The existence of these price differences, as well as their increase over time, suggests that developed and developing economies may compete on terms other than price. In theory, such competition may help insulate workers in developed economies from the relatively low wages earned by workers in developing economies.

Conventional models of international trade imply that developed countries like the United States and those in the EU have little to fear and much to gain from the emergence of China. In these models, comparative advantage drives countries to specialize in unique subsets of goods that do not compete directly on world markets. In models where comparative advantage flows from countries' relative endowments of capital, skill and labor, extremely labor-abundant countries like China are expected to produce and export relatively labor-intensive goods such as toys and t-shirts. More capital- and skill-abundant countries like Germany, on the other hand, ought to manufacture and export capital- and skill-intensive goods such as pharmaceuticals and electron microscopes.

The extent to which countries specialize in different sets of goods influences how directly their workers compete, and is therefore a key determinant of the distributional implications of globalization. When all countries produce the same products, price-wage arbitrage implies that reductions in the world price of goods influences wages in all countries: if China's entry into the world toy market leads to a sharp reduction in the price of toys, then the wages of the low-skill workers that make toys will be driven down in every country. On the other hand, if China produces toys and Germany does not, low-skill German workers only gain from the emergence of a toy industry in China: their nominal wages are unaffected by the surge in toy exports, and the decline in toy prices leads to an increase in the amount of income they can spend on other products.

Though the intuition for these outcomes is motivated by specialization that takes place across industries, specialization might also be expected within industries or even within products. One reason for this is aggregation. If the product codes used to measure international trade are 'too' aggregate, they will erroneously place goods that are essentially different into the same product classification: 'Televisions', for example, might capture both high-definition flat panel displays as well as receivers with conventional cathode ray tubes.

On the other hand, differences in countries' exports within the very narrow product classifications examined in this paper may also reflect a more subtle phenomenon – vertical differentiation: Japan and China might both produce and export high-definition televisions, but the Japanese televisions might employ more sophisticated technology, be of much higher quality, or contain a richer set of attributes than the ones exported by China. These vertical differences should manifest in prices, with Japanese televisions fetching a much higher price in the US market than Chinese televisions due to consumers' willingness to pay for them. As with across-industry specialization, within-industry specialization based on vertical differentiation can influence the degree to which workers in developed economies are insulated from workers in developing countries. Intuitively, the less substitutable goods of greater and less sophistication are, the less strong is price-wage arbitrage and the more insulated the workers in the two types of countries will be.

To learn more about the potential impact of Chinese competition on developed country outcomes, this paper uses US import data to assess the relative sophistication of the Chinese export bundle both across and within products over a very long time horizon. I first compare the range of manufacturing product categories China exports to the United States between 1972 and 2005 with the range of manufacturing product categories exported by other countries, notably the developed economies in the OECD. I assume that the more similar a non-OECD country's export bundle is to the OECD, the more sophisticated its exports are revealed to be in the across-product dimension.

I find that China's overlap with the OECD *across* products is substantial and increasing over time. This result is surprising given China's level of development, but it is consistent with its size. Recent models of international trade stress consumers' love of variety and the impact of countries' size on their ability to supply that variety. In these models, larger economies produce and export broader ranges of goods. China had the fourth largest economy measured in terms of World Bank real GDP in 2005, up from a rank of eighteen in 1972.

Over the same period, China's export-bundle similarity with the OECD jumped from a rank of nineteen to four, just behind Korea, Mexico and Taiwan. This increase was driven by China's very rapid penetration of US product markets. Indeed, while China was present in just 9% of all manufacturing product categories in 1972, it was present in 85% of categories by 2005. No other country's growth in product penetration comes close to this increase. Even groups of countries have a hard time matching progress on this dimension. Product penetration for all of Latin America, for example, increased from 38% in 1972 to 69% in 2005.

To get a sense of how closely China and developed economies compete *within* product markets, I examine export prices (i.e. unit values) within product categories for evidence of vertical differentiation. It is well known in the international trade literature that countries' export prices vary positively with their level of development, that is, with their per capita GDP or their relative endowments of capital and skill versus labor (Schott, 2004). This relationship is consistent with the idea that countries use their endowment or technological advantages to embed higher levels of sophistication in their goods, and that consumers pay a higher price for this higher sophistication.

In the analysis below, I compare the prices China receives for its exports in the US market to those received by other countries as well as those received by the composite OECD. I find Chinese export prices to be consistently lower than the prices of countries at a similar level of development, and that this disparity increases over time in most industries. In a direct comparison with the OECD, I show that Chinese export prices are on average 23% lower in Chemicals, 40% lower in Manufactured Materials and 60% lower in Miscellaneous Manufactures and Machinery from 1980 to 2005. These discounts have widened over the past five to ten years.

The gap between Chinese and OECD export prices suggests that competition between China and the world's most developed economies might be less direct than their overlap in product markets implies. Indeed, the competition in differentiated manufactured goods analysed here contrasts markedly with the often stark price competition found in undifferentiated commodities such as wheat documented by Kevin O'Rourke in his discussion of this paper. Furthermore, it is possible that increases in the China-OECD price gaps over time are a reflection of developed economies 'moving up' or 'moving out' in response to trade with low-wage countries, that is, their tendency to either raise the sophistication of their incumbent varieties or drop the least-sophisticated varieties from their export bundle. Upgrading of this sort would be consistent with theoretical models of product cycling as well as evidence emerging from micro-studies of firms' reactions to globalization. It would support the view that the world's most skill- and capital-abundant economies will specialize in the most sophisticated varieties within product markets even as production of low-end varieties is ceded to less-developed economies. If that is the case, there is hope that manufacturing in high-wage developing countries will continue to survive competition from low-wage countries like China.

The remainder of this paper is structured as follows. Section 2 provides a brief description of relevant theories of international trade that stresses the intuitions relied upon in the analysis; Section 3 provides a short overview of China's position in terms of its relative size and level of development; Sections 4, 5 and 6 describe the major results of the paper; Sections 7 and 8 provide an interpretation of these results; and Section 9 concludes with a discussion of where future research might be most helpful.

2. A BRIEF SUMMARY OF INTERNATIONAL TRADE THEORY

My comparison of countries' export mix and export prices is guided by several strands of international trade theory. This section provides a brief introduction to the basic assumptions and intuitions of these models.

The Heckscher–Ohlin model, which has countries' product mix varying with relative factor endowments, can be used both to understand why countries specialize according to comparative advantage and to gain insight into the relationship between specialization and the distributional implications of international trade. So-called 'new' trade theory models, on the other hand, articulate a connection between country size and the range of goods a country will produce. Finally, models of international product cycling provide intuition for the movement of once cutting-edge goods from developed to developing economies over time.

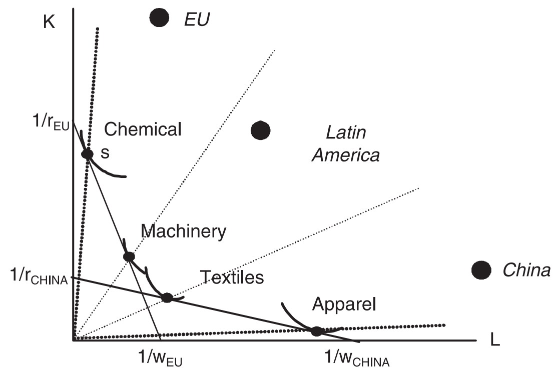

Figure 1. International specialization according to relative factor endowments

2.1. The Heckscher–Ohlin model ('old' trade theory)

The Heckscher–Ohlin model connects countries' resources to the mixes of goods they can profitably produce. A two-factor version of the Heckscher–Ohlin model, where the two factors are capital (K) and labor (L), is displayed in the Lerner diagram in Figure 1. This diagram features dollar-value isoquants for four industries – apparel, textiles, machinery and chemicals – that differ in terms of their capital intensity. Each isoquant traces out the amounts of capital and labor that can be combined to produce one dollar's worth of output in the noted industry. Given their relative positions in the figure, apparel is the most labor-intensive industry while chemicals is the most capital intensive: it takes relatively more capital to produce a dollar's worth of chemicals than a dollar's worth of apparel. Under standard assumptions, the four industries' unit-value isoquants carve out three 'cones of diversification', that is, three sets of relative endowment vectors selecting a unique mix of two industries. Dixit and Norman (1980) and Leamer (1984) provide detailed discussions of these assumptions and their implications.

A country's endowments of capital and labor determine the cone in which it resides. In the figure, the capital-abundant countries of the EU inhabit the most capital-abundant cone, while relatively capital scarce China is in the most labor-abundant cone. The countries of Latin America are assumed to reside in the middle cone.

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 of diversification, i.e. the two industries whose input intensities are most closely related to their endowments. Leamer (1987) provides a generalization of these implications to higher-dimensional settings.

The negative profits that the relatively capital-abundant countries of the European Union 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 EU (via the downward sloping isocost line defined by r_{EU} and w_{EU}) with the amount of capital and labor needed to produce one dollar's worth of output (via the dollar-value isoquants). A key message of Figure 1 is that relatively high production costs keep industries out of industries at odds with their comparative advantage.

The Heckscher-Ohlin model provides useful insight into the relationship between specialization and relative wages across countries. In the endowment-driven specialization depicted in Figure 1, for example, workers in the EU are insulated from goods-price changes caused by the emergence of China. If China's entry into world markets drives down the price of labor-intensive apparel, the relative returns to capital and labor in any country producing these goods will also change. In the figure, this is because of 'price-wage' arbitrage, that is, the fact that relative wage lines are defined by goods prices: when the price of a good falls, it takes more capital and labor to produce one dollar's worth of output, so the isocost lines tangential to the dollar-value isoquants adjust.

In Figure 1, relative wages in the EU are unaffected by China's entry into the apparel market. That is because its specialization breaks wage-price arbitrage: its participation in industries other than those produced by China means that its relative wages are determined solely by prices in those other industries. Indeed, if China were to drive down the price of apparel, EU workers would benefit by having more income available to spend on other products.

Trade barriers, of course, can provide incentives for countries to act against their comparative advantage. Import tariffs (which are assumed to be zero in Figure 1) drive a wedge between the price of a good inside a country and its price on world markets, that is, the prices displayed in the figure. If the EU were to impose sufficiently high import tariffs on apparel, then production of apparel in the EU would be profitable because the distorted EU price would cover its relatively high production costs. In that case, trade liberalization would necessitate the loss of apparel industry jobs and the lowering of their tariff-protected wages. As tariffs are removed, EU firms that found it profitable to produce apparel under tariff protection would drop those products or fail outright. Resources freed up from these adjustments would move towards firms producing chemicals and machinery, that is, the industries that are consistent with the EU's comparative advantage. As discussed in greater detail below, evidence in favour of such reallocations has been found in examinations of US firms' responses to trade liberalization.

In a similar way, trade policies that promote exports in China can increase the range of products Chinese firms export to the United States. Under those circumstances, the observed export overlap between China and the OECD would be 'artificially' high.

The specialization displayed in Figure 1 provides intuition for the first dimension of across-product sophistication developed in this paper. Because countries' product mix is a function of the relative similarity of their endowments, China and the EU are predicted to have few industries in common. In the figure, Latin America occupies the middle cone of diversification, with the labor-intensive portion of its product mix overlapping that of China and the capital-intensive portion of its product mix overlapping that of the EU. I return to a potential implication of such a setting in the discussion of Figure 4 in Section 7 below. In a more general, three-factor setting, these overlaps might be less extreme given Latin American land abundance. Leamer *et al.* (1999) offer a more detailed discussion of the potential effects of Latin American resource abundance on development, in particular, how the attractiveness of using low-cost resources provides a disincentive for capital accumulation.

This discussion highlights one method for gauging the ‘closeness’ of competition between China and the OECD: looking across industries and asking how many they export in common to a third country like the United States.

A slight change in perspective renders Figure 1 useful for understanding the second dimension of export sophistication relied upon in this paper – vertical differentiation. For that intuition, one should reinterpret the industry isoquants in Figure 1 as representing vertically differentiated products in a single industry. Instead of apparel, textiles, machinery and chemicals, consider four different types of televisions: cheap black-and-white tube televisions, colour tube televisions, rear-projection televisions and plasma displays. These vertically differentiated products might each be located on a separate dollar-value isoquant in the figure, and countries would choose to produce a different level of quality in the television market depending upon their relative endowments. Empirically, if such vertical differentiation takes place within the product classification codes used to track countries’ international trade, it might be discerned by examining the relative prices of countries’ exports within these product categories. That is the strategy I rely upon below.

