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Do Developed and Developing Countries Compete Head to Head in High Tech?

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Abstract

Concerns that (1) growth in developing countries could worsen the US terms of trade and (2) that increased US trade with developing countries will increase US wage inequality both implicitly reflect the assumption that goods produced in the United States and developing countries are close substitutes and that specialization is incomplete. In this paper we show on the contrary that there are distinctive patterns of international specialization and that developed and developing countries export fundamentally different products, especially those classified as high tech. Judged by export shares, the United States and developing countries specialize in quite different product categories that, for the most part, do not overlap. Moreover, even when exports are classified in the same category, there are large and systematic differences in unit values that suggest the products made by developed and developing countries are not very close substitutes—developed country products are far more sophisticated.

This generalization is already recognized in the literature but it does not hold for all types of products. Export unit values of developed and developing countries of primary commodity–intensive products are typically quite similar. Unit values of standardized (low-tech) manufactured products exported by developed and developing countries are somewhat similar. By contrast, the medium- and high-tech manufactured exports of developed and developing countries differ greatly.

This finding has important implications. While measures of across product specialization suggest China and other Asian economies have been moving into high-tech exports, the within-product unit value measures indicate they are doing so in the least sophisticated market segments and the gap in unit values between their exports and those of developed countries has not narrowed over time.

These findings shed light on the paradoxical finding, exemplified by computers and electronics, that US-manufactured imports from developing countries are concentrated in US industries, which employ relatively high shares of skilled American workers. They help explain why America's nonoil terms of trade have improved and suggest that recently declining relative import prices from developing countries may not produced significant wage inequality in the United States. Finally they suggest that inferring competitive trends based on trade balances in products classified as "high tech" or "advanced" can be highly misleading.

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INTRODUCTION

Recently, distinguished economists have raised doubts about the size and distribution of America's gains from trade as a result of its increasing trade with developing countries. On the one hand, in an article that attracted considerable attention, Paul Samuelson (2004) used a conventional Ricardian model to show how growth in developing countries such as China could reduce America's gains from trade. His argument is that as a result of productivity growth these countries could move up the technology ladder sufficiently to provide important competition for US exports. This could induce a decline in America's terms of trade and therefore its gains from trade.[1]

On the other hand, Paul Krugman raised concerns about the effect of growing trade with developing countries on wage inequality: in a column in 2007 he wrote "*It's no longer safe to assert that trade's impact on the income distribution in wealthy countries is fairly minor. There's a good case that it is big and getting bigger*." As in Samuelson's case, Krugman's reasoning is based on conventional trade theory. The crux of the concern is that the goods produced by developing countries whose relative prices have declined are close substitutes for those produced by unskilled labor in developed countries and therefore exert downward pressure on the relative wages of unskilled workers.

Actually, in the conventional two-by-two Heckscher-Ohlin trade theory framework, Samuelson and Krugman cannot both be correct. If the United States specializes in skill-intensive products, declining terms of trade will reduce skill premiums and more equal wages. But in both cases, these concerns reflect the presumption that developed and developing countries compete head to head i.e., that they occupy similar cones of diversification.

The empirical work on these concerns is, however, riddled with paradoxes. The evidence of substantial losses in US high-tech competitiveness is hard to square with America's improving nonoil terms of trade, and the evidence of increased manufactured imports from developing countries in skill-intensive sectors is hard to square with conventional Heckscher-Ohlin theory.

Support for Samuelson's concern does seem to come from the data on trade in "High-technology Products," reported annually by the US National Science Foundation (NSF) in its *Science Indicators* and in the data on trade in "Advanced Technology Products" reported in the monthly trade release of the US Department of Commerce. These data show major declines in the world market share of US high technology industries, from 20 percent in the early 1990s to 12 percent in 2005, primarily reflecting

1. Gomory and Baumol (2000) use a model with economies of scale to reach a similar conclusion.

losses in industries producing communications equipment, office machinery, and computers. By contrast China's share in high-tech exports rose from 8 percent in 1999 to 19 percent in 2005 to make it by far the world's largest exporter of high-technology products. In addition, America's historically strong trade balance in "advanced technology products" shifted from surplus to deficit in 2002, driven by US trade with developing countries such as China, Mexico, Malaysia, and Indonesia (NSF 2008).

Other research also appears to provide corroborating evidence. Schott (2008) finds that China's *export overlap with the OECD is much greater than one would predict given its low wages.*[2] Similarly, Rodrik (2006) finds that China's exports are associated with a productivity level that is higher than what would be expected given its income.

Despite this apparent support for Samuelson's concern, however, excluding oil, the terms of trade in manufactured goods of the United States, Germany, and Japan have all actually improved since the mid-1990s—the period when import growth from the developing countries accelerated.[3] Moreover since US nonagricultural export prices have increased as much as the prices of US manufactured goods imported from industrial countries, the source of the US (nonoil) terms of trade improvement is the declining relative prices of manufactured imports from developing countries.

While the evidence of declining relative prices of manufactured imports from developing countries may give some comfort with regard to Samuelson's concern, it seems to provide support for Krugman's worry about declining prices of unskilled labor–intensive products. But here too there are problems with the straightforward explanation. In apparent contradiction to conventional trade theory, the most disaggregated six-digit North American Industry Classification System (NAICS) data indicate that US manufacturing industries with high shares of manufactured imports from developing countries are actually *more* skill intensive than the industries with high shares of imports from developed countries (Edwards and Lawrence 2010a, 2010b). The rapid growth in imports of computers and electronics from developing countries exemplifies this contradiction. Three-quarters of US imports in this sector come from developing countries, yet it is the most skill intensive in US manufacturing.

There are numerous possible explanations for this puzzling result. The first, favored by Krugman (2008), is that aggregation bias conflates imported unskilled labor–intensive components and more skilled labor–intensive finished domestic products. This therefore disguises the detrimental impact of outsourcing unskilled-labor processes to developing countries on the wages of US workers who are either displaced or engaged in unskilled labor–intensive activities within US industries.[4]

2. See also Kiyota (2008) who compares US, EU, and Chinese exports to Japan.

3. Edwards and Lawrence (2010a) show that even when the trade deficit is taken into account, the US nonoil terms of trade have improved since the mid-1990s.

4. See also Blinder (2006) on the offshoring of business services that sparked considerable concern about the loss of US services jobs.

Four other hypotheses with different implications for wage inequality than posited by Krugman are also worth considering. The first is "factor-intensity-reversals": US imports from developing countries may be produced abroad with unskilled labor–intensive methods, but in the United States firms have automated and upgraded and thus use skilled labor–intensive methods to produce the same products. A second possibility is that given the increased global mobility of capital and technology, contrary to the implications of Heckscher-Ohlin theory, developing countries have acquired comparative advantages in some skill-intensive goods. This certainly is the impression left by the NSF Science and Commerce data cited above. A third possibility is that because of international supply chains, much of the value in the products deemed as from developing countries is actually produced in developed countries. In particular, imports that may arrive in the United States from developing countries like China are actually skill intensive because they contain large amounts of skill-intensive components and designs produced in more developed countries (such as Japan or the United States). A fourth possibility, though, is within category specialization: Domestic and imported goods are simply not close substitutes. Developing countries produce less skill-intensive varieties, while the United States and other developed countries produce more skill-intensive varieties. We have moved to a multicone world with more complete specialization than is assumed by conventional theory.[5]

In this paper we will resolve these paradoxes and distinguish among these explanations. We provide considerable support for the multicone explanation. We will deal with the problem of aggregation bias by using highly disaggregated trade data. Fortunately, these data distinguish very clearly between raw materials, intermediate components, and finished products and are therefore not as subject to aggregation bias. They are also reported as values and quantities, (e.g., in dozens or pounds) allowing for rough comparisons of prices differentials. Disaggregated data also allow a better understanding of the factors that could explain the fact that US imports from developing countries are concentrated in US industries that are relatively skilled labor intensive. In addition, since the first four explanations all assume that developed and developing country exports (or tasks) are similar (perfect substitutes) we will use disaggregated unit value data to help us distinguish the fifth explanation—imperfect substitutes—from the others.

One method we will use to determine head-to-head product competition in our effort to resolve these questions is to calculate a "similarity index" that captures the degree to which products share the same detailed classification categories. This allows us to explore *across-product specialization* in trade flows. Fortunately we can compile very fine-grained measures of similarity because the United States reports trade data in highly disaggregated 6- and 10-digit Harmonized Tariff System (HTS) categories. For example, the 10-digit HTS import category number 6103106030 contains values of "cotton waistcoats imported as parts of suits."

5. Support for this conclusion can be found in Schott 2003.

However, even at the 10-digit HTS level the data still reflect aggregation of products of different quality. For example, cotton waistcoats are not all created equal. Indeed, some may have much higher quality and different product attributes (e.g., silver versus gold buttons) than others. These differences should be reflected in different prices. Accordingly, we use a second method, ratios of average unit values at the most disaggregated level (typically either 10- or 6-digit HTS level) to distinguish between products even more precisely. This measure captures *within-product specialization.*

Data

To undertake this examination we concentrate on US trade in manufactured goods, (NAICS 331–333) dropping refined petroleum products from the data. We use the US trade data provided by Feenstra, Romalis, and Schott (2002) and the United States International Trade Commission. The data are highly disaggregated. There are about 9,000 export codes and approximately 12,000 import numbers. To exploit the US data we assume that the goods foreigners export to the United States that are captured in US import data are representative of the goods they generally export to the rest of the world. We also assume that the goods the US exports are representative of goods manufactured in the United States.

