Within- and Across-Product Specialization Revisited

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1 Introduction

In a recent important paper entitled "Across-product versus within-product specialization in international trade," Schott (2004, p. 648) reaches the following dramatic conclusion: "[Like Bowen, Leamer, and Sveikauskas (1987) and Trefler (1995)] I find no evidence of endowment-driven specialization *across* products here either. Over time, the United States increasingly sources the same products from both high- and low-wage countries. However, the data are consistent with specialization *within* products." Elsewhere in the paper, Schott (2004, p. 662) notes unhesitatingly, "The data reject old trade theory specialization due to comparative advantage *across* products."

Schott's excellent analysis is based on data on U.S. imports from all its trading partners disaggregated down to 10 digits within the United States Harmonized Tariff Schedule (HTS) classification. Arguing reasonably persuasively that a 10-digit category represents functionally the same *product*, Schott interprets observed import flows of the same 10-digit product from different trading partners as representing different *varieties* of the product. Price differences across these varieties are then interpreted as representing quality differences: the higher the quality of a variety, the higher its price.

Two key results lead Schott (2004) to the conclusion quoted in the opening paragraph of the paper. First, prices of varieties imported by the United States from different trading partners strongly correlate with the latter's per-capita incomes, capital per worker and skill level per worker. This result points to *within*-product specialization by richer countries in higher-quality products and by poorer countries in lower quality products. Second, Schott finds that despite being in mutually exclusive specialization cones, high-income and low-income countries continue to have vast numbers of 10-digit

products common to their export baskets. Schott reasons that this observation fundamentally contradicts the factor-endowments theories according to which production baskets of countries in mutually exclusive specialization cones should be entirely distinct.

In this paper, we revisit the issue of within- and across-product specialization. Our conclusions turn out to be contrary to those in Schott. We show that across product specialization remains pervasive. We do not suggest that our analysis overturns the specific empirical results of Schott as described in the previous paragraph. Those results are entirely robust. Instead, we show that his results are insufficient to rule out across product specialization.

There are many grounds on which we will contest Schott's conclusion that there is no evidence of endowments based across product specialization. Here we limit ourselves to mentioning what we regard as the key factor. Schott's analysis is exclusively based on the United States imports from its various trading partners. Such analysis ignores the role played by the United States exports to its trading partners in determining its pattern of trade. Likewise, it ignores the role of the exports by the United States' trading partners to countries other than the United States as well as their imports from these other countries in determining their patterns of trade. In essence, analyzing the pattern of trade from one-way flows reveals only a partial picture of the patterns of specialization of the countries. To fully get at the degree of within- versus across-product specialization in trade and whether within-product specialization and trade is differentiated by quality, we must consider data on both exports and imports.

For instance, a high-income trading partner such as Germany may export a high-quality product variety to the United States but may export a low-quality variety to China

or India. In the same vein, even though China exports a lower-quality variety than Germany to the United States, it may export a still lower-quality variety to Ghana. On the other hand, there is no guarantee that countries overwhelmingly import the same 10-digit products they export. Vastly different import and export baskets in terms of 10-digit products would imply across product specialization.

In this paper, we examine both export and import data of the United States disaggregated down to HTS 10-digit products from 1989 to 2001. This examination leads to a richer picture of within- versus across-product specialization. For example, we find that less than 30 percent (27.5 percent in 2001) of all products the United States trades are subject to movements in both direction meaning they are exported as well as imported. As many as two-thirds of the products the United States imports do not appear in its export basket. That is to say, the United States does not export a single variety of two-thirds of the products it imports. In a similar vein, the United States does not import one-third of the products it exports: No country exports to the United States a single variety of one-thirds of the latter's export products.

These results suggest a strong tendency towards across product specialization. Skeptics may argue, however, that the vast majority of trade may still be concentrated within products that are trades in both directions. To address this concern, we calculate the standard Grubel-Lloyd index of intra-industry trade. We find that at HTS 10-digit level of classification, the value of this index fluctuates around 21 percent between 1989 and 2001. Thus, a disproportionately large volume of the United States trade exhibits across product specialization.