2.2. New trade theory

A key implication of the Heckscher–Ohlin model is that trade between two countries increases with the disparity in their comparative advantage. This implication is at first sight hard to reconcile with the observation that a large share of international trade takes place within industries between relatively similar trading partners (Grubel and Lloyd, 1975). Germany and the United States, for example, carry on a robust two-way trade in automobiles.

This dissonance between theory and data has led to the development of ‘new’ trade theory models that emphasize consumer love of variety and horizontal product differentiation as drivers of international trade (see, for example, Krugman, 1980). In these models, firms ‘specialize’ in distinct horizontal varieties (e.g. Volkswagens and Fords), and consumers’ love of variety induces countries to engage in intra-product trade. An important implication of these models is that the number of horizontal varieties a country produces is predicted to be a function of the resources at its disposal – that is, the overall size of its economy or labor force. Hummels and Klenow (2005), for example, find a positive correlation between country size and the number of product categories countries export.

Though China is relatively skill scarce, its labor force and economy are quite large. Thus, a key implication for China from new trade theory models is that China will produce a greater number of varieties than smaller countries, all else being equal. To the extent that the industry or product classifications used to track international trade capture such horizontal differentiation, one would expect it to have greater product penetration in the US market than smaller countries. Note that to the extent horizontal product differentiation takes place *within* narrow product categories – for example red shoes versus black shoes – it is much more difficult to detect using existing trade datasets. In the results below, I find that larger countries have greater overlap with the range of products exported by the OECD, a feature of the data that fits this model well.

A related literature in international trade that provides insight into how the relative sophistication of countries' export can be measured considers the impact of economic growth on countries' terms of trade. The classical argument (e.g. Johnson, 1958) is that economic growth depresses a countries' terms of trade because the greater supply of exports associated with this growth leads to a decline in export prices. As noted above, this effect might be moderated or overturned by vertical differentiation, as the capital and skill deepening that occurs concomitant with development leads countries into cones of diversification anchored by more sophisticated products. Results in Schott (2004), for example, offer support for the view that emerging economies on relatively fast development tracks experience relatively rapid growth in export prices.

A negative correlation between economic growth and export prices might also be mitigated by horizontal differentiation: by increasing exports via variety proliferation rather than by exporting more and more of a given variety, downward pressure on export prices can be averted (Krugman, 1989, Corsetti *et al.*, forthcoming). As noted above, identifying this outcome in international trade datasets is difficult if horizontal differentiation occurs within product categories.

2.3. International product cycles

In models of international product cycling, developed countries invent and export the most sophisticated goods to developing countries until the latter figure out how to replicate them (Posner, 1961; Vernon, 1966, 1979). At that point, owing to their lower labor costs, developing countries drive developed countries out of the market and become the sole suppliers. A 'quality ladder' variant of this model has developed and developing countries trading dominance in varieties of a particular good over time, as developed countries re-enter the markets of existing goods by innovating and offering a more sophisticated version (Grossman and Helpman, 1991).

These models can provide intuition for how globalization influences relative incomes as well as the location of production. Zhu and Trefler (2005), for example, examine a model in which countries' comparative advantage is derived from differences in both productivity and factor-endowments. In the model, relatively fast productivity growth in developing countries allows them to catch up to developed countries. As a result of these gains, the least skill-intensive industries in the developed economies move to developing economies, where they become the most skill intensive. This movement raises the demand for skill in all countries, pushing up the skill premium and therefore income inequality. Productivity growth in developing economies also pushes up the skill premium via a more subtle channel: by raising the amount of output a given low-skilled worker can produce, relatively fast productivity growth in developing economies increases the world's effective supply of unskilled labor.

3. A BRIEF SUMMARY OF CHINA'S RELATIVE ENDOWMENTS

There is no doubt that China is labor abundant. Tables 1 and 2 provide complementary views of this labor abundance relative to other countries in Asia, the Caribbean, Latin America and the OECD. (A mapping of countries to regions is provided in Table 5 and discussed in the next section.) Table 1 compares China's relative endowments to the mean relative endowments of other countries, by region. The first four columns summarize educational attainment as estimated by Barro and Lee (2000). They reveal that highly skilled workers – that is, those with more than a secondary school education – are relatively scarce in Asia compared to Latin America, and scarcer still in China. While 13% of Latin America's population had attained a post-secondary education by 1999, the numbers are 8% and 3% for Asia and China, respectively. China also has a higher share of workers without any schooling than Latin America or the Caribbean: 21% of its population, versus 18% for both the Caribbean and Latin America, have never received formal schooling.

Table 2 reports the location of China in the distribution of other regions' 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 it below the median of the Asian, Latin American and Caribbean distributions. As indicated in the table, 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% of Asian countries, 68% of Latin American countries and 67% of Caribbean countries. By comparison, China's location in the World Bank PPP-adjusted real GDP distribution increases from the 94th to the 99th percentile from 1972 to 2005.

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 capital per capita in 1990 (from Nehru and Dhareshwar, 1993) of US$ 2274 is also relatively low, placing it at the 21st percentile of the Latin American distribution (between Ecuador and Honduras). I compare regions' capital per capita in Tables 1 and 2 using the median

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	32	32	27	8	0.14	3339
Carribean	18	44	31	7	0.08	6212
Latin America	18	49	20	13	0.25	5590
OECD	5	34	40	21	0.38	67688
China	21	42	36	3	0.10	2274

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 2. Where China fits in other regions' relative endowments

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 be 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. 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).

rather than the mean because of significant outliers (for Mexico and Uruguay among others) in the dataset.

Though China as a whole is extremely labor abundant, its provinces vary substantially in terms of their levels of development. This internal heterogeneity is noteworthy given the theoretical models discussed above. It implies that coastal Shanghai's relative skill- and capital-abundance may provide it with the resources to produce a more sophisticated range of goods than the much more labor-abundant inland province of Guizhou. As discussed above, such an outcome depends on factor immobility: if labor were freely mobile in China, workers in provinces with relatively low wages like Guizhou would have an incentive to move to provinces like Shanghai where wages are higher. These movements would lead to convergence in factor prices, relative endowments and product mix.

There is, of course, ample reason to believe that labor is not freely mobile within China. As documented in Bannister (2005), the Chinese government explicitly controls the ability of workers from the inland provinces to migrate and seek employment in

Table 3. Inter-regional relative endowment disparities within China

Province or region	PCGDP (CNY mill)	Illiteracy (%)	Province or region	PCGDP (CNY mill)	Illiteracy (%)
Shanghai Municipality	30 805	8.7	Hunan	5105	11.1
Beijing Municipality	19 846	6.5	Henan	4894	16.3
Tianjin Municipality	15 976	8.0	Chongqing Municipality	4826	4.0
Zhejiang	12 037	15.7	Shanxi	4727	9.1
Guangdong	11 728	9.2	Anhui	4707	20.3
Fujian	10 797	18.5	Qinghai	4662	30.5
Jiangsu	10 665	16.8	Jiangxi	4661	13.2
Liaoning	10 086	7.2	Ningxia Hui AR	4473	23.3
Shandong	8673	20.2	Sichuan	4452	24.3
Heilongjiang	7660	9.8	Yunnan	4452	16.8
Hebei	6932	11.4	Xizang (Tibet) AR	4262	66.2
Hubei	6514	15.0	Guangxi Zhuang AR	4148	12.4
Xinjiang Uygur AR	6470	9.8	Shaanxi	4101	18.3
Hainan	6383	14.6	Gansu	3668	25.6
Jilin	6341	6.8	Guizhou	2475	24.5
Neimongu (Mongolia) AR	5350	16.4			

Notes: The official CNY per USD exchange rate for 1999 is 8.27. Using this exchange rate, per capita GDP (PCGDP) ranges from US$3725 to US$299. Regions are sorted according to PCGDP. AR=Autonomous region.

Source: China Statistical Yearbook, 2000. Quoted from OECD (2001).

coastal provinces. As a result, the Chinese economy as a whole may be able to profitably produce a larger range of goods than would be expected of a country with a more uniform distribution of endowments at a similar aggregate level of development.

Unfortunately, data comparable to Tables 1 and 2 on the distribution of factors within China are 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 and illiteracy from the Chinese government quoted in OECD (2001). Regions in the table are sorted according to per capita GDP, which ranges from US$ 3275 (CNY 30 805) in Shanghai to US$ 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 US$ 10 855, US$ 5934 and US$ 3538, respectively, and that China's aggregate per capita GDP in that year is US$ 856. The final column of Table 3 reports Chinese regional illiteracy rates. These range from a high of 66% 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%, respectively. Intra-national PCGDP and illiteracy in China have a correlation of –0.33.

Though these comparisons are by no means rigorous, they and anecdotal evidence 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 China overall.

4. PRODUCT-LEVEL TRADE DATA

Product-level trade data provide much sharper resolution of the sophistication of countries' export bundles than traditionally available industry-level trade data for two reasons. First, while all countries generally export in all industries (e.g. 'machinery'), they exhibit substantial heterogeneity in their product participation within industries. Second, product-level international trade data permit examination of trading-partner heterogeneity within product markets via unit values (e.g. 'dollars per dozen shirts').

The data used in this paper are drawn from Feenstra *et al.* (2002) for 1972 to 1989 and the US Customs Service for 1990 to 2005. They record the customs value of all US imports by exporting country and year from 1972 to 2005 according to thousands of finely detailed categories, which I refer to as 'products' or 'goods'. Imports are classified according to the seven-digit Tariff Schedule of the United States (TSUSA) codes from 1972 through 1988 and according to the ten-digit Harmonized System (HS) codes from 1989 through 2005. As discussed further below, this break in the use of product codes in 1989 places some limits on our ability to track countries' exports at the product-level over time. I refer to imports at higher levels of aggregation, such as the one- or five-digit Standard International Trade Classification (SITC) system, as 'industries'. Note that SITC industry codes at the one-digit level are defined consistently throughout the sample period. I refer to country-specific imports within product categories as 'varieties'.

Table 4 lists the number of product categories by one-digit SITC industry in both 1972 and 2005. SITC codes beginning with 0 through 4 comprise resource products, while those beginning with 5 through 8 encompass manufacturing goods, which are the focus of this study. Two of the manufacturing industries, Manufactured Materials (SITC 6) and Miscellaneous Manufactures (SITC 8) – which include textiles (SITC 65) and apparel (SITC 84), respectively – account for the largest share of products in both periods. Machinery (SITC 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 SITC 9 (Not Elsewhere Classified) from the analysis.

To facilitate the comparison of countries' export bundles and unit values, I make use of the country-region assignments provided in Table 5. Three 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, 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 during the sample period. Even so, the 1974 cohort still includes Ireland and Turkey.

It should also be noted that my mapping of countries into regions places Japan in the OECD group rather than the Asia group. Finally, the actual set of countries

Table 4. TSUSA and HS products by one-digit SITC industry

One-digit SITC	Two-digit SITC examples	Product examples	Number of five-digit SITC	Number of products (1972/2005)
0 Food	Meat, Dairy, Fruit	Live Sheep	197	704/1954
1 Beverage/Tobacco	Wine, Cigarettes	Carbonated softdrinks	17	77/166
2 Crude Materials	Rubber Cork, Wood, Textile Fibers	Silkworm cocoons suitable for reeling	175	646/820
3 Mineral Fuels	Coal, Coke, Petroleum	Unleaded gasoline	26	49/114
4 Animal/Vegetable Oils	Lard, Soybean Oil	Edible tallow	24	60/80
5 Chemicals	Organic Chemicals, Dyes, Medicines, Fertilizer, Plastics	Chloroform	251	758/2108
6 Manufactured Materials	Leather, Textile Yarn, Paper, Steel	Diaries and address books of paper or cardboard	445	2868/4727
7 Machinery	Generators, Computers, Autos	Ultrasonic scanning apparatus	298	648/3071
8 Misc Manufacturing	Apparel, Footwear, Scientific Equipment, Toys	Boys' shorts cotton playsuit parts, not knit	258	1870/3738
9 Not Elsewhere Classified	Special Transactions, Coins, Gold	Sound recordings for State Department use	9	51/84

Notes: Number of products refers to seven-digit TSUSA categories for 1972 and ten-digit Harmonized System (HS) categories for 2005. SITC industries are consistently defined across the sample period and are therefore the same in both 1972 and 2005.