Results

We will show in this paper that there are distinctive patterns of international specialization that suggest developed and developing countries produce fundamentally different products. Judged by export shares, the US and developing countries specialize in quite different product categories that for the most part do not overlap. Moreover, even when they do overlap and exports are classified in the same category, there are large and systematic differences in unit values that suggest the products made by developed and developing countries are not very close substitutes—developed country products are far more sophisticated.

This generalization does not hold for all types of products. We find that export unit values of primary commodity-intensive products are typically quite similar and unit values of standardized manufactured products exported by developed and developing countries are not very different. But the medium- and high-tech manufactured exports of developed and developing countries differ greatly. In these product categories export unit values rise with per capita incomes and there is little evidence of substantial convergence over time. This suggests that, especially in these products, developed and developing countries are not competing through producing goods that are close substitutes.[6] Measures of across-product specialization suggest China and other Asian economies have been moving into high-tech exports, but the within-product measures indicate they are doing so in the least sophisticated market segments.

6. The product cycle theory of Vernon (1966) is one way to explain these findings.

The findings have important implications for our concerns. They bolster the argument that the United States and the developing countries are not competing head to head in export markets. They shed light on the paradoxical finding, exemplified by computers and electronics, that US-manufactured imports from developing countries are concentrated in industries that employ relatively high shares of skilled American workers and help explain why recently declining relative import prices from developing countries have not produced significant wage inequality (Lawrence 2008).

Other research provides support for these conclusions. Peter Schott in particular has been a major contributor to this type of work. He argues that international patterns of specialization are incompatible with the assumption, common in traditional trade theory, that countries all produce the same products. Instead, there are different cones of specialization that reflect differences in factor endowments (Schott 2003). He also finds that the differences in unit value of exports to the United States between developed and developing countries are systematic and can be ascribed to differences in factor endowments and factor production intensities (Schott 2004).[7] Schott (2008) finds that the overlap between China's exports to the United States and OECD exports to the United States exceed what one would expect given its wage rate, but that its unit values are substantially lower than those of OECD exports again suggesting a high degree of within-product specialization. Liu (2006) and Kiyota (2008) have both used similar disaggregated data to directly explore competition between US and Chinese exports in world and Japanese markets and reach similar conclusions: the United States and China occupy different parts of the export market.

EXPORT OVERLAP

We first explore the overlap between US exports and foreign exports to the United States using the data on commodity shares for 1990, 2000, and 2006. Like Schott (2008) in his analysis of the rising sophistication of Chinese exports to the United States, we measure the overlap in trade flows using indices of similarity at various levels of disaggregation. Whereas Schott benchmarks the composition of developing country exports to the United States against OECD exports to the United States, we extend this by also comparing the similarity of US exports and foreign exports to the United States.

The similarity index first involves calculating shares of each commodity and then summing the absolute difference in these shares.[8] If Xi is the share of commodity i in X and Yi the share of commodity i in country Y then we first calculate the absolute difference in the share of each commodity.

i.e., $| Xi - Yi |$

7. This result is also consistent with research by Harrigan (2000) showing that US producer prices did not fall substantially as a result of the Asian financial crisis, which lowered the world prices of many labor-intensive goods.

8. An alternative approach developed by Finger and Kreinin (1979) sums the minimum share for each commodity and produces an index in which confusingly 100 implies complete similarity and zero implies no overlap. See also Sun and Ng (2000).

We then sum these differences and divide by two to provide a similarity index SI_{XY} between X and Y, which is equal to 100 when the two series are completely different and equal to zero when they are completely similar.

$$SI_{XY} = \sum_i | Xi - Yi | /2$$

Consider, for example if there were just two commodities and two countries. If each fully specialized in exporting one of the products, the columns would be (0, 100) and (100, 0) and the index would measure 100 indicating no overlap. If both specialized in the same product, the columns would be (100, 0) and (100, 0) and the index would register zero indicating complete similarity.

One weakness in the measure is that it is sensitive to the level of disaggregation. Both countries might have half their exports in clothing, for example, and a measure at this level would indicate complete similarity, but one country might only be exporting shirts while the other only exports pants and this difference would show up if more disaggregated data was to be used. Accordingly we have calculated these indices at the most disaggregated level possible. The comparison of developing-country exports to the United States with aggregate high-income OECD exports to the United States is based on a time consistent 10-digit HTS classification constructed using the concordance mapping of Pierce and Schott (2009).[9] The comparison of foreign exports with aggregate US exports is based on 6-digit Harmonized System (HS) code as the 10-digit US export and import codes are not directly comparable.[10]

Table 1 reports the various export similarity indices for a selection of developed and developing countries in 1990, 2000, and 2006. We compare US imports from these countries with US imports from high-income OECD countries. We also compare the similarity of US imports with aggregate US exports. The two different comparisons yield remarkably similar results both in terms of the level and trend of the indices. Looking at the data for 2006, it is clear that in the sample Vietnamese exports are the most different from those of the United States and high-income OECD countries. Next most different are those from Hong Kong and then India. China and the category of other developing countries occupy intermediate positions, while developed countries such as Germany, Japan, and the category of "other developed countries" have the most similar structure to US exports.

The ordering of export similarity is broadly consistent with GDP per capita with exports from low-income countries displaying the least overlap with OECD exports and aggregate US exports, but exceptions are evident.[11] Surprisingly, Hong Kong's export similarity with the OECD and the United

9. The HTS classification has been revised on numerous occasions to reflect the development of new products. To ensure comparability across time, we convert all the HTS data to a time-consistent code using the concordance map developed by Pierce and Schott (2009).

10. The HS code is converted to the 1988/1992 revision to ensure comparability over time.

11. Highly disaggregated econometric estimates by Schott (2008) reveal a statistically significant association between

States was very low in 2006 despite incomes per capita similar to those in developed economies. The composition of Korea's and Mexico's exports to the United States was more similar to aggregate OECD exports than France's export bundle (and the United Kingdom in the case of Korea) in 2006, but this ordering is reversed in the comparison with aggregate US exports.

The change in similarity over time is also interesting. The export similarity of China, India, and Korea with the OECD and United States rose rapidly from 1990 to 2006 (see also figure 1). China, for example, rose from a low similarity position in 1990 to an intermediate position in 2006, but nevertheless remains more similar to other developing economies than developed countries including the United States. Schott (2008) also estimates that the rise in China's export similarity with the OECD is not exceptional and is consistent with predictions based on its size and level of development. A further observation is that almost the entire increase in China's export similarity took place between 1990 and 2000, with very little change in similarity from 2000 to 2006—a period in which US imports from China rose dramatically. Exports from Korea and India, in contrast, showed a steady increase in similarity with the OECD and aggregate US exports in both periods.

Overall, the similarity indices reveal a rising export similarity between many developing countries and the OECD and the United States. These trends are nevertheless not fully supportive of Samuelson's concerns. The rising similarity is broadly consistent with improvements in per capita growth in these countries and does not reflect exceptional increases in competition with US exports in recent years. Further, developing-country export similarity with the United States continues to be lower than for developed countries. Even developed countries show a fairly high degree of dissimilarity with US exports (typically around 50).

A comparison of cumulative import shares in table 2 corroborates this finding. China has been the focus of considerable attention in the debate on the effect of emerging economies on US welfare. We have therefore ranked products according to their shares in Chinese exports to the United States in 2006 and then sorted the other trade data by these rankings. Finally we cumulate the shares accounted for at each percentile of Chinese rankings. Table 2 compares China's manufacturing exports to the United States with those of other countries according to these cumulative shares.

The data reveal the weak overlap in the export bundles of developing countries with the United States and other developed countries. Products that accounted for 50 percent of US imports from China in 2006 made up just 8 percent of US imports from high-income OECD countries and 11 percent of US exports. In contrast, these products accounted for 52 percent of US imports from the Association of

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GDP per capita and export similarity with the OECD. In his simple regressions, China's export similarity to the OECD is greater than what would be predicted on the basis of its income per capita. However, China is no longer found to be an outlier after jointly controlling for size and level of development.

Southeast Asian Nations (ASEAN-4) category, 37 percent from Vietnam, but less than 10 percent from India and the category for "other developing countries." Interestingly, these products made up 27 (Hong Kong) to 56 (Singapore) percent of US imports from selected high-income Asian economies suggesting Chinese export growth to the United States may be at the expense of exports from these countries rather than other high-income economies, including the United States.

A similar story is evident if we look at products accounting for 80 percent of Chinese imports. These constituted just 21 percent of US imports from high-income OECD countries and 23 percent of US exports in 2006, but up to 76 percent of US imports from the ASEAN-4 and over 47 percent from the selected high-income Asian economies. It is clear from these results that by and large the goods the United States imports from China are very different from those that it exports or that are exported to the United States by high-income countries outside of Asia. Most Chinese exports are not competing with US or other developed-country exports.

UNIT VALUES

Another indicator of similarity is unit values. If US exports or imports from developed countries are similar to exports from developing countries in quality, composition, and price we would expect them to have similar unit values. In this section we investigate the similarity in unit values across countries using the highly disaggregated data drawn on in the earlier analysis.[12] As we will show, unit values of US imports from developing countries are substantially lower than those of equivalent products imported from high-income OECD countries and products exported by the United States. Further, unlike the export similarity indices that indicate rising across-product similarity in the export bundle of developing countries with aggregate US exports, the unit value analysis finds no such convergence. All told, these results convey a picture in which developed and developing countries tend to specialize in exporting different types of products.