Looking at both export and import data allows us to address another closely related question that has occupied many trade economists: To what extent is the observed intra-industry trade the result of two-way trade in quality-differentiated varieties and to what extent does it represent trade in attributes-differentiated varieties? Falvey (1981) offers an excellent theoretical analysis of how two-way trade in quality-differentiated varieties may arise within a factor-endowments model while Krugman (1979, 1980) and Helpman (1981) have provided the pioneering analyses of two-way trade in attributes-differentiated products.[1]

A superficial reading of Schott (2004) may lead one to conclude that a disproportionately large part of within-product trade is in quality-differentiated varieties: after all, according to his analysis, countries specialize in varieties of different qualities (as measured by unit values) according to their per-capita incomes and factor endowments. But a more careful consideration raises doubts about this inference along two separate lines. First, a very large proportion of the world trade is among rich countries. Taking at face value Schott's conclusion that per-capita income and factor endowments determine product quality of exports, these countries are likely to export product of more or less similar quality to one another.

Second and contrary to Schott (2004), countries may specialize in and export varieties of different qualities of a product. Recall that Schott's data are limited to the United States imports from its various trading partners. Limiting the data in this way precludes consideration of the possibility that the trading partners may produce and export other variety to other trading partners. Such a possibility is particularly relevant to the United States as an exporter. Given its skewed income distribution, diverse resource

[1] Mention may also be made of Lancaster (1980) and Dixit and Norman (1980) in this context.

base, and the large size, the home-demand bias models would predict that the United States would specialize in and export varieties of diverse qualities. This suggests further role for within-product trade in attributes- over quality-differentiated varieties.

An examination of unit values of varieties of 15 randomly selected 10-digit export products of the United Sates confirms this conjecture: The ratio of the highest to lowest unit value within the same 10-digit product varies from 5.4 to 208.6 across these products. Therefore, the United States exports varieties of diverse qualities of the same product. These varieties can mirror some of the import varieties of the same product thereby giving rise to attributes -differentiated two-way trade.

Separating two-way trade into quality- and attributes-differentiated varieties is likely to be controversial. The central issue concerns the method by which we should identify export and import flows within the same 10-digit product exhibiting similar unit values. The key contribution attempting this identification in the existing literature is Greenaway, Hine and Milner (1995). These authors use 5-digit SITC (Standard International Trade Classification) exports and imports of the United Kingdom vis-à-vis the rest of the world taken as a whole. A problem with this approach, however, is that given the varieties imported from and exported to different countries exhibit very different unit values, aggregating the trading partners into a single rest of the world results in a loss of important information contained in the data. Therefore, we do not try to separate vertically and horizontally differentiated products. Instead, we simply identify products and the associated trade that cannot be characterized as representing two-way trade in vertically differentiated varieties.

The paper is organized as follows. In Section 2, we outline Schott's basic results. In Section 3, we question his results on theoretical grounds. In Sections 4-7, we use the unit value and volume of trade data for the United States export and import to systematically make the point that across-product specialization remains pervasive in the data. In Section 8, we conclude the paper.

2 Schott's basic Analysis

Schott's argument that there does not exist any evidence for endowments-based across product specialization has two parts.[2] First, he demonstrates that unit values of the United States imports of 10-digit products from different countries strongly correlate with the latter's per-capita incomes and factor endowments: the higher the per-capita income and capital and skill endowment per worker of a partner country, the higher the unit value of imports from it. This establishes the presence of within product specialization along factor-endowments line.