Source: US Customs Service; author's calculations.

Table 5. US trading partners, by region

Country	Region	Country	Region	Country	Region
Afghanistan	AS	Bahamas	CAR	Suriname	LA
American Samoa	AS	Barbados	CAR	Uruguay	LA
Bangladesh	AS	Dom Rep	CAR	Venezuela	LA
Cambodia	AS	Guadeloupe	CAR	Australia	OECD
China	AS	Haiti	CAR	Austria	OECD
Fiji	AS	Jamaica	CAR	Belgium	OECD
Hong Kong	AS	Neth Antilles	CAR	Canada	OECD
India	AS	St. Kitts and Nevis	CAR	Denmark	OECD
Indonesia	AS	Trinidad	CAR	Finland	OECD
Kiribati	AS	Argentina	LA	France	OECD
Korea	AS	Belize	LA	Germany	OECD
Lao	AS	Bolivia	LA	Greece	OECD
Macao	AS	Brazil	LA	Iceland	OECD
Malaysia	AS	Chile	LA	Ireland	OECD
Mongolia	AS	Colombia	LA	Italy	OECD
Myanmar	AS	Costa Rica	LA	Japan	OECD
Nepal	AS	Ecuador	LA	Netherlands	OECD
New Caledonia	AS	El Salvador	LA	New Zealand	OECD
Pakistan	AS	Guatemala	LA	Norway	OECD
Papua New Guinea	AS	Guyana	LA	Portugal	OECD
Philippines	AS	Honduras	LA	Spain	OECD
Singapore	AS	Mexico	LA	Sweden	OECD
Sri Lanka	AS	Nicaragua	LA	Switzerland	OECD
Taiwan	AS	Panama	LA	Turkey	OECD
Thailand	AS	Paraguay	LA	UK	OECD
Vietnam	AS	Peru	LA		

Notes: Countries sorted alphabetically by region. Region affiliations are mutually exclusive. AS=Asia. CA=Caribbean; LA=Latin America. OECD definition excludes post-1973 entrants (e.g. Mexico and Korea).

within each region used in computing any given summary statistic may vary depending upon data availability.

My comparison of Chinese and other countries' trade patterns proceeds under the assumption that US trading partners' exports to the US accurately reflect their domestic production as well as their exports to other markets. This assumption is partially justified by the relative openness of the US economy and its attractiveness as an export destination. Nevertheless, variation in countries' demand, the existence of tariff and non-tariff barriers (for example, the global Multifiber Arrangement or the subsequent Agreement on Textiles and Clothing), 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. Deardorff (2004), for example, offers an insightful discussion of how transport costs create and influence countries' 'local' comparative advantage. On the other hand, as Fontagné, Gaulier and Zignago (2007) document in this volume, the basic trends I find in this paper are echoed in the import statistics of other countries, albeit at a higher level of product aggregation.

5. ACROSS-PRODUCT SOPHISTICATION

To provide greater context for understanding US trading partners' export similarity, I briefly compare China's performance in the US market in terms of market share and product penetration to that of other regions. Even cursory analysis reveals that China's performance in these dimensions has been exceptional.

5.1. Chinese market share and product penetration

Table 6 reports the US market share of Asia, Latin America, the OECD and China in terms of import value (V), by industry, for the first and last years of the sample. The market share of region r in year t and industry i is the sum of the regions' exports to the United States as a share of all countries exports to the United States,

$$MS_{tri} = 100 \times \sum_{c \in r} V_{tci} \Big/ \sum_{c} V_{tci}, \qquad (1)$$

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

The market shares displayed in Table 6 convey several messages. First, they show that exports from the world's most developed economies, proxied here by the aggregate OECD, dominate the US market, though less so over time. While the OECD accounted for 83% of manufacturing imports in 1972, this share falls to 48% by 2005. Second, they reveal that China is the main contributor to Asia's overall growth. China's share of manufacturing imports increases steadily from essentially 0% in 1972 to 19% in 2005, driven by a relatively large gain in Miscellaneous Manufacturing (which includes apparel and toys). By comparison, over the same interval, the remaining countries in Asia saw their market share increase from 10% to 16%.

China's 19 percentage point jump in market share dominates all other US trading partners except for Mexico, whose market share rises from 2 to 10%. Table 7 reports

Table 6. US import value market share by region and year

SITC1 industry	China		Asia		Latin America		OECD	
	1972	2005	1972	2005	1972	2005	1972	2005
5 Chemicals	0	4	2	6	6	6	85	76
6 Manufactured Materials	0	15	10	14	5	15	80	48
7 Machinery	0	17	5	17	2	15	93	50
8 Misc Manufacturing	0	36	29	20	4	13	64	27
Overall Manufacturing	0	19	10	16	3	14	83	48

Notes: Cells display the market share of each region's or country's exports to the US. Asia results exclude China.
Source: Author's calculations.

Table 7. Largest gains in market share, 1972 to 2005

Country	1972	2005	Change	% change
China	0.04	19.26	19.22	47 912
Mexico	1.96	10.44	8.47	431
Malaysia	0.42	2.61	2.19	524
Ireland	0.25	2.22	1.97	797
Korea	1.79	3.32	1.53	85
Thailand	0.20	1.38	1.18	601
Brazil	0.50	1.39	0.89	176
Israel	0.53	1.30	0.77	145
Indonesia	0.04	0.74	0.69	1634
India	0.77	1.36	0.59	76
Singapore	0.58	1.11	0.53	92
Average	0.10	0.54	0.44	465

Notes: Table lists US trading partners with the top ten absolute changes in US manufacturing import market share between 1972 and 2005.

Source: Author's calculations.

the countries with the top ten absolute changes in manufacturing market share between 1972 and 2005. China tops the list.

Increases in market share occur through increasing exports of incumbent products and an increase in the number of products exported. Table 8 focuses on regions' performance in the latter by examining manufacturing product penetration by industry over the sample period. Each cell in the table reports the percentage of products in each industry exported by China or the countries in the noted regions. Regional penetration is 100% if every product in the industry is exported by at least one country in the region and 0% if no country in the region exports any of the industry's products to the United States. The total number of products in each industry in 1972 and 2005 is reported in the final column of Table 4. As above, results for Asia exclude China and Japan.

As indicated in the table, product penetration by the OECD is virtually 100% throughout the sample period. This fact, by itself, is puzzling from the standpoint of the Heckscher–Ohlin model: why should the most developed economies in the world export every good? The answer, discussed in more detail below, comes from new trade theory: the most developed economies are among the largest.

Table 8 also shows that product penetration by Asian and Latin American countries, though substantially lower than the OECD in 1972, has increased markedly over time. Finally, Table 8 reveals that China, by itself, has experienced a very large increase in product penetration, from 9% of all products in 1972 to 85% by 2005. Table 9, which ranks countries with the biggest absolute gains in penetration between 1972 and 2005, shows that China's 76 percentage point increase is the largest of any trading partner by a factor of more than two.

Overall, China's nominal manufacturing exports to the United States grew from US$ 9 million in 1972 to US$ 176 billion in 2005. To gauge the relative importance

Table 8. Product penetration by region and year

SITC1 industry	China		Asia		Latin America		OECD	
	1972	2005	1972	2005	1972	2005	1972	2005
5 Chemicals	4	76	16	70	22	51	98	97
6 Manufactured Materials	7	80	45	81	34	70	96	97
7 Machinery	1	83	56	87	51	75	100	99
8 Misc Manufacturing	16	91	72	89	45	74	98	95
Overall Manufacturing	9	85	51	83	38	69	97	97

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

Source: Author's calculations.

Table 9. Largest gains in product penetration, 1972 to 2005

Country	1972	2005	Change	% change
China	9	85	76	853
Korea	19	55	36	195
India	18	53	35	190
Mexico	26	57	31	118
Thailand	6	36	31	544
Taiwan	30	56	26	88
Indonesia	2	28	26	1315
Brazil	14	39	25	183
Malaysia	3	25	22	644
Canada	52	73	21	41
Average	7	13	6	90

Notes: Table lists US trading partners with the top ten absolute changes in US manufacturing import product penetration between 1972 and 2005.

Source: Author's calculations.

of product penetration in this increase, I decompose China's overall manufacturing export growth into that which is attributable to continuously produced goods (the 'intensive' margin) and that which is due to the net adding and dropping of products (the 'extensive' margin). In contrast to Table 8, Table 10 examines the extensive margin according to five-digit SITC industries rather than TSUSA or HS product categories. The reason for this, as noted above, is that TSUSA and HS categories change frequently throughout the sample period. SITC industries have just a single break, in 1988: before 1988, the data are tracked with SITC Revision 2; after 1988, they are tracked with SITC Revision 3. As a result, decompositions are performed for each half of the sample. Results are shown for China's overall manufacturing exports to the United States (final two rows) as well by manufacturing industry.

As indicated in the table, the relative contribution of the extensive versus intensive margins varies across industries and time periods. The extensive margin is relatively more important in the first half of the sample than in the second half, particularly for

Table 10. Decomposing China's US export growth, 1972 to 2005

Industry	Margin	1972–88	1989–2005
5 Chemicals	Intensive Margin	43	77
	Extensive Margin	57	23
6 Manufactured Materials	Intensive Margin	53	79
	Extensive Margin	47	21
7 Machinery	Intensive Margin	1	95
	Extensive Margin	99	5
8 Misc Manufacturing	Intensive Margin	66	99
	Extensive Margin	34	1
Overall Manufacturing	Intensive Margin	55	94
	Extensive Margin	45	6

Notes: Table decomposes nominal Chinese export growth to the United States over the noted intervals according to the net increase due to continuously exported five-digit SITC industries (the 'intensive margin') and the net growth due to the adding and dropping of industries (the 'extensive margin'). Amounts are rounded to the nearest integer. First period tracks products according to SITC revision 2; second period tracks products across SITC revision 3.

Source: Author's calculations.

Machinery. Overall, the extensive margin accounts for 45% of China's export growth from 1972 to 1988 but just 6% of its growth from 1989 to 2005. Note that the results in Table 10 may underestimate the importance of the extensive margin to the extent that they use five-digit SITC industries rather than the more numerous seven-digit TSUSA or ten-digit HS product categories.

5.2. Export similarity with the OECD

This section gauges the relative sophistication of China's manufacturing export bundle in terms of its similarity to that of the aggregate OECD. Two findings stand out. First, China's export similarity with the OECD increases substantially, and far more than for any other US trading partner, over the sample period. Second, though China's export similarity with the OECD is higher than one would expect given relative level of development, it is consistent with its size.

I measure the overlap in countries' export bundles via Finger and Kreinin's (1979) export similarity index (ESI). For any two US trading partners c and d in year t, this index is just the sum of the two countries' minimum presence in each good,

$$ESI_t^{cd} = \sum_p \min(s_{tp}^c, s_{tp}^d), \tag{2}$$

where presence (s_{tp}^c) is just the share of country c's export value in manufacturing product p relative to all of its exports in year t. This bilateral measure can be computed using all manufacturing products or by manufacturing industry. In either case the index is bounded by zero and unity: ESI_t^{cd} equals zero if countries c and d have no products in common in year t and ESI_t^{cd} equals unity if their exports are distributed

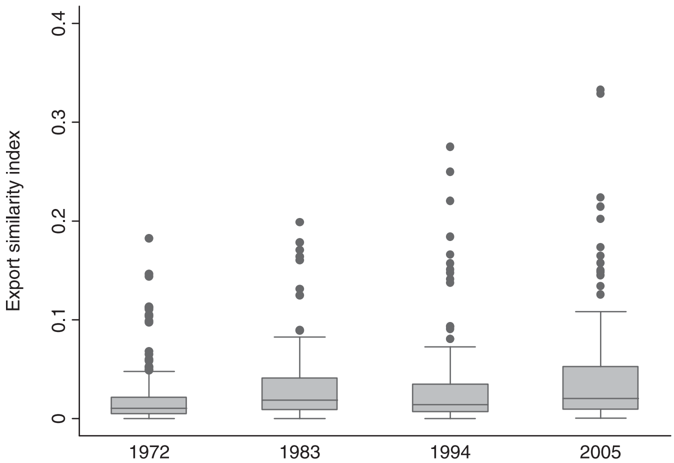

Figure 2. Distribution of countries' export similarity with the OECD, 1972 to 2005

Note: Figure displays the distribution of non-OECD countries' export similarity index (ESI) vis-à-vis the OECD over ten-year intervals between 1972 and 2005. Boxes outline the interquartile range, while lines within each box report the median.