The analysis is based on annual data from 1990 to 2006. Unit values of imports from foreign countries are compared to import unit values from high-income OECD countries as well unit values of aggregate US exports. In the comparison with the OECD, we first calculate the ratios of unit values using 10-digit data. We then weight the 10-digit unit value ratios by the annual share of each product in total US imports from high-income OECD countries.[13] For the comparison with US export unit values,

12. There are a number of data quality issues that arise in using this data. Errors in measurement can result in highly volatile unit value measures. The units of measurement are also not applied consistently over all periods and across countries. In what follows, we deal with outliers in unit values by eliminating the top and bottom 1 percent of data ranked according to price level. In constructing relative unit values, we also ensure that we only compare products measured using the same units. Note that in doing so, we eliminate the measurement units and hence are able to aggregate up the relative unit value indicator.

13. This measure therefore also captures the effect of changes in the US import bundle over time. The alternative is to use

we use 6-digit HS data and annual US export values as weights. The advantage of using OECD import unit values as the reference price is that we are able to present a much finer resolution of the relative price relationship.

Even at the ten-digit level, unit values are imprecise measures. In particular, relatively high values could indicate higher prices for similar products, higher quality, or within any category, a larger share of products with higher unit values. Nonetheless, as reported in table 3 below the results are quite remarkable, and correlate very strongly with levels of development.

Our selected countries are clearly grouped into two categories, particularly when import unit values are compared against US exports. The import unit values of high-income countries—such as the United Kingdom, France, the category for "other developed countries," Japan, and Germany—on average equal or exceed US export unit values by up to 60 percent (see figure 2). There is some movement in their relative price ratios over time, but in most cases the price relative to US exports is not too dissimilar in 2006 from 1990. US import unit values from Singapore are the exception rising from 64 percent of US export unit values in 1990 to 119 percent in 2006.

Looking at unit values relative to high-income OECD imports, we also see relative prices in excess of 1 for most high-income countries, but in this case we see a slight decline in the relative price over the period 1990–2006, perhaps reflecting rising convergence of prices within European countries who account for a high proportion of high-income OECD trade. Engel and Rogers (2004), for example, find that retail prices converged in European markets, particularly in the 1990s.

The second grouping covers the low and middle-income countries as well as some of the high-income Asian economies such as Korea, Taiwan, and Hong Kong. Looking first at China, it is striking that Chinese import unit values at the product level have hardly changed relative to OECD imports and aggregate US exports over the entire period. On average, Chinese import unit values were 43 percent of OECD import values and 34 percent of US export unit values in 2006, which is insignificantly different from the relative unit values in the early 1990s. The rising similarity in across-product composition of Chinese exports to the OECD and the United States is therefore not replicated in the relative price data, an observation also found by Schott (2008).

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trade weights for a fixed period, but this leads to the elimination of all products not exported in all years. This potentially eliminates a high proportion of trade from the calculation, if growth occurs through exports of new products rather than increased exports of existing products. There is some evidence for this effect. Product market penetration (share of total products exported) by developing countries into the US market rose rapidly from 1990 to 2006. For example, the share of products (at 6-digit HS level) exported by China rose from 53 percent in 1990 to 90 percent in 2006. The equivalent share for the ASEAN-4 and India rose from 42 percent and 32 percent in 1990 to 64 percent and 69 percent in 2006, respectively. However, the extensive growth arising from exports of new products accounted for between 5 to 6 percent of overall export growth in these periods, except for India where it accounted for 17 percent of export growth. The implication is that the weighted average, using annual export values as weights, does not differ substantially from those using fixed weights.

Unit values of imports from India, Mexico, and countries in the ASEAN-4 relative to the high-income OECD category and the United States are also low and relatively stable over time, ranging from 40 percent to 60 percent of the price of US exports. Surprisingly, relative unit values of imports from Taiwan, Korea, and especially Hong Kong are similar to the selected low- and middle-income countries, despite their relatively high incomes per capita. These newly industrialized Asian economies have therefore faced a rising similarity in exports to the United States with China, which has been combined with relative prices similar to those of developing Asian countries. This raises the possibility that that Samuelson's concerns about the effect of developing-country growth on welfare is being played out within newly industrialized Asian economies rather than industrialized Europe and North America.

The relative similarity in unit values amongst Asian developing and new industrialized Asian economies may also explain why production fragmentation and outsourcing has not raised the export unit values of developing Asian economies. According to our data, widespread relocation of production from industrialized Europe or North America to Asia would be expected to raise within-product unit values in these countries. In contrast, production fragmentation—being driven by the relocation of production from newly industrialized Asian economies to their developing neighbors—would have a much smaller impact on within-product unit values in the developing countries.

Another exception is the category for "other developing countries." Import unit values from other developing countries are very similar to US export unit values in all periods and show a slight increase relative to high-income OECD imports. This reflects a product composition effect. As shown in table 2, there is a very low overlap in imports from other developing countries and China. Additional disaggregated analysis reveals that imports of nonpetroleum manufactures from other developing countries are concentrated in textiles and clothing (27 percent) and base metals (23 percent). These products show relatively little variation in prices across countries including relative to US exports. The primary source of price differences across countries is in the machinery, transport, and specialized equipment sectors. We explore this further in the disaggregated analysis presented later.

Finally, we formally test for the relationship between exporter income and within-product price variation by regressing the weighted average unit value relative to the United States ($\ln(P_c/P_c^{US})$) on the log of GDP per capita (in constant 2000 purchasing power parity prices) ($\ln(GDPPC)_c$) using 2000 data and 152 countries. Our results presented below are consistent with those of Schott (2004).[14]

$$\ln(P_c/P_c^{US}) = -4.4 + 0.42 \ln(GDPPC)_c \text{ , R2 = 0.49, Obs = 152}$$
$$se \qquad (0.72) \quad (0.07)$$

and

14. The regression is weighted by the 2000 share of each country in US imports. The standard errors are robust to heteroskedasticity.

$$\ln(P_c/P_c^{US}) = -3.5 + 0.33\ \ln(GDPPC)_c - 0.51\ \text{Dchina},\ R2 = 0.56,\ \text{Obs} = 152$$
$$se \quad (0.65)\ (0.06) \quad (0.16)$$

We find a positive and statistically significant association between a country's GDP per capita and its weighted average price of exports to the United States relative to aggregate US exports. We also reestimate the equation but include a dummy variable for China to identify whether its relative prices differ significantly from predictions. Like Schott (2008) we find that Chinese products trade at a substantial discount (51 percent) given its GDP per capita. However, once we include population, the dummy variable is no longer significant, as is also found by Schott (2008).

All told, these results convey a picture in which developed and developing countries tend to specialize in exporting different types of products. Nevertheless, by looking at averages of all the data, we are perhaps missing some of the important insights that would be better obtained by focusing on more disaggregated classifications of the data. We therefore shift our focus to a more disaggregated analysis. In the following section we evaluate developing country exports to the United States according to various measures of product sophistication. We then look more closely at the top 50 NAICS six-digit level exports of China to the US in 2006.

The conclusions already drawn do not change. While the sophistication of developing-country exports to the US has risen, price levels of these sophisticated products remain a fraction of US export prices. Much of the action in terms of import penetration by developing countries, and China in particular, occurs within the NAICS category 334 Computer & Electronic Product Manufacturing. Nonetheless, the average Chinese unit value within these products was around a third of the average for the United States. Other top exports from China were also only a fraction of the price of US exports. This provides further evidence of a high degree of within-product specialization by developing and developed countries.

PRODUCT COMPOSITION ACCORDING TO LEVEL OF SOPHISTICATION

The concern about emerging-economy exports to the United States is not only that they are becoming more similar to US exports in general, but that the rising similarity has been driven by rapid increases in exports in the same "sophisticated" products exported by the United States.

If production and export of sophisticated products stimulates an acceleration in overall growth of the economy and supply of these very products, as is argued by Lall (2000) and Hausmann, Hwang, and Rodrik (2007), then the sophistication of the current structure of exports is a foreshadow of competitiveness pressures that are to come.

What is meant by sophistication is often not clear and can cover the use of sophisticated production processes to produce a good or the export of goods that embody sophisticated goods. Even the highly disaggregated product classification used by the US International Trade Commission is insufficient to perfectly isolate the production process from product composition. Further, as shown in the relative price analysis, there is substantial within-product variation in quality. We nevertheless draw on two measures of sophistication: a product technology classification developed by Lall (2000) and an export productivity measure developed by Hausmann, Hwang, and Rodrik (2007).

Our first indicator of the sophistication of foreign exports to the United States draws on the technological classification of exports developed by Lall (2000) which is described in table 4. *Resource-based* (RB) manufactures tend to be simple and labor intensive or intensive in use of natural resources. *Low-technology* (LT) manufactures tend to be undifferentiated products that compete on price (hence labor costs are important) and are produced using stable, well-diffused technologies. *Medium-technology* (MT) products comprise the bulk of skill- and scale-intensive technologies in capital goods and intermediate products and tend to have complex technologies with moderately high levels of R&D, advanced skill needs, and lengthy learning periods. Finally, *high-technology* (HT) products have advanced and fast-changing technologies with high R&D investments and require sophisticated technology infrastructures and high levels of specialized technical skills.

In all categories there are exceptions (e.g., amongst RB products the synthesis of fuel from coal requires skill-intensive technologies), but in general the skill requirements tend to rise with the degree of technological complexity. Lall (2000) also argues that the potential for productivity-led growth, as opposed to growth through factor accumulation, rises with the degree of technological complexity. He, for example, argues that technology-intensive trade structures offer better prospects for future growth as their products grow faster in trade and have larger spillover effects in terms of generating capabilities that can be used in other activities. His argument is therefore similar to that of Hausmann and Rodrik (2003) and Hausmann, Hwang, and Rodrik (2007), who use a different measure of sophistication.

Table 5 outlines the 1990 and 2006 share structure of US manufacturing imports for China, other low- and middle-income countries, and high-income OECD countries according to the technological classification. The table reveals the diverse patterns of specialization across regions as well as the remarkable shift in the composition of US imports from low- and middle-income countries toward medium- and high-technology products. High-income countries' exports to the United States are concentrated in medium- and high-technology manufactures and there has been little change in this structure over the full period.