The second step relies on a theoretical implication of the factor endowments theory. To explain, following Schott (2004), suppose we divide the trading partners into three categories according to their per-capita income levels: high, middle and low. Suppose further that in the integrated free-trade equilibrium, factor prices equalize within each

[2] In passing, we may note that the subject of within- and across-product specialization has been the subject of study for nearly fifty years under the rubric of inter- versus intra-industry trade. Key empirical contributions to this literature other than those mentioned in the text include Verdoon (1960), Balassa (1965, 1966), Grubel (1967), Grubel and Lloyd (1971, 1975), Finger (1975) and Chipman (1985). Among theoretical contributions on the subject, mention may be made of Davis (1995, 1997), Bhagwati and Davis (1999), Chipman (1988) and Rodgers (1988). Controversies have existed in the past about both the existence of intra-industry trade in attributes-differentiated products and whether or not the traditional models associated with names of Ricardian and Heckscher-Ohlin theories can explain such trade. Finger (1975) questions the existence of attributes-based intra-industry trade while Davis (1995, 1997) argues that the traditional theories can be modified to explain such trade.

group but differ across them. Letting capital and labor be the two factors of production, assume the wage-rental ratio is the highest in high-income group, next highest in the middle-income group and the lowest in the low-income group.

This is shown in Figure 1 where we measure capital on the vertical axis and labor on the horizontal axis. We depict three cost lines each associated with costs worth a dollar but at three different wage and rental rates. HH', MM' and LL' are the wage-rental lines reflecting one dollar of cost in the high-, middle- and low-income countries, respectively, in the integrated equilibrium under free trade. Isoquants marked v, w, x, y and z represent five different commodities with each representing output worth one dollar at the equilibrium world prices. A plausible inference from this construction is that there is at most one commodity, w, that high- and middle-income countries could both produce and one, y, which middle- and low-income countries could both produce. There is no commodity that high- and low-income countries could both produce, however.

Schott demonstrates that in the data both low- and high-income countries export the vast majority of 10-digit products to the United States.[3] He reasons that this is only possible if commodities such as v and w on the one hand and y and z on the other represent the same 10-digit product albeit of different quality. Specialization is, thus, largely an intra-product rather than across-product phenomenon.

This inference can be subject to a number of criticisms. We begin with questioning the validity of the "chain proposition" except under some very strong assumptions.

[3] Pham (2008) points out that this outcome depends critically on the inclusion of China among the low-income countries.

3 The Limitations of the Chain Proposition

The validity of the chain proposition can be questioned on two grounds. First, Deardorff (1979) has analyzed the above "chain proposition" in considerable detail and shows that it strictly holds under very stringent conditions. In the presence of trade in intermediate inputs, an important aspect of reality, these conditions are: failure of factor prices to equalize internationally; free trade; and no transport costs. Of these assumptions, the first one is clearly satisfied in the data used by Schott (2004). But trade is surely accompanied by tariffs and transport costs. Deardorff shows that under these circumstances, with intermediate inputs present, there is no guarantee for the chain proposition to hold. Deardorff further shows that even absent intermediate inputs, the chain proposition collapses if output or export subsidies are present. Given that developing countries often resort to subsidies of various kinds to promote industrialization, we cannot ignore this failure of the chain proposition. Thus, the conclusion reached by Schott (2004) can be questioned on theoretical grounds.

The second objection to the chain proposition rests on the possibility that high and low income countries may have access to different technologies. It is a straightforward matter that when countries have different technologies available, the most capital abundant and most capital scarce countries can have common products in their production baskets. These products will simply be produced using very different mixes of the factors of production.

4 Beyond Unit Values of Imports

More serious criticisms of Schott's conclusion rely not on the failure of the chain proposition to hold but his exclusive reliance on unit values of the United States imports

from its various trading partners to reach his conclusions. A full assessment of the patterns of trade also requires consideration of the full pattern of specialization, export and import volumes and how they are distributed across various products.

To elaborate on this point, we turn to HTS 10-digit product data for exports and imports. We take these data from Feenstra, Lipsey and Bowen (1997) in the updated form. Export and import data are available on a comparable basis for years between 1989 and 2001. These data provide the quantity (for example, meters of cloth, tons of steel or number of shirts) and dollar value of the United States exports to and imports from each trading partner for each of the thousands of 10-digit products. Consistent with Schott (2004), we refer to each 10-digit bilateral flow as a variety of the 10-digit product. For example, "cotton knit men's shirts" exported by China to the United States defines a variety of this product. Using the quantity and value associated with the flow, we can calculate the unit value of the variety. This unit value is what we call the price of the variety. The higher the price (unit value), the higher is the quality of the variety. When varieties differ according to quality, we refer to the phenomenon as vertical differentiation. When they command the same price, we assume they differ only in attributes (red shirt of a given quality versus blue shirt of the same quality) and refer to the phenomenon as horizontal differentiation.