Source: Author's calculations.

identically across products. To compare two regions (or to compare a region with China), I sum exports over all countries in the region first and then use region-level rather than country-level export shares in equation (2).

Figure 2 summarizes the distribution of non-OECD countries' export similarity with the OECD using box-and-whisker plots displayed at eleven-year intervals from 1972 to 2005. The box for each year spans the inter-quartile range of the data, while lines within the boxes record the median observation in each year. Circles above the whiskers represent individual observations that are outliers. A key message of the figure is that non-OECD countries' product-mix overlap with the OECD is increasing with time. This trend can be seen in the boxes' slow rise across the eleven-year intervals.

Perhaps unsurprisingly, China's exports are more similar to the other countries of Asia than with either the OECD or Latin America. This similarity is evident in Table 11, which reports China's ESI with Asia (which excludes China), Latin America and the OECD at eleven-year intervals from 1972 to 2005. The table reveals that China's overlap with countries outside Asia also has grown substantially over time.

China's export overlap with the OECD has increased far more than for any other US trading partner. Table 12 reports the twenty countries whose export bundle most resembles the OECD, at eleven-year intervals over the sample period. As indicated in the table, China's ESI increase from 0.05 to 0.21 results in its rank jumping from 19 in 1972 (near India) to a rank of 4 in 2005 (just behind Taiwan, Mexico and Korea). In the table, China's rank is highlighted and in bold text.

Table 11. Regions' export similarity with China

Region	Export similarity with China			
	1972	1983	1994	2005
Asia	0.14	0.30	0.37	0.46
Latin America	0.05	0.10	0.20	0.26
OECD	0.05	0.08	0.15	0.21

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

Table 12. Countries with the highest export similarity to the OECD, 1972 to 2005

1972		1983		1994		2005	
Mexico	0.18	Mexico	0.20	Mexico	0.28	Korea	0.33
Brazil	0.15	Korea	0.18	Korea	0.25	Mexico	0.33
Taiwan	0.14	Taiwan	0.17	Taiwan	0.22	Taiwan	0.22
Israel	0.11	Israel	0.16	Brazil	0.19	**China**	**0.21**
Korea	0.11	Brazil	0.16	Hong Kong	0.17	Brazil	0.20
Argentina	0.11	Hong Kong	0.13	Singapore	0.16	Poland	0.17
Hong Kong	0.11	Singapore	0.13	**China**	**0.15**	Israel	0.17
Czech Republic	0.10	Argentina	0.09	Malaysia	0.15	India	0.16
Poland	0.10	Yugoslavia	0.09	Israel	0.14	Singapore	0.15
Yugoslavia	0.10	Hungary	0.08	Thailand	0.14	Hong Kong	0.15
Colombia	0.07	Poland	0.08	Argentina	0.09	Thailand	0.15
South Africa	0.07	Saudi Arabia	0.08	Poland	0.09	Argentina	0.13
Venezuela	0.06	**China**	**0.08**	India	0.09	Hungary	0.13
Singapore	0.06	South Africa	0.07	Philippines	0.08	Malaysia	0.11
Hungary	0.05	Neth Antilles	0.07	Venezuela	0.08	Indonesia	0.11
Romania	0.05	India	0.07	Hungary	0.07	Philippines	0.10
Cyprus	0.05	Philippines	0.07	Indonesia	0.07	South Africa	0.10
Gibraltar	0.05	Panama	0.06	South Africa	0.07	Panama	0.09
China	**0.05**	Thailand	0.06	Bermuda	0.06	Romania	0.08
India	0.05	Colombia	0.06	Colombia	0.06	Colombia	0.08

Notes: Table displays non-OECD countries with the highest manufacturing export similarity index (ESI) with the OECD at noted intervals from 1972 to 2005.
Source: Author's calculations.

Regression analysis reveals that although China's manufacturing export similarity with the OECD is exceptional in terms of its level of development, it accords with its size. Table 13 reports coefficients from an OLS regression of the log of trading partners' ESI with the OECD on logs of measures of countries' relative development and size as well as a set of four China-decade interactions for the 1970s (i.e. 1972–1979); the 1980s (i.e. 1980–1989); the 1990s (i.e. 1990–1999) and the 2000s (i.e. 2000–2005),

$$\log(ESI_{tc}) = \alpha_t + \textit{country characteristics} + \gamma_d CHINA_d + \varepsilon_{tc}. \qquad (3)$$

Table 13. Export similarity with the OECD, all manufacturing

	ESI_{ct}	ESI_{ct}	ESI_{ct}	ESI_{ct}	ESI_{ct}
Log (Real $PCGDP_{ct}$)	0.015***			0.005***	0.020***
	0.003			0.002	0.004
Log (Skill $Abundance_{ct}$)		0.022***			
		0.005			
Log (Real GDP_{ct})			–0.192***	–0.189***	
			0.042	0.043	
Log (Real GDP_{ct})2			0.005***	0.004***	
			0.001	0.001	
Log ($Population_{ct}$)					–0.031
					0.019
Log ($Population_{ct}$)2					0.001**
					0.001
China 70s	0.049***	–0.010	–0.056***	–0.039***	–0.048*
	0.005	0.008	0.012	0.012	0.025
China 80s	0.070***	0.016**	–0.059***	–0.043**	–0.033***
	0.003	0.007	0.017	0.017	0.027
China 90s	0.134***	0.086***	–0.028	–0.014	0.027
	0.003	0.009	0.026	0.025	0.028
China 00s	0.164***	0.146***	–0.028	–0.016	0.055*
	0.005	0.009	0.033	0.032	0.029
Constant	–0.073***	–0.019	2.023***	1.961***	0.013
	0.021	0.011	0.469	0.472	0.146
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	3405	555	3405	3405	3405
R^2	0.24	0.21	0.63	0.65	0.48

Notes: Table reports OLS regression results of non-OECD countries' manufacturing export similarity with the OECD (ESI) on countries' real per capita GDP (PCGDP), skill abundance, real GDP and population from 1972 to 2005. Data on GDP and population are from the World Bank. Data on skill abundance are from Barro and Lee (2000). Explanatory variables include China dummies interacted with dummies for the 1970s (i.e., 1972–1979), 1980s (i.e., 1980–1989) and 1990s (i.e., 1990–1999) and the 2000s (i.e., 2000–2005). Robust standard errors adjusted for clustering at the country level reported below each coefficient. ***, ** and * denote statistical significance at the 1, 5 and 10% levels, respectively.

The China-decade interactions, indexed by *d*, facilitate examination of the extent to which China's actual export similarity index deviates from what the regression model would predict. Because the variables in the regression are in natural logs, these deviations can be interpreted as percentages. Robust standard errors adjusted for clustering at the country level are reported below each coefficient in the table.

In Table 13, I use PPP-adjusted real GDP as well as population, both from the World Bank's World Development Indicators database, to measure countries' size. For countries' level of development, I employ World Bank PPP-adjusted real per capita GDP and skill abundance, defined as the share of the population attaining a secondary or higher level of education according to Barro and Lee (2000). The latter data are available at five-year intervals rather than annually, a feature of the data accounts for the large difference in the number of observations across the columns of Table 13. To increase the sample size, I use the 1970 value for 1972 and the 2000 variable for 2005, so that there are two observations per decade; this change does not affect results in any substantial way. I use per capita GDP rather than an explicit measure of capital abundance to assess countries' level of development because the latter are unavailable for a large set of countries or for the full 1972 to 2005 sample period.

Results for four different specifications are reported. The first two columns indicate that countries' export similarity with the OECD increases with their level of development, that is, their per capita GDP or skill abundance. At the same time, the China-decade interactions reveal that China is a positive outlier relative to countries at a similar stage of development, and increasingly so over time: in column one, the coefficients for the China-decade dummies increase from 4.9% for the 1970s to 16.4% for the 2000s. These coefficients indicate that China exhibits significantly greater overlap with the OECD than one would expect from a country with its per capita GDP. Note that the magnitudes of the coefficients on the China-decade interactions are consistent with the unconditional export similarity indexes reported in Table 12. Though I also examined quadratic relationships in the first two specifications, they are statistically insignificant and are therefore omitted from the table.

The third column of Table 13 reveals that a substantially larger share of the variation in countries' export similarity indexes can be explained by a quadratic in country size than by relative levels of development. The R^2 in column three, at 63%, is three times higher than the R^2 in columns one and two. Moreover, the results in column three demonstrate that once one controls for country size, the coefficients on the China-decade interactions are negative and significant in the 1970s and 1980s and statistically indistinguishable from zero in the last two decades. This trend indicates that China overlapped less with the OECD than one would have expected early on, when its economy was more-or-less closed to the world, but that this situation reversed once it began entering world markets.

The fourth column of Table 13 demonstrates that simultaneously controlling for countries' level of development with per capita GDP contributes little additional explanatory power but results in China-decade coefficients that are closer to zero in magnitude across all four decades. Thus, after one jointly controls for size and level of development, China looks less like an outlier than it does after controlling for size alone.

As a check on the results in columns one through four, the final column of Table 13 repeats the specification in column four but uses population rather than GDP to measure countries' size. Results are very similar, though China's export similarity to the OECD is now significantly *larger* than one would expect in the final years of the sample. The China-decade interactions for the 1990s and 2000s are a statistically insignificant 2.7 and a statistically significant 5.5%, respectively. This outcome suggests China's PPP-adjusted GDP attributes relatively larger size to the country than its population, which seems reasonable.

A similar pattern of results is evident across the one-digit SITC industries within manufacturing. Table 14 reports the results of regressing ESI indexes specific to each industry on the specification from column four of Table 13. Coefficients for per capita GDP and GDP reveal that export similarity rises with both level of development and size.

Table 14. Export similarity with the OECD, by manufacturing industry

	5 – Chemicals ESI_{ct}	6 – Manuf Materials ESI_{ct}	7 – Machinery ESI_{ct}	8 – Misc Manuf ESI_{ct}
Log (Real $PCGDP_{ct}$)	0.006**	0.005**	0.008***	0.011***
	0.003	0.002	0.002	0.003
Log (Real GDP_{ct})	–0.163***	–0.213***	–0.214***	–0.137***
	0.029	0.044	0.044	0.028
Log (Real $GDP_{ct})^2$	0.004***	0.005***	0.005***	0.003***
	0.001	0.001	0.001	0.001
China 70s	–0.035***	–0.055***	–0.047***	0.003
	0.009	0.013	0.011	0.012
China 80s	0.030***	–0.043**	–0.028*	–0.014
	0.011	0.018	0.016	0.014
China 90s	0.037**	–0.023	–0.013	0.001
	0.016	0.024	0.024	0.019
China 00s	0.042**	–0.004	–0.047	0.011
	0.020	0.03	0.031	0.024
Constant	1.698***	2.221***	2.214***	1.314***
	0.325	0.493	0.497	0.303
Year fixed effects	Yes	Yes	Yes	Yes
Observations	2695	3286	2975	3359
R^2	0.60	0.66	0.67	0.62

Notes: Table reports OLS regression results of non-OECD countries' manufacturing export similarity with the OECD (ESI) on countries' real per capita GDP (PCGDP) and GDP from 1972 to 2005. Explanatory variables include China dummies interacted with dummies for the 1970s (i.e., 1972–1979), 1980s (i.e., 1980–1989) and 1990s (i.e., 1990–1999) and the 2000s (i.e., 2000–2005). Robust standard errors adjusted for clustering at the country level reported below each coefficient. ***, ** and * denote statistical significance at the 1, 5 and 10% levels, respectively.