Contrast this with Chinese exports to the United States. In 1990, 74 percent of US imports of manufactured goods from China were accounted for by low-technology products (mainly clothing) and only 7 percent by high-technology products. By 2006, high-technology products accounted for 35 percent of US imports of manufactured goods from China with all of the increase attributable to electronics and electrical products. The share of high-technology products in US imports from the category other low- and middle-income countries also rose, but at a slower pace from 18 to 25 percent.

The sophistication of Chinese export bundles to the United States appears to be exceptional. This is also the conclusion of Rodrik (2006) who finds that China's export profile to the world is especially skewed toward products where high-income countries have a comparative advantage.[15] Replicating his approach using foreign exports to the United States (figure 3), we also find that Chinese manufactured exports were associated with an income level (EXPY)[16] that was six times higher than its GDP per capita in 2000.[17] In 1990, the income level associated with its export bundle was 10 times its GDP per capita, but rapid growth (relative to growth in EXPY) reduced this to a factor of 3.7 by 2006. Thus while Chinese growth is converging on the income level associated with its export bundle to the United States, the gap nevertheless remains sizable and suggestive of substantial additional capacity for economic growth.

China is not alone in the exceptional sophistication of its export bundle to the United States. Figure 3 reveals that the export profile of many other emerging and newly industrialized economies is more sophisticated than what is predicted on the basis of their per capita income. These countries include Thailand, Mexico, Malaysia, Korea, and less so India and Indonesia. All these countries, including China, experienced rising income levels associated with their export bundles from 1990 to 2006, reflecting a shift in the composition of exports to the United States toward higher productivity sectors.

The rising technology intensity of emerging and newly industrialized country exports to the United States appear to confirm Samuelson's concerns about head-to-head competition with the United States in those products where the United States has a comparative advantage. However, as discussed earlier, rising sophistication of exports, as measured using trade value data, may obscure a high degree of within-product specialization. We therefore reevaluate the apparent rise in sophistication of emerging and newly industrialized country exports to the United States using unit value data.

15. He also argues that China's composition of exports reflects production- and technology-oriented policies, not comparative advantage.

16. Hausmann and Rodrik (2003) developed a measure, termed $EXPY_c$ of the productivity level associated with country *c*'s export bundle. This indicator is an export share–weighted average of commodity level measures of productivity ($PRODY_j$), which in turn reflect the weighted average incomes of the countries exporting that commodity. Therefore, products which account for a high share of exports by high income per capita countries will be characterized by a high *PRODY*. In a subsequent paper Hausmann, Hwang, and Rodrik (2007) show that their measure of *EXPY* is also a good predictor of future growth.

17. Commodity level *PRODY* is calculated using UNComtrade data for 2000 and 2001. The indices are calculated at the HS six-digit level using the H0 1988/1992 revision. GDP per capita, measured in constant 2000 purchasing power parity prices, is used as the income variable and is obtained from World Development Indicators. Countries are only used if trade data are available in both periods. A total of 147 countries are used. Only manufactured products (NAICS 31–33) are used to calculate *PRODY*. *EXPY* of country *j* is calculated as $EXPY_j^{USA} = \sum_l \frac{m_{jl}^{USA}}{M_j^{USA}} PRODY_l$ where m_{jl}^{USA} / M_j^{USA} is the share of product *l* in country *j*'s total manufacturing exports to the United States.

We present three diagrams of the weighted average unit value of US imports relative to US exports for manufactured goods over the period 1990–2006. Figure 4 focuses on US imports from China, figure 5 focuses on the aggregate import unit values from low- and middle-income countries, while figure 6 looks at import unit values from high-income OECD countries. In all cases, relative prices are first calculated at the six-digit HS level and then aggregated according to their technology classification using annual US export values as weights. We are therefore comparing average within-product price differences assuming that the structure of trade reflects that of US exports. Note that we therefore do not account for across-product specialization and these weighted average relative unit value measures therefore underrepresent the overall degree of specialization.

We first look at Chinese and low- and middle-income country import unit values relative to US exports. The relative price measures are neatly grouped into two categories. The relative price of resource-based and low-technology products ranges between 0.5 and 1.2 for China and 0.8 and 1.2 for all developing economies. This is expected as these products, particularly resource-based products, tend to be relatively undifferentiated. Product differentiation is not a key determinant of the competitiveness of these products.

This is contrasted by medium- and high-technology products. The unit values of US import from China of these products lies between 15 and 30 percent of the equivalent products exported by the United States. Further, remarkably, there has been no significant movement in these relative prices over the entire 16 years covered in the sample. Looking at the average for all low- and middle-income countries, the level of relative prices is slightly higher than for China alone, but there is also no change in the trend over time.

Contrast these diagrams with figure 6 comparing the unit values of high-income OECD imports with aggregate US exports. US imports of medium- and high-technology manufactures from high-income OECD countries are on average 80 percent of the unit value of the equivalent product exported by the United States. Resource-based and low-technology import unit values are 30 to 90 percent higher (and increasing over time for resource-based products) than the equivalent aggregate US export price.

These findings are not a particular outcome of our choice of technology classification or reference price. We replicate these findings if we compare foreign unit values to US import unit values from high-income OECD countries as opposed to aggregate US export prices. Classifying products according to the sophistication measure of Hausmann and Rodrik (2003) leads to the same conclusion. The unit values of US imports of low productivity products (*PRODY*) from low- and middle-income countries (and China alone) are between 80 to 100 percent of aggregate US export unit values in 2006. Amongst high productivity products (top 20 percent) unit values are 30 to 40 percent of the equivalent US export unit value.

Such vast and sustained differences in US export prices and import prices of medium- and high-technology products from low- and middle-income countries are indicative of a high degree of within-product specialization. These are also the products that accounted for the dramatic rise in the technological intensity of developing-country exports to the United States and the increases in the export similarity indices shown earlier. These results imply that much of the growth and the apparent rise in sophistication of developing-country exports to the United States have been driven by the export of different products to what is currently being exported by the US (and other high-income OECD countries). The rise in sophistication of developing-country exports suggested by their rising technology intensity of trade volumes is thus exaggerated.

DISAGGREGATED ANALYSIS

Next we drill down even further. We have assembled six-digit NAICS data for Chinese imports to the United States, high-income OECD imports to the United States, and US exports for 2006. We then rank these according to their share in US imports from China in 2006, and report the top 50 industries, which accounted for about 58 percent of all US-manufactured imports from China. Table 6 presents a comparison of unit values, relative unit values, and cumulative trade shares for these top 50 products.

Electronics sectors feature very prominently: Four of the top five Chinese industries and 9 out of the top 50 industries come from the NAICS category 334 that covers computer and electronic products.[18] In the short space of six years, Chinese exports of 334 products increased from $24.2 billion in 2001 to $108.3 billion in 2007, with their share in overall US imports of these products rising from 12 to 37.2 percent. Indeed, the $84.1 billion increase in US imports from China constituted almost all of the $88.4 billion growth in US imports from all countries.

Apparel, textiles, and footwear products also feature prominently, making up 16 of the top 50 industries and 14 percent of the value of Chinese exports to the US in 2006. The remaining industries are diverse covering, amongst others, machinery, electrical equipment, transport equipment, chemicals, wood products, and fabricated metal products.

The disaggregated data reinforces our earlier observation of substantial across-product and within-product specialization of Chinese exports to the United States. Computer and electronic products (334) constitute a sizable share of total US manufacturing exports (16.5 percent in 2006). Yet few of the large US export industries in the electronics sector are also prominent export industries from China. The strongest US performance in electronics was in semiconductors (334413), which constituted 4.3 percent

18. They include: audio and video equipment (334310)—6.6 percent of 2006 exports; electronic computers (334111)—6 percent; other computer equipment (334119)—5.1 percent; and wireless communications equipment (334220)—4.4 percent.

of US exports in 2006 but only 0.6 percent of Chinese exports to the United States in 2007. The only other US industry within the top 50 Chinese export industries that accounted for more than 1 percent of US manufacturing exports in 2006 is iron and steel mills (1.3 percent). Altogether these top 50 industries only made up 16.1 percent of US manufacturing exports in 2006. Similarly, the overlap of these 50 industries with high-income OECD exports to the United States is low, accounting for 16.5 percent of the exports to the United States. The prominent export industries of China are therefore very different from those that dominate the export bundle of the United States and high-income OECD countries.

In addition, the prices of goods within these top 50 Chinese export industries is consistently lower than the equivalent price of goods exported by the United States and high-income OECD countries. For example, the average price per unit of audio and video equipment (334310), the top import industry from China in 2006, was $89. The comparable price of US exports in this industry was $198 and $424 for high-income OECD imports. There are very few instances where the Chinese price exceeds that of the United States (10 times) and the OECD (4 times). If we weight up the relative price data using Chinese import values as weights, we find that products from these top 50 industries are, on average, 32 percent of the price of equivalent high-income OECD imports and 49 percent of the price of equivalent US exports. Such vast differences in prices suggest that China exports very different products than those exported by high-income OECD countries and the United States.

CONCLUSIONS

Samuelson and Krugman raised various concerns about the impact of developing countries on US welfare and wage inequality. In this paper we assess the evidence using highly disaggregated trade data and reasons to question both positions. The reason is the high degree of international specialization in trade flows that suggests that aside from natural resource–intensive products such as steel, manufactured goods produced and exported by the United States and other developed countries are very different from those exported by developing countries in general and China in particular.