We can now proceed to offer several pieces of evidence in favor of across-product specialization. We begin by identifying products that explicitly exhibit inter-industry specialization. In the traditional Ricardian and Heckscher-Ohlin comparative advantage models, across product specialization by a country can manifest itself in export products that the country does not import and import products that it does not export. This

determination cannot be made without examining the data for *both* exports and imports of different products. Are there 10-digit products with strictly positive exports but zero imports and strictly positive imports but zero exports?

To answer this question we report in Table 1 the total number of products the United States exported to and imported from all trading partners put together in columns 2 and 3, respectively, for each of the years from 1989 to 2001. In column 4, we report the number of products flowing in both directions. These are the products subject to two-way trade. Finally, using the information in columns 2-4, we derive the percentage of imported products not exported and that of exported products not imported in columns 5 and 6, respectively.

The results in columns 5 and 6 tell a startling story: In every year shown, the United States did not export approximately two-thirds of the products it imported and it did not import approximately one-third of the products it exported. Going purely by the product composition of exports and imports, the United States exhibits dramatic degree of across product specialization.

5 Across Product Specialization in Products Subject to Two-way Trade

Our second empirical point with respect to within- versus across-product specialization is that even if every product happens to be subject to two-way trade, the likelihood of complete absence of across product specialization is at best tiny. Countries would still be net exporters of products using their abundant factors more intensively and net importers of products using their scarce factors more intensively. The model with

two countries and two monopolistically competitive products introduced by Krugman (1981) to study inter- versus intra-industry specialization best illustrates this point.[4]

In this two-product model, each product is horizontally differentiated with large number of potential varieties and is produced using a single factor, a product-specific labor. The two products and their varieties enter symmetrically in the consumer's utility function. The two countries are identical in all respects (including size) except their *relative* endowments of the two types of labor. Production of each variety is subject to internal scale economies with complete symmetry across varieties within as well as across products. It is then straightforward that each country produces more and is a net exporter of the product requiring the type of labor with which it is better endowed. Symmetrically, it is a net importer of the product using the type of labor scarce in it. All varieties produced by each country are exported to the other. Thus, there is both intra-industry and inter-industry trade. But only in the special case when the two countries have identical endowments of the two types of labor is specialization purely within products. Any difference in the relative endowments gives rise to some across product specialization.

Empirically, the extent of within-product specialization can be measured using the Grubel-Lloyd (GL) (1971) index. This index is written as

$$(1) \qquad GL = \frac{\sum_i [(X_i + M_i) - |X_i - M_i|]}{\sum_i \{X_i + M_i\}} = \frac{2\sum_i \text{Min.}(X_i, M_i)}{\sum (X_i + M_i)}$$

Here X_i and M_i denote the values of total exports and total imports of product i, respectively, by the United States. The first terms in the numerator, $X_i + M_i$, represents

[4] A short and simple exposition of the model can be found in Bhagwati, Panagariya and Srinivasan (1998, pp. 184-6).

gross two-way trade in product i. The absolute value of within-product trade imbalance, $|X_i - M_i|$, represents across-product trade in product i since, assuming balanced trade in aggregate, it must be covered by equivalent imbalance of the opposite sign in other products. Therefore, the term in the square brackets equals within-product trade in product i. Summing over all products, we obtain the absolute value of within-product trade across all products. Dividing this sum by gross two-way trade across all products yields within-product trade as a proportion of total trade. If the exports of product i are exactly balanced by imports of product i, all trade in product i is within-product. If this condition is met for all products, *all* trade is within product and none is across product. In this case, the numerator and denominator of the index are equal and the index achieves its highest possible value of 1. At the other extreme, if either the exports or imports of product i equal 0, there is no two-way, within-product trade in product i and this product contributes 0 to the numerator of the index. If this condition holds true for all products, there is no within-product trade in any product and the value of the index reduces to 0.[5]