Coefficients for the China-decade interactions for Machinery and Manufactured Materials follow the same pattern as they do for aggregate manufacturing. For Miscellaneous Manufactures, the interactions are statistically indistinguishable from zero in all four decades. In Chemicals, however, China has greater overlap with the OECD than one would expect given *both* its level of development and size. As demonstrated below, this industry is the one in which China's export prices most closely resemble those of the OECD.

6. WITHIN-PRODUCT SOPHISTICATION

This section measures the relative sophistication of Chinese export varieties within products in terms of relative prices. I find that Chinese varieties exhibit relatively low prices compared to countries with similar per capita GDP, and that this 'China discount' widens with time. *Vis-à-vis* the OECD, I find that Chinese relative export prices are low throughout the sample period and that they have decreased over the last five to ten years.

An extremely useful feature of the product-level US trade data is the inclusion of both quantity and value information for a large number of goods and countries. This renders possible the calculation of unit values as a measure of price. I compute the unit value of product *p* from country *c* (u_{pc}), by dividing the free-on-board (fob) import value by import quantity (Q), $u_{pc} = V_{pc}/Q_{pc}$. 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. For some years and products, there are multiple country observations of value and quantity in the raw data. In those cases, I define the unit value to be a value-weighted average of the observations. Availability of unit values ranges from 77% of product-country observations in 1972 to 84% of observations in 2005.

It is important to note that the unit values are measured with error. A study by the US General Accounting Office (1995), for example, identified classification error and underlying product heterogeneity as two major sources of unit value error in an in-depth analysis of eight products. Of course, identifying potential heterogeneity within product categories is a goal of this section.

To assess the price of Chinese exports relative to similarly developed countries, I regress country-product log unit values on country characteristics, a set of controls for distance and trade costs and, as above, a set of China-decade interactions for the 1970s, the 1980s, the 1990s and the 2000s,

$$\log(u_{tpc}) = \alpha_{tp} + \textit{country characteristics} + \textit{controls} + \gamma_d CHINA_c + \varepsilon_{tpc}. \qquad (4)$$

The regression also includes year-product fixed effects (α_{tp}) that account for the fact that units vary markedly across different kinds of goods. Note that although I do not screen the data in the regressions presented below, I get substantially similar results if I eliminate potentially suspect observations, that is, those where just a single unit are shipped or where total value is low. Robust standard errors adjusted for clustering at the country level are displayed below coefficients.

Unit values are known to increase with transportation costs (Hummels and Skiba, 2004). This relationship has been interpreted as capturing Alchian and Allen's (1964) idea that firms have an incentive to ship their highest quality goods to their furthest customers when facing per unit transport costs. As a result, in all specifications I control for US trading partners' great circle distance from the United States, whether or not a trading partner is landlocked, and *ad valorem* measures of tariff and transport costs. Inclusion of these variables follows Harrigan (2005). I compute *ad valorem* tariff and transport rates as the share of duties and customs, insurance and freight (cif) charges per import value, respectively, at the product-country-year level. Data on distance and being landlocked are from the Centre D'Etudes Prospectives et D'Informations Internationales (CEPII) website. Data on duties and cif charges are from Feenstra *et al.* (2002) and the US Customs Service.

The first two columns of Table 15 examine the quadratic relationship between unit values and per capita GDP, while the latter two columns focus on skill abundance. Both sets of results indicate that higher levels of development are associated with larger unit values over the ranges of per capita GDP and skill abundance observed

Table 15. China's relative export prices, all manufacturing, 1972 to 2005

	$Log(uv_{pct})$	$Log(uv_{pct})$	$Log(uv_{pct})$	$Log(uv_{pct})$
Log (Real PCGDPct)	−0.685**	−0.723**		
	0.299	0.328		
Log (Real $PCGDP_{ct}$)2	0.056***	0.057***		
	0.019	0.020		
Log (Skill $Abundance_{ct}$)			−1.300**	−0.952**
			0.554	0.455
Log (Skill $Abundance_{ct}$)2			0.265***	0.210***
			0.087	0.072
China 70s		−0.080		−0.190**
		0.176		0.081
China 80s		−0.162*		−0.186***
		0.084		0.066
China 90s		−0.403***		−0.659***
		0.041		0.088
China 00s		−0.480***		−0.758***
		0.065		0.079
Log ($Distance_c$)	2.536***	2.494***	4.282***	3.992***
	0.737	0.742	0.827	0.790
Log ($Distance_c$)2	−0.158***	−0.155***	−0.268***	−0.249***
	0.049	0.049	0.052	0.052
$Landlocked_c$	0.303***	0.298***	0.312***	0.316***
	0.070	0.069	0.073	0.074
Ad Valorem Tariff $Rate_{pct}$	−0.334**	−0.293**	−0.113	−0.066
	0.147	0.146	0.110	0.097
Ad Valorem Trade $Cost_{pct}$	−0.065	−0.067	−0.215***	−0.217***
	0.04	0.042	0.068	0.069
Constant	−5.270*	−4.859*	−12.492***	−11.903***
	2.825	2.871	3.218	3.133
Product-year fixed effects	Yes	Yes	Yes	Yes
Observations	3 745 640	3 745 640	811 498	811 499
R^2	0.80	0.80	0.80	0.80

Notes: Table reports OLS regression results of country-product unit values on country and product characteristics from 1972 to 2005. Explanatory variables include four China-decade dummies for the 1970s (i.e., 1972–1979), 1980s (i.e., 1980–1989) and 1990s (i.e., 1990–1999) and the 2000s (i.e., 2000–2005). Robust standard errors adjusted for clustering at the country level reported below each coefficient. Data on per capita GDP (PCGDP), GDP and population are from the World Bank. Data on unit values, duty and transport costs are from the US Customs Bureau. ***, ** and * denote statistical significance at the 1, 5 and 10% levels.

in the sample. Consistent with the literature, the controls for distance indicate that countries that are further from the United States or without access to ports export goods whose unit values are higher within product categories. Coefficients for *ad valorem* tariff and freight rates indicate that unit values decline with policy barriers and shipping costs and are in accord with results reported by Harrigan (2005).

Results for the China-decade interactions in the second and fourth columns of Table 15 show that Chinese products sell at an increasing discount relative to countries at similar levels of development over time. In the per capita GDP regression, this discount declines from a statistically significant −8% in the 1970s to a statistically

Table 16. Countries exhibiting the largest *conditional* unit value discounts

1970s		1980s		1990s		2000s	
Japan	–0.59	Hong Kong	–0.69	Hong Kong	–0.96	Hong Kong	–1.08
Hong Kong	–0.57	Mexico	–0.52	Mexico	–0.62	Oman	–0.77
UAE	–0.51	Japan	–0.45	UAE	–0.61	Mexico	–0.59
Guyana	–0.45	Costa Rica	–0.37	Oman	–0.55	Kuwait	–0.50
Costa Rica	–0.41	Macao	–0.33	Mongolia	–0.49	UAE	–0.49
Oman	–0.35	Dom Rep	–0.32	Haiti	–0.46	**China**	**–0.48**
Mexico	–0.31	Haiti	–0.30	Guatemala	–0.43	Syrian	–0.48
Dom Rep	–0.29	UAE	–0.30	Nepal	–0.43	Korea	–0.45
Mali	–0.28	Cyprus	–0.29	**China**	**–0.40**	Haiti	–0.44
Haiti	–0.27	Venezuela	–0.27	Japan	–0.37	Malawi	–0.43
Burkina Faso	–0.24	Guyana	–0.26	Honduras	–0.35	Macao	–0.37
Honduras	–0.23	Guatemala	–0.25	El Salvador	–0.35	Nepal	–0.35
Korea	–0.22	Bolivia	–0.21	Korea	–0.33	Mongolia	–0.35
El Salvador	–0.19	Korea	–0.19	Nicaragua	–0.33	Pakistan	–0.34
Trinidad	–0.16	Bangladesh	–0.19	Venezuela	–0.32	Japan	–0.33
Iceland	–0.15	Paraguay	–0.18	Czech Republic	–0.32	Guatemala	–0.31
Spain	–0.11	Iceland	–0.18	Syrian	–0.32	El Salvador	–0.26
Italy	0.10	Switzerland	–0.18	Macao	–0.30	Paraguay	–0.25
Cote d'Ivoire	0.10	**China**	**–0.16**	Bahrain	–0.28	Bahrain	–0.21
Brazil	0.11	Romania	–0.12	Bangladesh	–0.24	Benin	–0.21

Notes: Table displays countries with the top 20 largest unit value discounts conditional on level of development and trade costs, in log points. Estimates are derived from estimation of equation (4), where each country's country-decade dummies are estimated in a seperate regression. Estimates insignificant at the 10 percent level, including China in the 1970s, are omitted. Estimates for China are highlighted.

Source: Author's calculations.

significant −48% in the 2000s. For skill abundance, deviations are also statistically significant in all four decades and decline from –19% to –76% between the 1970s and the 2000s.

China is not alone in exhibiting such *conditional* unit value discounts, that is, discounts that deviate from what one would predict given relative levels of development and trade costs. Other outliers are reported in Table 16. This table ranks countries according to the largest average negative deviations observed in each decade. The coefficients listed in the table are derived from a separate estimation of the regression in column two of Table 15 for each country in the sample, where the China-decade interactions are replaced with interactions specific to the country. In Table 16, I exclude country-decade coefficients that are statistically insignificant at the 10% level.

Overall, China's conditional discounts receive ranks of 19, 9 and 6 in the 1980s, 1990s and 2000s. (China's 8% discount for the 1970s does not appear in the table because it is statistically insignificant.) Two other countries with relatively large conditional discounts are Hong Kong – the perennial leader – and Macao, both of which are notable as transhipment points for Chinese exports.

Other countries with relatively large conditional discounts include Mexico, Korea and Japan. Japan, whose conditional discounts fall over time, is notable in that it, like China, is often accused of maintaining a relatively low nominal exchange rate in

Table 17. China's relative export prices, by industry, 1972 to 2005

	5-Chemicals $Log(uv_{pct})$	6-Manuf Materials $Log(uv_{pct})$	7-Machinery $Log(uv_{pct})$	8-Misc Manuf $Log(uv_{pct})$
Log (Real $PCGDP_{ct}$)	−1.020***	−0.868***	−0.935	−0.607**
	0.294	0.271	0.725	0.289
Log (Real $PCGDP_{ct})^2$	0.072***	0.064***	0.067	0.052***
	0.018	0.017	0.045	0.018
China 70s	−0.483***	−0.055	−0.560	−0.051
	0.138	0.188	0.379	0.188
China 80s	−0.305***	−0.221**	−0.446**	−0.118
	0.071	0.087	0.171	0.09
China 90s	−0.246***	−0.332***	−1.120***	−0.242***
	0.039	0.050	0.072	0.053
China 00s	−0.395***	−0.344***	−1.162***	−0.363***
	0.067	0.060	0.110	0.062
Log ($Distance_c$)	1.180*	2.288***	3.523**	2.177***
	0.586	0.613	1.374	0.785
Log ($Distance_c)^2$	−0.061	−0.138***	−0.230**	−0.137***
	0.038	0.040	0.091	0.051
$Landlocked_c$	0.591***	0.305***	0.216	0.261**
	0.079	0.052	0.138	0.099
Ad Valorem Tariff $Rate_{pct}$	−0.131*	−0.329	0.122	−0.389*
	0.073	0.268	0.424	0.206
Ad Valorem Trade $Cost_{pct}$	−0.095*	−0.379***	−0.010	−0.517***
	0.053	0.036	0.008	0.058
Constant	−0.456	−5.156**	−5.048	−3.380
	2.184	2.363	5.397	3.052
Product-Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	423 328	1 247 031	756 866	1 318 415
R^2	0.64	0.71	0.79	0.73

Notes: Table reports OLS regression results of country-product unit values on country and product characteristics from 1972 to 2005. Explanatory variables include four China-decade dummies for the 1970s (i.e., 1972–1979), 1980s (i.e., 1980–1989) and 1990s (i.e., 1990–1999) and the 2000s (i.e., 2000–2005). Robust standard errors adjusted for clustering at the country level reported below each coefficient. Data on per capita GDP (PCGDP), GDP and population are from the World Bank. Data on unit values, duty and transport costs are from the US Customs Bureau. ***, ** and * denote statistical significance at the 1, 5 and 10% levels.

order to stimulate exports. Conditional discounts for Mexico are relatively stable over time, while those for Korea increase. Switzerland's presence in the table in the 1980s is interesting and perhaps due to it having better infrastructure than the typical landlocked country. Unconditionally, Switzerland has among the highest unit values in the sample. For the most part, the most developed OECD countries have negligible (e.g. Germany) or significantly positive (e.g. France) conditional deviations across decades.