Our findings suggest that great caution is required when using of measures of "advanced-technology" trade that are routinely produced by the US Department of Commerce in its monthly trade release to track performance. When imports from developing countries are important, the trade balances in particular high-tech products are not likely to capture competitiveness in similar products (or intermediates). This is especially the case for information technology products.

The large differences in prices we find are indicative of a high degree of specialization. US imports from developing countries are not close substitutes for US exports or US imports from OECD countries. This explains both why the US terms of trade have improved as developing countries have expanded their exports and why the wages of unskilled US workers have not experienced the downward pressures that would have been expected if they were still producing goods that were similar to those made by developing countries.

The paradoxical finding that US imports from developing countries are concentrated in US industries in which skilled rather than unskilled workers have relatively high payroll shares is predominantly the result of intraindustry international specialization along the lines of skill. The large and persistent differences in the unit values of exports from developed and developing countries in highly disaggregated data are inconsistent with other explanations for the paradox that assumes perfect substitution. These include factor-intensity reversals, aggregation bias, and claims that inputs from developed countries account for much of the value added contained in imports from developing countries.

REFERENCES

Blinder, Alan S. 2006. Offshoring: The Next Industrial Revolution? *Foreign Affairs* 85, no. 2 (March/April): 113–128.

Boorstein, Randi, and Robert C. Feenstra. 1991. Quality Upgrading and Its Welfare Cost in US Steel Imports, 1969–74. In *International Trade and Trade Policy*, eds. Elhanan Helpman and Assaf Razin. Cambridge, MA: MIT Press.

Broda, Christian, and David Weinstein. 2006. Globalization and the Gains from Variety. *Quarterly Journal of Economics* 121, 2: 541–585.

Diewert, W. Erwin. 1976. Exact and Superlative Index Numbers. *Journal of Econometrics* 4: 115–145.

Edwards, Lawrence, and Robert Z. Lawrence. 2010a. *Rising Tide: Is Growth in Emerging Economies Good for the United States?* Forthcoming, Washington: Peterson Institute for International Economics.

Edwards, Lawrence, and Robert Z. Lawrence. 2010b. US Trade and Wages: The Misleading Implications of Conventional Trade Theory. National Bureau of Economic Research Working Paper. Cambridge, MA: National Bureau of Economic Research.

Engel, Charles, and John H. Rogers. 2004. European Product Market Integration after the Euro. *Economic Policy* 39: 347–384.

Feenstra, Robert C. 1988. Quality Change under Trade Restraints in Japanese Autos. *Quarterly Journal of Economics* 103: 131–146.

Feenstra, Robert C. 1994. New Product Varieties and the Measurement of International Prices. *American Economic Review* 84: 157–177.

Feenstra, Robert C. 2004. *Advanced International Trade: Theory and Evidence*. Princeton, NJ: Princeton University Press.

Feenstra, Robert C., John Romalis, and Peter K. Schott. 2002. US Imports, Exports, and Tariff Data, 1989–2001. National Bureau of Economic Research Working Paper 9387. Cambridge, MA: National Bureau of Economic Research.

Finger, J. Michael, and Mordechai E. Kreinin. 1979. A Measure of "Export Similarity" and Possible Uses. *The Economic Journal* 89: 905–912.

Gomory, Ralph E., and William J. Baumol. 2000. *Global Trade and Conflicting National Interests*. Cambridge, MA: MIT Press.

Harrigan, James. 2000. The impact of the Asia crisis on US industry: an almost-free lunch? *Economic Policy Review*. Federal Reserve Bank of New York, Sep: 71–81.

Harrigan, James, and Geoffrey Barrows. 2009. Testing the Theory of Trade Policy: Evidence from the Abrupt End of the Multifiber Arrangement. *The Review of Economics and Statistics* 91, no. 2: 282–294.

Hausmann, Ricardo, and Dani Rodrik. 2003. Economic Development as Self-Discovery. *Journal of Development Economics* 72, no. 2: 603–633.

Hausmann, Ricardo, Jason Hwang, and Dani Rodrik. 2007. What you Export Matters. *Journal of Economic Growth* 12, no. 1: 1–25,

Kiyota, Kozo. 2008. *Are US Exports Different from China's Exports? Evidence from Japan's Imports*. University of Michigan, Research Seminar in International Economics Discussion Paper 576 (April).

Krugman, Paul R. 2007. Trade and Inequality, Revisited. Available at http://voxeu.org (accessed on June 15, 2007).

Krugman, Paul R. 2008. Trade and Wages, Reconsidered. *Brookings Papers on Economic Activity* (Spring): 103–137.

Lall, Sanjaya. 2000. *The Technological Structure and Performance of Developing Country Exports, 1985–1998.* Queen Elizabeth House Working Paper 44. Oxford University: Queen Elizabeth House.

Lawrence, Robert Z. 2008. *Blue-Collar Blues: Is Trade to Blame for Rising US Income Inequality?* Washington: Peterson Institute for International Economics.

Liu, Zhou. 2006. *The Economic Interdependence of China and the World.* Harvard University PhD Dissertation.

Pierce, Justin R., and Peter K. Schott. 2009. Concording US Harmonized System Categories over Time. Center for Economic Studies Working Paper 09-11. Washington: US Census Bureau.

NSF (National Science Foundation). 2008. *Science and Engineering Indicators 2008.* Available at www.nsf.gov.

Rodrik, Dani. 2006. *What's So Special about China's Exports*? National Bureau of Economic Research Working Paper 11947. Cambridge, MA: National Bureau of Economic Research.

Samuelson, Paul A. 2004. Where Ricardo and Mill Rebut and Confirm Arguments of Mainstream Economists Supporting Globalization. *Journal of Economic Perspectives* 18, no. 3: 135–146.

Sato, Kazuo. 1976. The Ideal Log-Change Index Number. *Review of Economics and Statistics* 58: 223–228.

Schott, Peter K. 2003. One Size Fits All? Heckscher-Ohlin Specialization in Global Production. *The American Economic Review* 93, no. 3: 686–708.

Schott, Peter K. 2004. Across-product Versus Within-product Specialization in International Trade. *The Quarterly Journal of Economics* 119, no. 2: 646–677.

Schott, Peter K. 2008. The Relative Sophistication of Chinese Exports. *Economic Policy* 23, no. 53: 5–49.

Sun, Guang-Zhen, and Yew-Kwang Ng. 2000. The Measurement of Structural Differences between Economies: An Axiomatic Characterization. *Economic Theory* 16, no. 2: 313–321.

Vartia, Yrjö. 1976. Ideal Log-Change Index Numbers. *Scandinavian Journal of Statistics* III: 121–126.

Vernon, Raymond. 1966. International Investment and International Trade in the Product Cycle. *Quarterly Journal of Economics* 80 (May): 190–207.

Wang, Zhi, and Shang-Jin Wei. 2008. *What Accounts for the Rising Sophistication of China's Exports?* National Bureau of Economic Research Working Paper 13771. Cambridge, MA: National Bureau of Economic Research.

Table 1 Export similarity indices for manufactured goods, ranked by similarity with high-income OECD in 2006

	Export similarity with high-income OECD country exports to US HS 10-digit data (1.00 is completely different)				Export similarity with US exports, 6-digit data			
	1990	2000	2006	Change 1990–2006	1990	2000	2006	Change 1990–2006
Vietnam		0.97	0.92			0.96	0.93	
Hong Kong	0.78	0.81	0.82	0.04	0.79	0.79	0.8	0.01
India	0.92	0.87	0.82	–0.11	0.91	0.85	0.79	–0.12
Singapore	0.82	0.82	0.81	–0.01	0.78	0.76	0.76	–0.03
ASEAN-4	0.82	0.77	0.81	–0.02	0.83	0.74	0.76	–0.07
China	0.85	0.75	0.75	–0.10	0.89	0.76	0.74	–0.14
Taiwan	0.73	0.72	0.74	0.01	0.73	0.67	0.69	–0.04
Other developing	0.78	0.76	0.74	–0.04	0.78	0.77	0.73	–0.05
France	0.69	0.67	0.68	–0.01	0.62	0.61	0.60	–0.02
Mexico	0.67	0.59	0.61	–0.06	0.70	0.63	0.63	–0.07
UK	0.59	0.56	0.57	–0.02	0.55	0.53	0.57	0.02
Korea	0.72	0.66	0.56	–0.15	0.77	0.70	0.66	–0.12
Japan	0.39	0.40	0.45	0.05	0.58	0.54	0.60	0.02
Germany	0.50	0.46	0.44	–0.06	0.59	0.53	0.53	–0.06
Other developed	0.33	0.29	0.26	–0.07	0.54	0.50	0.48	–0.06

Note: Processed petroleum products are excluded. Similarity indices based on high-income OECD countries use time-consistent HS10 code constructed using the concordance mapping of Pierce and Schott (2009). The indices based on US exports are calculated using time-consistent code based on the 1988–1992 Revision of HS. ASEAN-4 consists of Indonesia, Malaysia, Philippines, and Thailand. Other developing consists of other low- and middle-income countries.

Source: Authors' calculations.