Purely as a theoretical matter, measured within-product trade rises or remains unchanged as we move from less to more aggregated data. Aggregating over products with opposite signs of trade balance necessarily increases the numerator while aggregating over products with the same signs of trade balance leaves the numerator

[5] Acquino (1978) and Helpman (1987) have noted that an imbalance in trade biases the IIT in ways that does not lend itself to correction. For example, suppose beginning with balanced trade initially, a trade deficit arises. Suppose further that the deficit arises because the exports of a product not subject to two-way trade fall. This will not change the numerator but will reduce the denominator. The IIT will rise in value despite no change in the extent of two-way trade. On the other hand, suppose the deficit arises because the imports of a product not subject to two-way trade rise. Again, the numerator is unchanged but this time the denominator rises and the IIT falls. Finally, suppose the deficit arises because the imports of a product subject to two-way trade rise but they are initially more than the exports of the same product. Once again, the numerator does not change but denominator rises and the IIT falls.

unchanged.[6] Therefore, increased aggregation cannot lower measured within-product trade and is actually likely to raise it. In the limit, if we aggregate all trade flows into a single product, all trade would be measured as intra-industry. At the other extreme, if we define every single flow as a different product, all trade would be inter-industry.

Table 2 reports the values of the Grubel-Lloyd index using data disaggregated at 10, 8, 6 and 4 digit levels of HS classification. Across-product trade as measured by the Grubel-Lloyd index declines only slightly as we move from 6-digit to 8-digit aggregation but then drops sharply as we move to the 10-digit classification. This may be because disaggregation gets much finer as we go from 8- to 10-digit disaggregation than when we go from 6- to 8-digit disaggregation. But this requires verification. Whatever the reason, it is clear that finer disaggregation is important for getting at the accurate measure of within- versus across-product trade.

An alternative way approach to explaining why the absence of inter-industry specialization is not likely is to relate the pattern of specialization to the factor content of trade. A moment's reflection would show that absent inter-industry specialization, net factor flows through trade would be zero. No across-product specialization at 10-digit product classification would imply that trade within each 10-digit product category is strictly balanced. Given factor content calculations employ common input-output tables for exports to and imports from various sources of the same product, this would imply the

[6] For example, consider two products, 1 and 2, with (X_1, M_1) and (X_2, M_2) as the associated flows of exports and imports, respectively. First, suppose product 1 exhibits trade surplus and product 2 is subject to trade deficit. Then these two products contribute $2(M_1 + X_2)$ to the numerator of the Grubel-Lloyd index. If we aggregate over these products and the resulting new product exhibits trade surplus, it contributes $2(M_1 + M_2)$ to the numerator of the index. Given $M_2 > X_2$ by assumption, the aggregation leads to an increase in the value of the numerator. If the aggregated product exhibits trade deficit, it contributes $2(X_1 + X_2)$, which also raises the numerator since $X_1 > M_1$ by assumption. Second, if products 1 and 2 both show deficit or both show surplus, aggregating over them leaves the numerator of the Grubel-Lloyd index unchanged.

factor content of each 10-digit category showing no net factor flows. But virtually all of the available calculations of factor content of trade contradict this conclusion.

6 Specialization Across Agriculture, Industry and Services

Yet one more reason why no across-product specialization thesis is incorrect is that Schott (2004) only considers import data for manufactures (SITC1 products 5 to 8). The analysis of only a subset of sectors even when we include both export and import data, is insufficient to conclude in favor of no endowments based across product specialization. The full spectrum of products includes agriculture, industry and services. And within this broad classification, we know that the United States is a net exporter of agricultural and services products and net importer of unskilled-labor-intensive manufactures. Casual empiricism suggests that this specialization across broad product categories is consistent with the abundance of fertile land and skilled labor that impart the United States comparative advantage in agriculture and services, respectively. Likewise, scarcity of unskilled labor lends the country comparative disadvantage in unskilled-labor-intensive products.