Unit value regressions for one-digit SITC manufacturing industries are reported in Table 17. Here, too, the China discount becomes more negative over time in all sectors except Chemicals. Across industries, discounts are greatest in Machinery.

A more direct comparison of Chinese and OECD manufacturing export prices reveals that Chinese goods sell at an increasing discount *vi-à-vis* the OECD across manufacturing industries. I compare Chinese and OECD export unit values according to log unit value ratios,

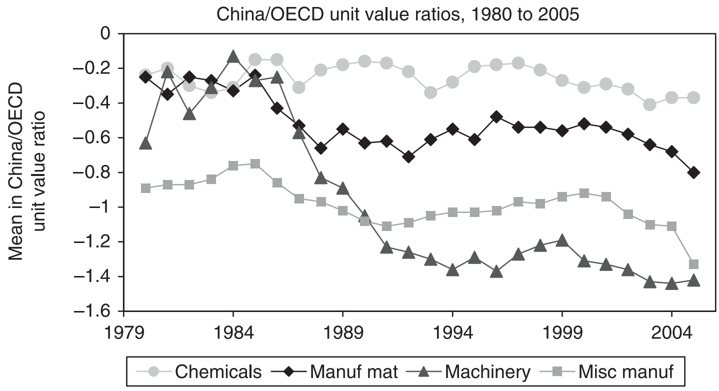

Figure 3. OECD/China log unit value ratios, 1980 to 2005

Note: Figure displays mean natural log China/OECD unit value ratio across products in noted industry, by year. Log unit values for each year and industry are significantly different from zero at the 1% in almost all cases.

Source: Author's calculations.

$$\log(UVR_{tp}) = \log(u_{tp}^{China})/\log(u_{tp}^{OECD}), \quad (5)$$

where u_{tp}^{China} and u_{tp}^{OECD} are the unit values of product p in year t for China and OECD countries, respectively. As above, log unit value ratios less than zero indicate a China discount.

Figure 3 reports the mean log unit value ratio between the OECD and China by manufacturing industry between 1980 and 2005. Two features of the data are noteworthy. First, the fact that all ratios are less than zero indicates that OECD exports generally sell for more than Chinese exports in all years. The China discount is greatest in Machinery and Manufactured Materials and lowest in Chemicals, perhaps because that manufacturing industry contains relatively more goods (chloroform, for example) that are commodities. Chinese machinery varieties in 2005, for example, are priced at a 25% discount ($e^{-1.4}$) relative to OECD machinery varieties. T-tests of these log unit value ratios (not reported) indicate that virtually all are statistically significantly different from zero at the 10% level.

The second noteworthy feature of the results in Figure 3 is that the Chinese price discount generally declines over the last five to ten years in all four industries. This trend is most pronounced in Manufactured Materials and Miscellaneous Manufactures.

7. INTERPRETATION OF RESULTS: HOW CLOSE IS CHINA TO THE OECD?

This paper highlights two facts. First, China's manufacturing export bundle increasingly overlaps with that of the world's most developed economies. Second, within product markets, China's exports sell at an increasing discount relative to the exports of the OECD.

The first fact implies that competition between the OECD and China is heating up, as China enters more and more product categories in which the OECD is present. On the other hand, the substantial price disparities observed between Chinese and OECD exports within product markets suggests Chinese exports may be of lower quality than OECD exports. To the extent that consumers view goods of low and high quality as poor substitutes, competition between China and the OECD might be less extreme than their growing overlap in terms of export bundles would otherwise imply.

The fact that the price gap between Chinese and OECD varieties is widening over time may be an indication of international product cycling, that is, that developed countries are specializing in ever-more sophisticated varieties as a response to globalization. Such a response would be consistent with more direct evidence of quality upgrading observed in firm-level data. Bernard, Jensen and Schott (2006), for example, examine US manufacturing plants' reactions to increased import penetration from low-wage countries as tariff rates and transportation costs fall from 1972 to 1997. Changes in exposure to low-wage countries varied substantially across industries, with firms in labor-intensive industries like apparel facing far greater low-wage country import penetration than firms manufacturing in more skill- and capital industries like scientific equipment. In their study, the authors find that firms in industries experiencing greater exposure to low-wage country imports are more likely to shrink or die, suggesting that firms 'move out' of products inconsistent with their country's comparative advantage during trade liberalization.

On the other hand, Bernard, Jensen and Schott (2006) also find evidence of firms' 'moving up' in response to trade liberalization. First, plants with higher exposure to low-wage country imports are more likely to switch into industries that are more skill and capital intensive, and less exposed to low-wage country exports, than the industries they leave behind. Second, within industries subject to the same level of low-wage country exposure, plants that are more capital intensive are more likely to survive and grow. To the extent that plants' capital intensities within industries rise with the sophistication of the goods they produce in those industries, this finding implies US firms adjust their product mix in line with US comparative advantage. Both of these adjustments can be interpreted as a reallocation of economic resources within and across plants towards the manufacture of more sophisticated goods.

These adjustments provide intuition for why trade with developing countries will not necessarily lead to the elimination of all manufacturing jobs in the developed world. Even though increased trade with China may cause the OECD to abandon the production of its less-sophisticated goods, production of more-sophisticated goods (or the research, design, etc. services associated with them) is in principle always waiting to take its place. Indeed, as is often pointed out, the creative destruction associated with these reallocations should be encouraged: allowing countries to produce according to their comparative advantage enhances the efficiency of production and encourages the availability of a wider variety of products at lower prices to all consumers in all countries, raising standards of living. In a theoretical model, Bernard, Redding and Schott (2006) demonstrate that trade liberalization forces firms to focus on their 'core competencies' by dropping relatively unproductive goods that are at odds with their comparative advantage. In doing so, aggregate productivity rises due to gains in efficiency that occur both within and across firms. For the United States between 1972 and 2001, Bernard Jensen and Schott (2004) show that although industries exposed to the highest levels of low-wage competition have experienced the largest declines in employment, their real output nevertheless increased.

As these facts and the theoretical discussion in Section 3 make clear, all workers do not fare equally well under trade liberalization. In developed countries, low-skill workers are disproportionately likely to be dislocated from their jobs, and they may also have the hardest time finding matches with new employers. Not every apparel worker that loses their job in Germany can find immediate employment with a pharmaceutical firm manufacturing the latest biotechnology drugs. In a study of displaced workers in the United States, Kletzer (2001) finds that manufacturing workers dislocated by import competition accept an average pay cut of 13% in moving to their next job. Across workers, one third of respondents report earning the same wage or more in their new job, while one fourth report earning at least 30% less.

It is precisely such losses to workers, and not jobs, which should be the focus of trade policy. Temporarily shielding certain jobs from import competition merely postpones an inevitable reallocation that becomes more painful the longer it is delayed. Instead, trade policy should facilitate the ability of workers to find new employment when existing occupations disappear. As Denmark's 'flexicurity' program reveals, this goal can be achieved in part by providing workers with incentives to undergo retraining necessary for re-employment in viable sectors. But trade policy must also encompass broader support for the primary, secondary and tertiary educational institutions that provide workers with human capital before they even enter the workforce. It should also consider how these institutions should evolve in a fast-paced global economy. Obviously, it is only by maintaining their relative human capital abundance that developed economies will retain production of the world's most sophisticated goods.

Other proposals to reduce labor-market frictions might also be considered. Davidson and Matusz (2006) compare several such policies – including wage subsidies, employment subsidies, trade adjustment assistance, and training subsidies – in terms of their ability to transfer some of the aggregate gains from trade to those whose jobs are displaced by it. A well-designed wage insurance plan, for example, might give dislocated workers an incentive to accept a job where the wage is initially low but where the wage may increase with time, retraining and experience (Kletzer, 2004). These policies may also reduce the time displaced workers spend unemployed. Though the cost of such assistance is not trivial, they can also aid in gathering support for trade liberalization at the outset: as reported by Scheve and Slaughter

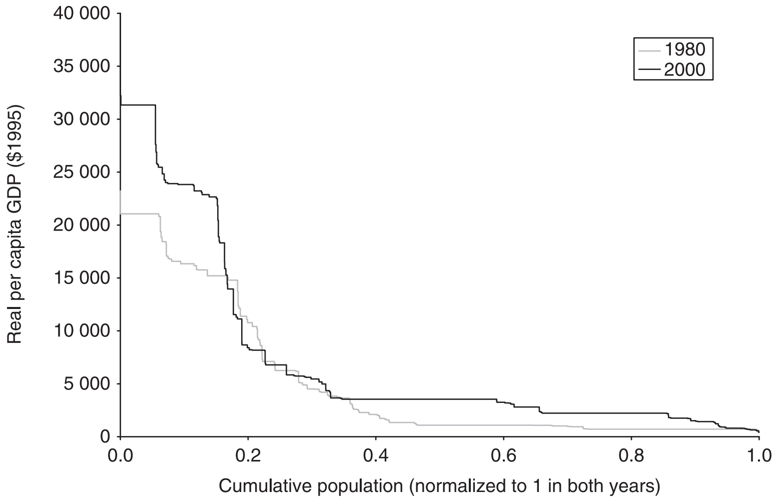

Figure 4. Per capita GDP and population, 1980 versus 2000

(2001), public opinion about free trade increases when it is linked to worker adjustment programs.

In many ways, speculation today about the impact on developed economies of trade with China mirrors the debate over trade with Japan that took place in the 1980s. Back then, it was the Japanese who were poised to take over the world's manufacturing, and it was the Yen rather than the Yuan that was under-valued. It turned out that although competition with Japan was painful for developed countries, firms in these economies were able to adjust.

One manifestation of this adaptability is displayed in Figure 4, which is drawn from Leamer and Schott (2005) and which compares countries' per capita GDP and population in 1980 and 2000. Each country is represented by a horizontal line segment, with the height of the segment indicating the country's per capita GDP and its length measuring the country's share of the world's population. The area enclosed by the rectangle extending up from the x-axis therefore represents each country's total GDP. The United Kingdom, with a small population and high per capita GDP appears as a short (unlabelled) horizontal line high up on the left while China and India, with a large populations and low per capita GDP appear as long lines near the bottom.

Trade barriers were relatively high in the 1980s compared with today, and many critics warned that if they were lowered outsourcing would reduce wages in developed economies. In the language of Figure 4, it was feared that the line for 2000 would be flatter and somewhere nearer the world average for per capita GDP than the line for 1980. That did not occur. As indicated in the figure, the 20% of the world's population living in wealthy economies have experienced substantial earnings growth since 1980, and so, incidentally, have the 60% who live in the world's poorest countries. It is the middle-income countries, whose goods occupy the middle cone of Figure 1 and are perhaps insufficiently differentiated from those exported by the lowest-wage countries, whose incomes have stagnated.

8. CAVEATS: DOES PRICE EQUAL QUALITY?

This paper – in line with much of the literature on export unit values – interprets differences in countries' export prices within product categories as evidence of quality gaps. This assumption is reasonable when products possess only vertical attributes, that is, attributes for which all consumers agree to pay more. It is unlikely that the price differences observed between the OECD and China are solely a reflection of production costs, though this interpretation does appear to be on many policy makers' minds. If that were true, it would only be a matter of time before OECD countries, with their very high (quality-adjusted) prices, are driven from the market entirely. Indeed, if Chinese and OECD varieties were perfect substitutes, demand for OECD exports would cease immediately absent any supply constraints allowing them to retain customers in the short run. O'Rourke and Willamson (2005) provide a stark demonstration of such competition in the market for (undifferentiated) wheat during the late 1800s and early 1900s, where very soon after low-cost United States entered the market, world prices plummeted. This does not appear to have occurred in present-day manufacturing.