Table 2 Overlap in export bundle with China, 2006 (percentage of total exports)

	Low- and middle-income country exports to US					High-income Asian country exports to US				High-income	
China	ASEAN-4	Mexico	India	Vietnam	Other	Korea	Hong Kong	Singapore	Taiwan	High-Income OECD exports to US	US exports
5	10	0	0	0	0	0	0	1	1	0	0
10	13	2	0	0	1	13	1	4	5	2	1
15	21	3	0	3	1	19	2	20	14	3	2
20	24	12	1	3	1	21	3	20	19	4	2
25	25	15	1	11	2	21	3	21	19	4	3
30	32	15	1	12	2	22	5	39	20	4	4
35	38	17	3	19	3	22	10	40	22	5	4
40	40	18	3	22	3	23	11	42	25	6	5
45	50	20	4	30	4	31	14	55	37	7	9
50	**52**	**23**	**6**	**37**	**9**	**33**	**27**	**56**	**44**	**8**	**11**
55	56	27	21	45	14	36	48	56	47	11	13
60	64	29	22	47	15	37	53	58	50	12	14
65	67	33	26	53	17	41	56	59	54	14	16
70	69	36	33	57	21	42	63	59	59	15	17
75	73	41	39	63	24	43	66	60	62	17	18
80	**76**	**48**	**42**	**70**	**29**	**47**	**74**	**62**	**67**	**21**	**23**
85	79	52	46	77	35	50	77	63	71	24	28
90	84	56	68	84	43	56	85	65	79	31	35
95	89	64	77	93	52	62	92	73	86	40	43
100	100	100	100	100	100	100	100	100	100	100	100

Notes: Overlap using HS (Rev. 1988–1992) 6-digit data.

Source: Authors' calculations.

Table 3 Average unit values relative to high-income OECD exports to the US and aggregate US exports, ranked by price relative to OECD in 2006

	Unit values relative to OECD exports			Relative to US exports		
	1990	2000	2006	1990	2000	2006
UK	1.66	1.20	1.30	1.28	1.16	1.30
Singapore	1.04	0.96	1.19	0.64	0.93	1.19
Germany	1.38	1.02	1.07	1.20	0.97	1.06
Japan	1.13	1.11	1.05	1.02	1.06	1.08
Other developed	1.17	1.07	1.04	1.08	1.09	1.13
Other developing	0.74	0.89	1.00	0.97	0.95	1.08
France	1.50	1.03	0.83	1.53	1.19	1.29
ASEAN-4	0.53	0.63	0.65	0.44	0.42	0.40
Korea	0.59	0.62	0.59	0.46	0.52	0.61
Mexico	0.64	0.68	0.59	0.50	0.50	0.44
Taiwan	0.47	0.43	0.52	0.38	0.34	0.39
India	0.58	0.34	0.48	0.50	0.34	0.50
China	0.46	0.39	0.43	0.25	0.25	0.34
Vietnam		0.17	0.37		0.19	0.31
Hong Kong	0.65	0.41	0.32	0.46	0.42	0.35

Source: Authors' calculations.

Table 4 The technological classification of exports

Primary products	
Fresh fruit, meat, rice, cocoa, tea, coffee, wood, coal, crude petroleum, gas, metals	
Manufactured products	
RB1: Agro/forest-based products	Prepared meats/fruits, beverages, wood products, vegetable oils
RB2: Minerals-based products	Ores & concentrates, petroleum/rubber products, cement, cut gems, glass
LT1: "Fashion cluster"	Textile fabrics, clothing, headgear, footwear, leather manufactures, travel goods
LT2: Other low-technology	Pottery, simple metal parts/structures, furniture, jewelry, toys, plastic products
MT1: Automotive products	Passenger vehicles and parts, commercial vehicles, motorcycles and parts
MT2: Process industries	Synthetic fibers, chemicals and paints, fertilizers, plastics, iron, pipes/tubes
MT3: Engineering industries	Engines, motors, industrial machinery, pumps, switchgears, ships, watches
HT1: Electronics and electrical products	Office/data processing/telecommunications equipment, TVs, transistors, turbines, power generating equipment
HT2: Other high-technology	Pharmaceuticals, aerospace, optical/measuring instruments, cameras
"Special" transactions	
Electricity, cinema film, printed matter, art, coins, pets, non-monetary gold	

RB = resource-based manufactures
LT = low-technology manufactures
MT = medium-technology manufactures
HT = high-technology manufactures

Source: Lall (2000). Authors' calculations.

Table 5 Share structure of US manufacturing imports by technology classification (percent)

	China 1990	Other low- and middle-income 1990	High-income OECD 1990	China 2006	Other low- and middle-income 2006	High-income OECD 2006
Resource-based manufactures	3	20	17	5	13	18
RB1: Agro/forest-based products	1	13	12	3	8	11
RB2: Other resource-based products	2	7	6	2	5	7
Low-technology manufactures	74	36	14	38	29	9
LT1: "Fashion cluster"	56	29	7	23	22	3
LT2: Other low-technology	18	7	7	15	7	7
Medium-technology manufactures	17	26	53	22	33	56
MT1: Automotive products	0	7	30	2	14	34
MT2: Process industries	2	5	6	3	7	8
MT3: Engineering industries	14	13	17	17	13	15
High-technology manufactures	7	18	15	35	25	17
HT1: Electronics and electrical products	6	17	14	34	23	9
HT2: Other high-technology	1	1	2	1	1	9
Other	0	1	1	1	1	1

Source: Authors' calculations.

Table 6 Prices, relative prices, and cumulative trade shares of top 50 Chinese export industries in 2006

			Prices US dollars per unit				Chinese price relative to:		Cumulative share total trade values (millions of US dollars)		
NAICS code	Description	Units	China	High-income OECD	US exports	Mexico	High-income OECD	US exports	China	High-income OECD	US exports
334310	Audio and video equipment	NO	89	424	198	614	0.21	0.45	7	1	0
334111	Electronic computer	NO	652	1,901	2,490	706	0.34	0.26	13	1	1
334119	Other computer peripheral equipment	NO	113	508	907	221	0.22	0.12	18	2	2
334220	Radio, TV broadcasting, and wireless equipment	NO	96	164	493	105	0.58	0.19	22	3	3
316214	Women's footwear (except athletic)	PRS	8	52	19	25	0.15	0.43	24	3	3
333313	Office machinery	NO	84	1,939	757	15	0.04	0.11	26	3	3
335211	Electric housewares and household fan	NO	12	86	77	16	0.14	0.15	28	4	3
315239	Women's and girls' cut and sew outerwear	DOZ	82	247	73	81	0.33	1.12	30	4	3
316219	Other footwear	PRS	8	37	15	13	0.23	0.55	31	4	3
331111	Iron and steel mills	KG	1	1	2	1	0.75	0.58	32	6	4
315232	Women's and girls' cut and sew blouse and shirt	DOZ	84	143	29	28	0.59	2.89	33	6	4
314129	Other household textile product mills	NO	5	11	7	5	0.41	0.64	34	6	4
316991	Luggage	NO	3	53	8	9	0.07	0.41	36	6	4
316213	Men's footwear (except athletic)	PRS	14	53	35	40	0.26	0.39	37	6	4
334112	Computer storage device	NO	35	211	1,495	1,097	0.17	0.02	38	6	5
332999	Other misc. fabricated metal products	KG	3	8	7	4	0.58	0.4	39	7	5
337127	Institutional furniture	NO	37	105	103	75	0.36	0.35	40	7	5
315234	Women's and girls' cut and sew suit, coat, skirt	DOZ	100	804	95	85	0.12	1.03	40	7	5
334418	Printed circuit assembly (electronic)	NO	30	58	28	36	0.52	1.08	41	7	5
335129	Other lighting equipment	NO	3	76	36	20	0.04	0.08	42	8	5
334419	Other electronic component	NO	9	52	126	51	0.17	0.07	43	8	6
336399	All other motor vehicle parts	NO	12	7	49	10	1.54	0.25	44	10	6
335121	Residential electric lighting fixture	NO	10	100	46	5	0.1	0.22	44	10	6
326211	Tire (except retreading)	NO	39	78	89	48	0.5	0.44	45	10	6
335221	Household cooking appliance	NO	73	293	344	245	0.25	0.21	46	10	6
334210	Telephone apparatus	NO	39	365	963	57	0.11	0.04	46	10	6
325199	All other basic organic chemical	KG	7	31	4	3	0.22	1.52	47	12	9
334413	Semiconductor and related device	NO	2	4	3	1	0.56	0.82	47	14	14

(table continues on next page)

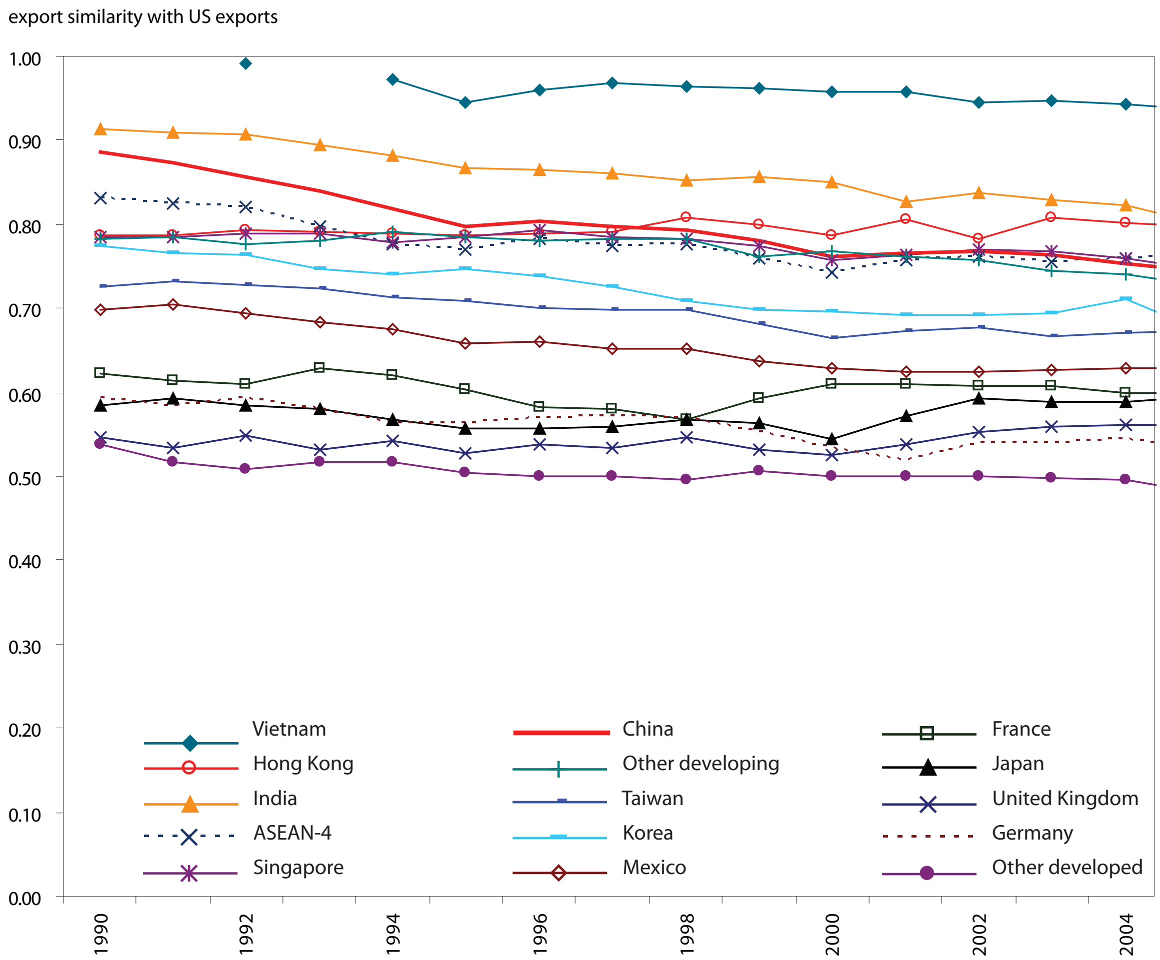
Table 6 Prices, relative prices and, cumulative trade shares of top 50 Chinese export industries in 2006 *(continued)*

			Prices US dollars per unit				Chinese price relative to:		Cumulative share total trade values (millions of US dollars)		
NAICS code	Description	Units	China	High-income OECD	US exports	Mexico	High-income OECD	US exports	China	High-income OECD	US exports
337121	Upholstered household furniture	NO	85	206	114	198	0.41	0.74	48	14	14
316992	Women's handbag and purse	NO	7	145	24	25	0.05	0.3	49	14	14
339932	Game, toy, and children's vehicle	NO	2	2	5	2	1.05	0.44	49	14	14
315228	Men's and boys' cut and sew other outerwear	DOZ	108	340	47	82	0.31	2.29	50	14	14
315231	Women's and girls' lingerie and nightwear	DOZ	40	113	13	34	0.35	3.1	50	14	14
333415	AC, warm air heating, and refrigerator equipment	NO	116	728	1,920	340	0.16	0.06	51	14	14
332510	Hardware	KG	4	8	10	7	0.46	0.42	51	14	14
339920	Sporting and athletic goods	NO	10	54	63	34	0.24	0.26	52	14	14
314999	All other misc. textile product mills	NO	1	2	16	1	0.42	0.05	52	14	14
333991	Power-driven handtool	NO	31	181	174	65	0.17	0.18	53	14	15
315291	Infants' cut and sew apparel	DOZ	23	78	43	36	0.3	0.54	53	14	15
335312	Motor and generator	NO	22	473	1,845	32	0.05	0.01	54	15	15
337124	Metal household furniture	NO	23	151		51	0.15		54	15	15
315999	Other apparel accessories and other apparel	DOZ	11	125	17	22	0.11	0.64	55	15	15
315223	Men's and boys' cut and sew shirt	DOZ	86	148	25	37	0.58	3.39	55	15	15
332911	Industrial valve	NO	7	20	72	8	0.33	0.15	55	15	16
336991	Motorcycle, bicycle, and parts	NO	68	5,064	6,768	52	0.02	0.01	56	16	16
339999	All other miscellaneous	NO	3	6	36	2	0.6	0.37	56	16	16
322223	Plastics, foil, and coated paper bag	KG	3	4	5	2	0.8	0.61	57	16	16
321211	Hardwood veneer and plywood	M3	488	692	433	503	0.7	1.13	57	16	16
339115	Ophthalmic goods	DOZ	24	308	126	4	0.08	0.19	57	16	16
315233	Women's and girls' cut and sew dress	DOZ	158	982	126	87	0.16	1.25	58	17	16

Note: Products are classified according to multiple units, even within the NAICS 6-digit classification. The unit corresponding to the largest Chinese trade flow is used to select the units for the dollar price per unit. Price levels at the 6-digit NAICS level are constructed by weighting up unit values at the 10-digit level using trade values as weights. For relative prices, the import weighted average (Chinese imports as weights) for each 6-digit category is presented. The relative price presented therefore differs slightly from those that can be calculated using the price levels. The denominator (OECD price) used in the relative price calculation is the import weighted average unit value of high-income OECD countries.

Source: Authors' calculations.

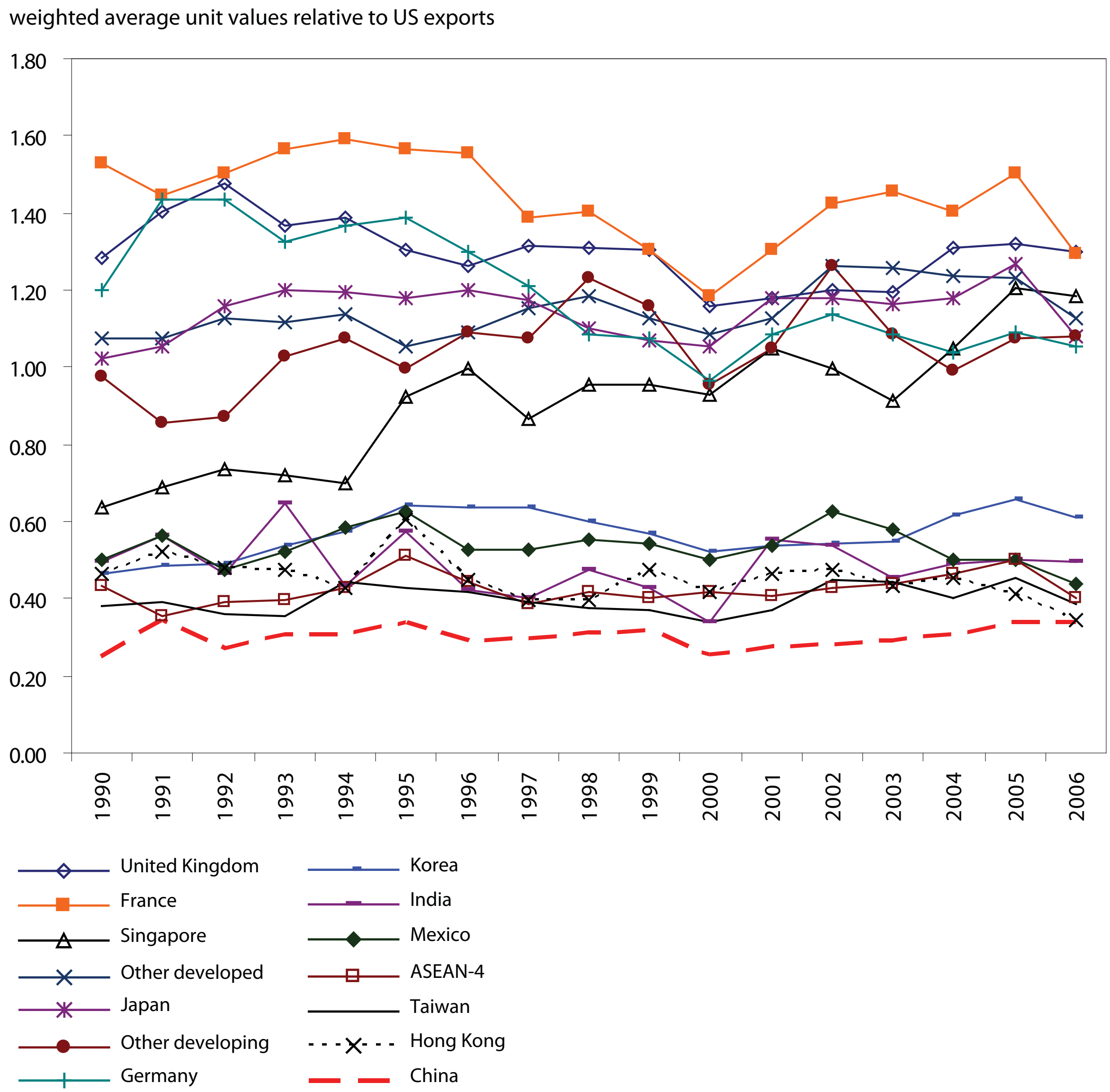
Figure 1 Export similarity with aggregate US manufacturing exports



Notes: Calculated using HS (Rev. 1988–1992) 6-digit data.

Source: Authors' calculations.