A more rigorous assessment of quality could be accomplished in two ways. The first would be to accumulate very detailed information on the hedonic attributes of goods exported by US trading partners. Because such information is very expensive to collect, it is generally unavailable. On the other hand, pilot studies of a handful of industries do exist. Sutton (2007a,b), for example, documents detailed 'benchmarking' of manufacturing plants in the automobile-component and machine-tool industries to assess China and India's attempts to catch up to developed economies.

An alternate approach, pursued by Hallak and Schott (2006) and Khandelwal (2006), proposes the use of empirical techniques to recover information on countries' export quality using information on export quantities as well as prices. Hallak and Schott focus on countries' global net trade, while Khandelwal takes account of their US market share. The basic intuition behind their procedures is straightforward. For example, a country observed to have rising net trade in the presence of constant prices is assumed to have rising quality: if demand is a function of quality-adjusted prices, stable observed prices and growing net trade imply rising quality. Though identification is more difficult if one allows for both horizontal and vertical differentiation within product categories, preliminary estimates from Hallak and Schott indicate that China's export quality is significantly lower than that of the OECD.

Exporters' efforts to promote sales abroad can also influence the trends observed in this paper. Policies such as export subsidies and explicit or implicit exchange rate management can both inflate the range of products a country like China exports to the United States as well as lower their prices. China's efforts in this regard are well known (Naughton, 1996). It would be quite useful to examine the extent to which such policies influence the major findings of this paper, but comprehensive datasets tracking their extensiveness across both countries and time do not yet exist.

A related issue concerns the more fundamental question of where exporters' quality originates. In the theoretical models discussed above, export sophistication emanates from relative endowments in capital and skill. This line of thinking – as well as the use of unit values to proxy for quality – ignores the potential contribution of imported intermediate inputs. China, of course, has been the recipient of a staggering level of foreign direct investment, much of it to make use of the country as an export platform. Rodrik (2006), for example, argues that the attractiveness of China's export processing zones has exerted an important affect on the sophistication of its exports. Decomposing countries' export quality according to the relative contributions of its factor endowments versus its imported inputs would be a very valuable exercise. Unfortunately, it too, is hampered by the general unavailability of data mapping countries' imports into their exports.

9. CONCLUSION

This paper documents the extent to which developed economies are exposed to China in terms of both the breadth of products they export and the range of prices those products command. It finds that China and developed economies overlap considerably in terms of export mix, but much less so, and less over time, in terms of export prices. It interprets these findings as being consistent with other evidence suggesting that developed economies compete with developing economies like China by raising the quality of their exports. It points out that such competition offers hope to workers in developed economies who fear their standards of living will fall as a result of globalization. On the other hand, the paper highlights the difficulties associated with identifying quality competition and acknowledges that alternate interpretations of the evidence are not unreasonable.

Though the results in this paper provide insight into how China and developed economies compete, it raises a number of questions requiring further research. First, what factors govern developed-country firms' ability to move up the quality ladder and thereby 'escape' competition from low-wage countries? Research by Khandelwal (2006), for example, finds that products vary widely in terms of the 'length' of their quality ladders. As a result, developed-country firms in high-ladder industries may have more 'room' to 'move away' from competition from low-wage countries than firms in low-ladder industries, but they may also have greater incentives to invest in increasing the length of the ladder. We need a better understanding of these dynamics.

Second, how substitutable are high- and low-end product varieties within export markets? When specialization takes place across wholly different products, say t-shirts and electron microscopes, it is relatively easy to be sanguine about the inability of declining t-shirt prices to influence the wages of electron-microscope manufacturers.

One suspects that price-wage arbitrage is much more likely when developed and developing economies specialize in vertically differentiated varieties: price declines in conventional televisions may influence the price of high-end plasma displays. Though estimating such substitutability is beyond the scope of this paper, research in Khandelwal (2006) suggests that the within-product substitutability of imports is lower for products characterized by long quality ladders. If this is true, the quality gaps discerned above will help insulate workers in high-wage countries from the low labor costs of developing countries.

Third, to what extent will China's internal heterogeneity in relative factor endowments, as well as differences in the rates of skill and capital deepening across provinces, lead some regions of the country to raise the sophistication of their products more quickly than others? Quality variation across Chinese provinces cannot be discerned in the international trade data used in this paper; it merely reflects the value-weighted average unit value of exports from all regions of the country. When data for Chinese exports by region become available, it would be useful to determine whether the exports of the more developed coastal provinces are closer substitutes for OECD exports than the exports of provinces in the interior.

A final question for further research involves investigating the speed of product cycling. Is globalization hastening the migration of varieties from developed to developing economies? What are the implications of this acceleration?

Discussion

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China' s emergence as an important actor on international markets is one of the most interesting economic developments of the last decades. Peter Schott's paper focuses on a central aspect of this development: China's breathtaking export performance. The analysis addresses a number of highly interesting and relevant questions and concerns: Will competition from China eventually eliminate manufacturing in industrialized countries? Are developed or developing countries more affected by competition from China? Can the export performance of China in terms of export similarity with the OECD be explained on the basis of differences in country size and factor endowments, as standard models of trade theory would suggest? What are the policy implications of Chinese export growth? The answer to the first question is good and bad news at the same time: The 'bad news' is that China's export similarity with OECD countries, measured on the basis of standard product classification, is higher than that of other non-OECD countries, given China's relative level of development. This suggests that manufacturing in industrialized countries is exposed to intensive competition from China. But a comparison of export prices within

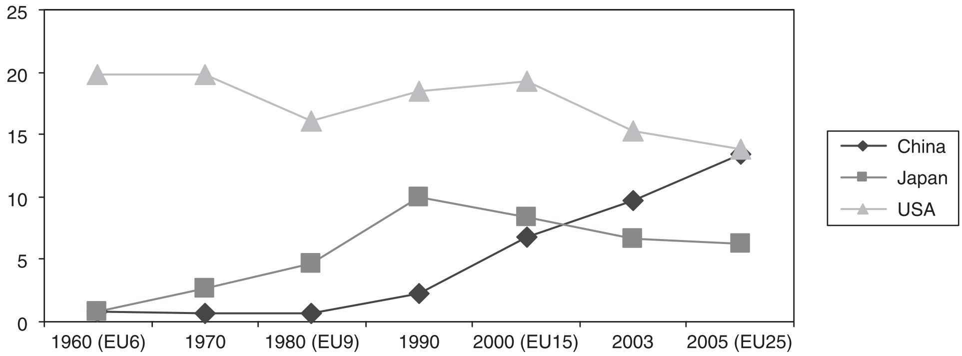

Figure 5. European Union impact market shares 1960–2005

Source: Eurostat.

product varieties reveals that Chinese products are selling at a considerable discount relative to goods produced in OECD countries. This discount seems to increase over time. If prices are seen as an indicator of product quality, and if goods of different quality are poor substitutes, this finding suggests that OECD countries have been able to avoid competition by moving up the quality ladder, i.e. by producing more sophisticated goods.

A first question which naturally arises in this context is whether the Chinese exports to the US are similar to the exports to other developed countries, in particular the EU. Figure 5 illustrates the development of European imports from China, compared to the imports from other major trading partners.

The numbers show that the development of EU imports from China is similar to that of the US. The market share of China in EU imports, which was negligible in 1980, has grown quickly over the last two decades, overtook that of Japan a few years ago and is currently equal to the market share of imports from the US. No other trading partner has experienced a similar development.[1] Although these numbers are aggregates, which tell us nothing about the similarity of the goods imported from China to those imported from the US or those produced by European firms for the home market, it seems that the unique export performance of China is not a phenomenon which is particular to the US. The bilateral trade deficit with China, however, is larger in the US than in Europe. In 2005, the EU bilateral trade deficit with China was €106 bn, compared to $202 bn deficit for the US. Of course, one should take into account that the economic interpretation of bilateral trade deficits is difficult. In the political debate they do play an important role, though.

Another question raised by Peter Schott´s analysis is whether the composition of exports can really be interpreted as a good indicator of the development of the

[1] The number of EU member countries included in these numbers has changed. But imports to individual large EU countries like Germany or France show similar patterns.

Chinese export industry and the underlying technological and economic development of the country as a player in world markets. In their recent survey paper on the economic development of China, Branstetter and Lardy (2006) point to two reasons why this may be problematic. Firstly they argue that the large high tech product share in Chinese exports should not be interpreted as evidence that Chinese firms are able to compete in human capital intensive high technology sectors:

> 'China is able to export huge quantities of electronic and information technology products only because it imports most of the high value added parts and components that go into these goods. China, in short, does not in any real sense manufacture these goods. Rather it assembles them from imported parts and components.' (ibid., p. 38).

As an example, Branstetter and Lardy (2006) point to China's exports and imports of electronics and information technology products. In 2003, China exported \$142 bn in this product group, but it imported \$127 bn in the same group, mostly parts and components. If China's contribution to the production of these goods just consists of low productivity assembly services provided by unskilled workers, this seems to be well in line with what is usually perceived as the country's comparative advantage. This suggests that export similarity may be a misleading indicator of the degree of competition to which workers of industrialized countries are exposed. It could be the case that industrialized countries export the high tech components to other countries, where these parts are essentially assembled. Of course, it remains to be demonstrated that this is really the case. Peter Schott is aware of this caveat and points to the fact that there are currently no data available which would allow this issue to be explored.

Secondly, Brandstetter and Lardy (2006) point to the fact that most of the exported electronics and information technology products are not manufactured by Chinese-owned firms but by foreign firms which operate in China and use the country as an export platform. For instance, in 2003, foreign firms accounted for 92% of China's exports in computers, components and peripherals and 74% of exports of electronics and telecommunications equipment. Most of these firms are wholly foreign-owned firms, rather than joint ventures (Gilboy, 2004), so that diffusion of technological knowledge will proceed only slowly. Moreover, many domestically-owned Chinese-owned firms seem to spend little on research and development and networks for research and innovations seem to be poorly developed (Gilboy, 2004). This suggests that the growing share of high tech products in exports should not be interpreted as evidence that 'genuinely' Chinese firms are closing the technological gap to firms from industrialized countries.

The key role of foreign firms for the development of the Chinese export industry has its roots in the way foreign trade policy evolved. Naughton (1996) argues that 'China . . . embarked on the process of transition with a highly centralized, monopolistic foreign trade regime. . . . Since 1978 China has gradually . . . established a system in which most trade is governed by market forces' (p. 295). '. . . by 1986–87 China had established two separate trading regimes . . . One is an . . . export promotion regime . . . most domestic firms are excluded while foreign firms can participate . . . the other is the traditional import substitution regime' (p. 298). He further reports that at least up to the mid-90s, there was a strong geographical correlation between foreign direct investment and foreign trade in China. For instance, in 1994, the export to GDP ratio of the province of Guandong was 106%. Almost 40% were produced by foreign firms. The export to GDP ratio in the rest of China was only 14%, and less than 25% was produced by foreign firms.

From the perspective of the industrialized countries and in particular the workers in the manufacturing sector, it is an open question whether the dominance of foreign firms in the Chinese export industry is a reason for optimism, though. For instance, in 2003, among the 200 of China's largest exporters 28 were Taiwan owned firms.[2] All were electronics manufacturers. If workers in the electronics industry in the US or in Europe lose their jobs, it is probably of secondary importance to them whether they do so because of competition from China or from Taiwan. Moreover, even if US or European firms were key players in the Chinese export industry, European and US workers might lose because they are replaced by Chinese workers.

There are two further issues which question the ability of China to maintain its growth in exports in the years to come. The first issue is the impact of this performance on the trade policy debate in the US and in other industrialized countries. Messerlin (2004) reports that since 1995, an average share of 15% of all anti-dumping measures in force in the US were directed against China. It is possible if not likely that trade policy measures against imports from China will play a role in the 2008 presidential elections.

The second issue is the exchange rate regime. For some time, the Chinese exchange rate policy has been criticized for subsidizing exports through undervaluation. There is an ongoing debate on whether or not the undervaluation of the Yuan is a recent phenomenon, but there is no doubt that it has been undervalued at least since 2002, when the Chinese authorities had to build up unrecorded currency reserves to sustain the exchange rate of the Yuan to the dollar. This undervaluation gives rise to a serious misallocation of resources. Part of the current Chinese export industry is likely to lose its competitiveness if the exchange rate is corrected.

In summary, this paper represents an important contribution to the analysis of China's economic development and its impact on the industrialized world. The fact that the economic interpretation of indicators like export similarity and export pricing faces several difficulties shows that there is a fascinating research agenda ahead.

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This is a difficult paper to comment on. It is tightly argued and tightly focussed. It provides compelling evidence documenting two stylized facts, both of which are

[2] China Economic News Service, June 28, 2004, cited in Brandstetter and Lardy, 2006, p. 40.

interesting, and possibly even important. All of this is good news for the reader, but not such good news for the discussant. In my remarks I will thus place this paper in a somewhat longer-run context, before going on to make two minor comments, and one major one, regarding the author's argument.

The big issue which this paper implicitly addresses is the long-run political sustainability of the current phase of globalization. Although the author provides us with both good and bad news, on the whole the paper is meant to be reassuring. It thus seems worth noting that the historical evidence is *not* reassuring as regards the ease with which markets can be kept open in the face of large-scale trade in 'competing' goods between world regions with very different factor endowments.

Prior to the 19th century, inter-continental freight rates remained high, and such trade as did occur between continents involved goods with a very high value to weight ratio. In 1608–10, more than a century after da Gama, fully 80% of Portuguese imports from Asia involved pepper and other spices. As late as the 1750s, the majority of British and Dutch imports from Asia and the Americas consisted of tea, coffee, pepper and spices, sugar, tobacco, and other goods which could either not be produced in Europe at all, or only with great difficulty (Findlay and O'Rourke, 2007, Table 5.8). This of course implied that there were no European producers of these goods who felt threatened by these imports. The politics of trade during the mercantilist era thus involved inter-state competition over which country would get the rents thought to be associated with successfully monopolizing such trades.

All of this changed some time during the 19th century, as a result of the new steam-driven transport technologies associated with the Industrial Revolution. Harley's (1988, Figure 1) evidence on ocean freight rates suggests that 1840 is as good a candidate for a turning point as any other, since his data show British freight rates fluctuating around a fairly steady trend up to that date, and collapsing thereafter. Not coincidentally, the period after 1840 also saw the beginnings of a mass trans-Atlantic trade in such bulk commodities as wheat, and a collapse in wheat price gaps between land-scarce and land-abundant continents (Figure 6). Intercontinental trade now impacted on domestic producers of such goods, and began to have the effects on income distribution predicted (retrospectively) by two Swedish observers of the period, Heckscher and Ohlin. The politics of trade now involved intra-state distributional conflict, and there soon followed a backlash against the grain trade across Continental Europe driven by discontented farmers, with barriers to agricultural trade being erected that remain with us to this day (O'Rourke, 1997; O'Rourke and Williamson, 2005).

The fact that the GATT liberalized trade fairly successfully in the aftermath of 1945 is not as reassuring as it might be, since the Western countries that were primarily involved were prosperous and shared similarly high capital–labor and human-capital–labor ratios. Notably, they did differ in terms of their land–labor ratios, and agriculture was an exception to the generally liberal trend. With the spread of communism, and decolonization, the South was for decades largely absent from this process, and insofar as it exported goods to the North, these were largely

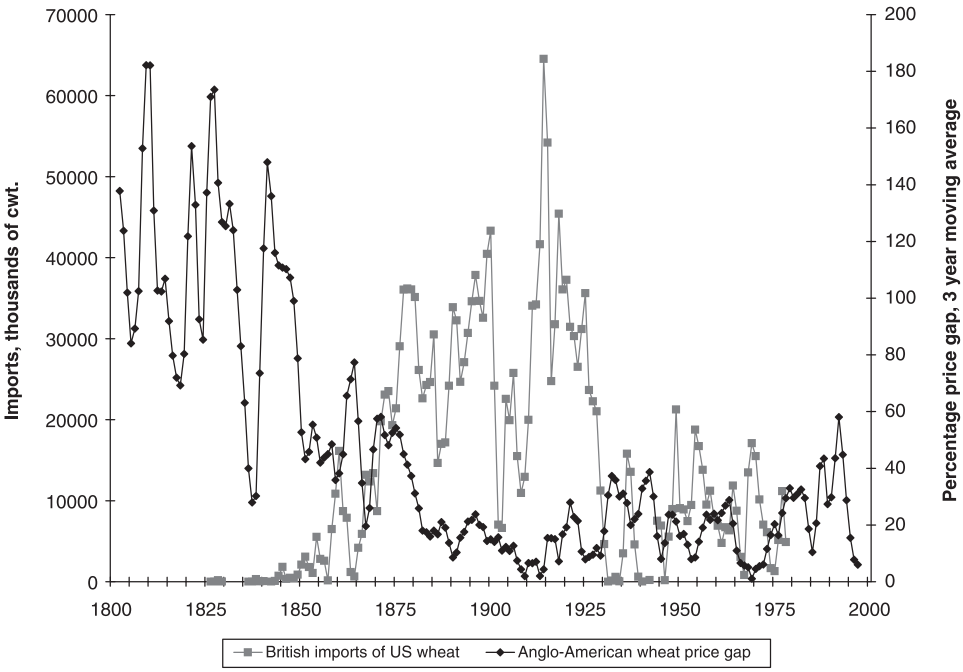

Figure 6. Anglo–American wheat trade, 1800–2000

Source: O'Rourke and Williamson (2005), Figure 3, p. 10.

non-competing primary products. Since the 1980s, however, the South has massively liberalized, and as Figure 7 shows, this has coincided with a dramatic shift in the structure of its exports to the North, as the Industrial Revolution spreads across the globe, and the Great Specialisation that Dennis Robertson (1938) memorably described unravels. While this is good news for the South, one has to query whether current trends will last, since once again rich European markets are mass importing competing goods – manufactures on this occasion – from continents with very different factor endowments. Will European (and North American) unskilled labor demand protective tariffs, as did European farmers over a century ago? Presumably this will in part depend on how badly European labor is hurt by Chinese competition.

Schott's paper contains bad news and good news for these workers. The bad news is that China's exports overlap with OECD exports a lot, and that this overlap has been increasing over time. The paper succeeds in establishing this stylized fact in convincing fashion, which is worrying since this makes it more likely that OECD wages will be influenced by Chinese competition.

The good news, for Schott, is that the prices obtained by Chinese exporters for their products are unusually low given China's size and endowments, and that they have been falling relative to OECD prices. Schott assumes that price differentials reflect quality differences between products. The price data thus suggest that Chinese exports remain relatively unsophisticated, and that OECD manufacturers have been

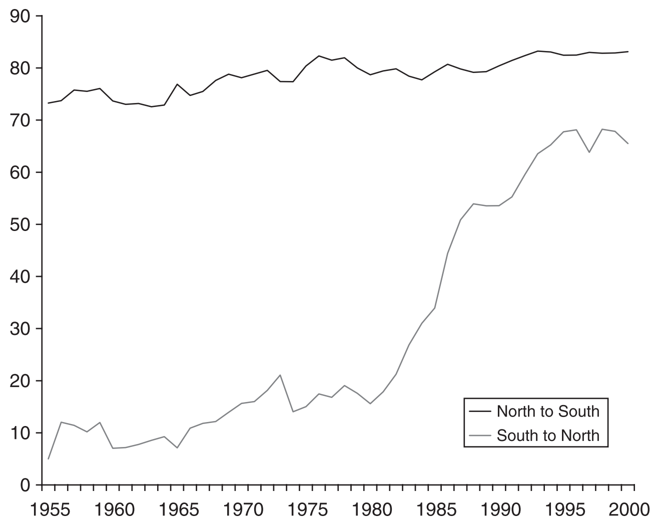

Figure 7. Manufactured products' share of exports, 1955–2000

Source: UNCTAD.

engaged in quality upgrading within product categories. All of this may limit the extent to which Chinese and OECD firms compete head-on, thus shielding OECD workers in a way that 19th century European farmers could not have been.

My minor comment on this argument is as follows. The empirical strategy relies on the assumption that Chinese exports to the US are representative of Chinese exports and production generally. Is this necessarily the case? As Schott points out, Harrigan (2005) has recently provided evidence that the quality of goods transported varies with distance. Not surprisingly, the further you are from the US, the higher will be the unit values of the goods you ship there, *ceteris paribus*, a finding which this paper confirms. To be sure, Schott finds that Chinese export prices are low, even controlling for distance from the US market, but it would still be of interest to see if Schott's findings for the US can be generalized to OECD markets closer to China, such as Japan.

The major comment is that Schott's evidence for optimism is largely to be found in his Figure 3. What that seems to show, however, is that the fall in relative Chinese unit values was largely limited to the late 1980s and early 1990s (although there was another important dip after 1999 or 2000). Figure 8 below shows that this was also a period in which the real value of the Chinese renminbi fell dramatically. In a careful study taking account of the dual nature of China's exchange rate system during 1998–93, Wang (2004) finds that the Chinese manufacturing unit-labor-cost-based real exchange rate depreciated by roughly 85% between 1984 and 1993. A worried Western worker might well interpret Schott's relative price evidence quite differently than does Schott. According to such a pessimistic reading, it was this real depreciation that lowered relative Chinese prices, not a deterioration in relative Chinese quality,

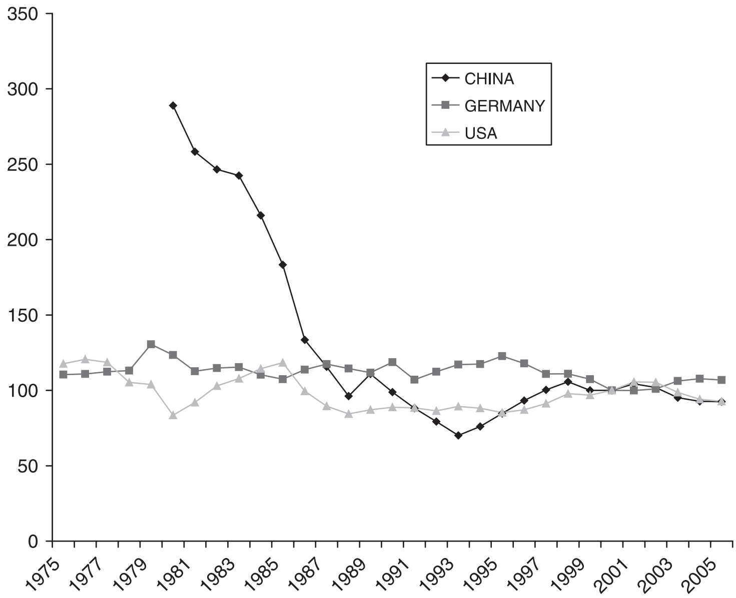

Figure 8. Real exchange rates, 1975–2005

Source: World Development Indicators.

and this relative price fall then spurred a massive growth in Chinese exports, with potentially adverse consequences for unskilled OECD workers.

Schott's benign conclusions may well be valid, but without firmer evidence linking prices and quality I fear that they won't sway wavering protectionists. Having said this, the issues raised in this paper are of major importance for the future of the international trading system. I look forward to seeing future work by Schott and others on the subject.

Panel discussion

Much of the discussion focussed on the identification of price and quality changes. Carlin, for example, asked how much of market share increase was driven by changes in cost competitiveness. Once the cost change is taken into account, any positive value of the China dummy (influencing the value of products) can be assumed to come from an improvement in product quality. Similarly any negative value of the China dummy can be interpreted as a decrease in quality. Several panel members were also interested in the results on the terms of trade. Redding pointed out China's export growth has a positive terms of trade impact on countries that are not competing in the same products, for example the US, and that the closest competitors such as

Mexico are the real losers. Some panel members were also uncertain about the interpretation to give to the China dummy and would have liked to see how it compares, for example, with an India dummy. Some panel members also thought that the optimistic tone of the introduction and conclusion on the impact of Chinese competition on income distribution in the OECD could not be fully justified by the results of the paper.

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