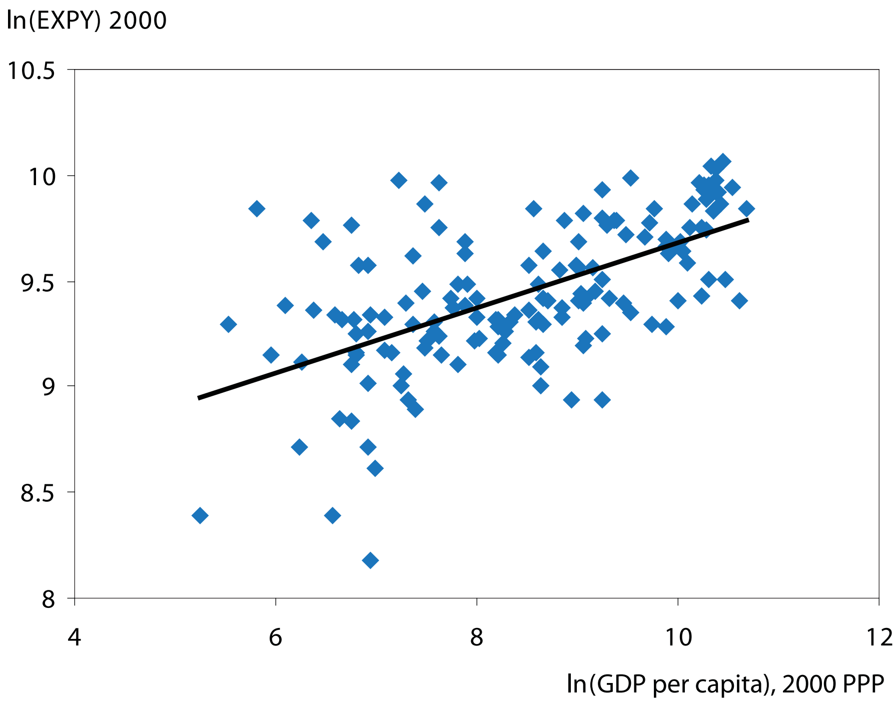
Figure 2 Weighted average unit values relative to US exports



Notes: Calculated using HS (Rev. 1988–1992) 6-digit data and annual US exports as weights.

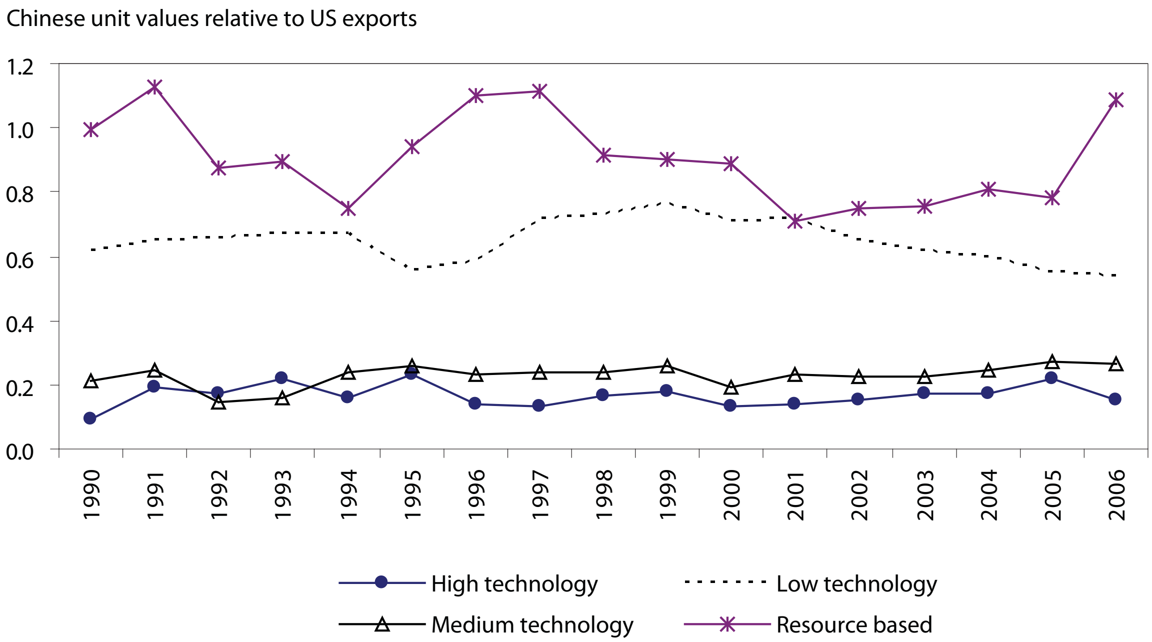
Source: Authors' calculations.

Figure 3 Relationship between manufacturing EXPY and per-capita incomes in 2000



Source: Authors' calculations.

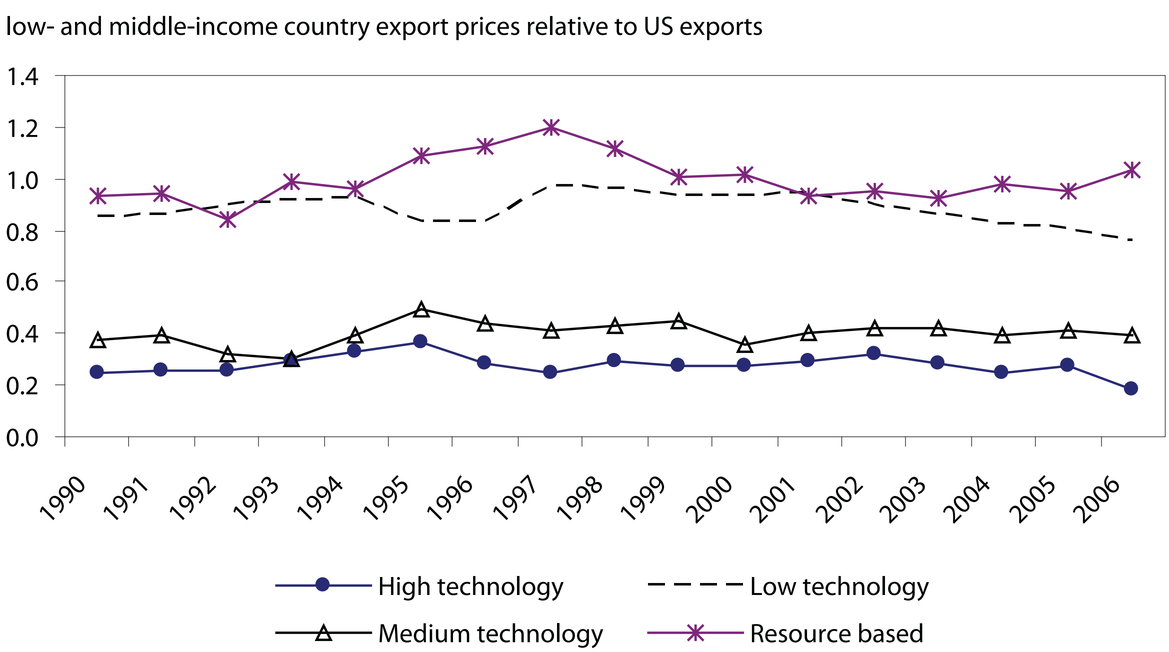
Figure 4 China's export prices relative to US exports



Notes: Own calculations based on 6-digit HS data. Individual country average calculated using total US exports as weights. Weighted average for region calculated by aggregating the country level average using total bilateral import values as weights. Manufactures classified as primary products in the Lall technology classification are excluded from these diagrams.

Source: Authors' calculations.

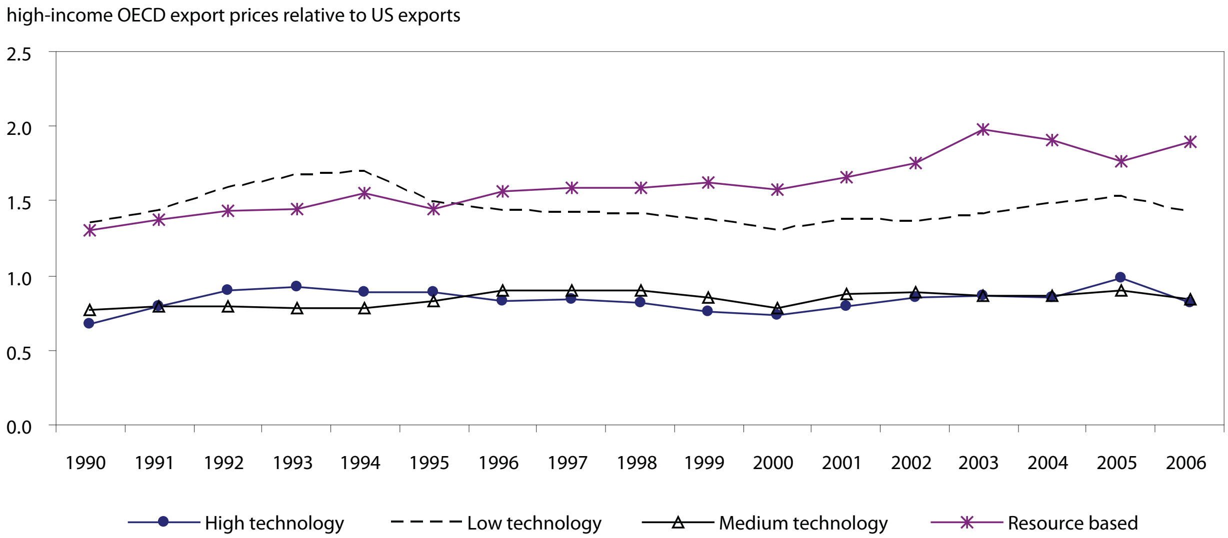
Figure 5 Low- and middle-income export prices relative to US exports



Notes: Own calculations based on 6-digit HS data. Individual country average calculated using total US exports as weights. Weighted average for region calculated by aggregating the country level average using total bilateral import values as weights. Manufactures classified as primary products in the Lall technology classification are excluded from these diagrams.

Source: Authors' calculations.

Figure 6 High-income OECD export prices relative to US exports



Notes: Own calculations based on 6-digit HS data. Individual country average calculated using total US exports as weights. Weighted average for region calculated by aggregating the country level average using total bilateral import values as weights. Manufactures classified as primary products in the Lall technology classification are excluded from these diagrams.

Source: Authors' calculations.