7 Is All Within-product Specialization Really Vertical?

Schott (2004) argues that within product trade exhibits vertical specialization with rich countries exporting high-quality varieties and poor countries exporting low-quality varieties. Once again, reaching this conclusion requires an examination of both exports and imports. We turn to this examination in the present section.

The Grubel-Lloyd index presented in the previous section represents all within product trade. In particular, it does not distinguish between two-way flows differentiated

by quality (vertical differentiation) and those that are differentiated by attributes (horizontal differentiation). For example, suppose the product category subject to within-product trade is men's shirts. If the United States exports and imports men's shirts that command more or less the same prices (unit values), the differentiation is horizontal. On the contrary, if the United States exports fashion shirts commanding high prices and imports generic shirts that command low prices, the differentiation is vertical.

If we naively extrapolate from Schott's finding of specialization by countries according to their per-capita income levels along quality dimension, we would conclude that much of within-product trade is in vertically differentiated varieties. But a more careful consideration suggests that this is an incorrect inference. Specifically, two factors point to continued importance of within-product trade in horizontally differentiated products.

First, a very large part of the United States trade takes place with other high-income countries. Therefore, even if we assume that the United States is specialized in high value added varieties of all products, its two-way trade in these varieties with the rich countries is still likely to exhibit horizontal rather than vertical differentiation.

Second and much more importantly, an analysis of unit values shows that the United States exports are subject to as much or more dispersion along the quality dimension as its imports. Tables 3 and 4 substantiate this claim. In table 3, we report the characteristics of unit values of exports of 15 randomly selected 10-digit products. The last column shows the ratio of maximum to minimum unit value for each product. The minimum value of this ratio is 5.4 and the maximum value 208.6. That is to say, the highest quality variety is minimally 5.4 times as expensive as the lowest quality variety

and can be as much as 208.6 times more expensive when we consider exports! If specialization were in varieties exhibiting quality consistent with per-capita income, the United States should specialize in mainly high-quality products. But it actually produces a wide spectrum of varieties ranging from very low to very high quality products and exports them. The large variation in unit values, also reflected in large values of the coefficient of variation in column 5 of the table, suggests the United States may be exporting horizontally differentiated varieties at a number of quality levels.

Table 4 further confirms these points. In this table, we compare the dispersions in unit values of exports and imports in the year 2001. We report the mean value, standard deviation and maximum and minimum values of the coefficients of variation for exports and imports. Mean values of the coefficient of variation for exports and imports are remarkably close to each other. Much more surprisingly, however, the minimum value of the coefficient of variation is lower and maximum value higher for exports than imports.

The variations in the unit values of exports and imports by themselves are insufficient to judge their quantitative importance, which depends on the volume of trade in horizontally versus vertically differentiated varieties. The answer to this latter question is more complex than may appear at first blush, however. The reason is that with multiple trading partners, horizontal and vertical trade are mixed up.

To explain this point, suppose the United States has two trading partners, A and B. Suppose we represent the unit values associated with trade (exports or imports) with A and B by the first and second elements in the unit value vectors, respectively. Now consider four alternative pairs of export and import unit value vectors, respectively: (10 10) and (10 10); (100 100) and (10 10); (10 100) and (10 100); and (10 100) and (100

10). In the first case, differentiation is unambiguously horizontal and in the second one unambiguously vertical. But the last two cases are less clear-cut. By matching unit values bilaterally, we could say that trade is horizontal in the third case and vertical in the fourth case. But bilateral comparisons are questionable. For instance, in the fourth case, we could argue that the United States exports the varieties with unit values 10 and 100 and it also imports varieties with unit values 10 and 100 and therefore the underlying trade is horizontally differentiated. While plausible, this case is clearly not the same as the first one that carries no ambiguity.

Given this complexity, we do not try to separate the volume of intra-industry trade into horizontally and vertically differentiated components. Instead, we identify products that cannot be claimed as vertically differentiated at least on the average. We impose the minimum requirement that in order for the exports and imports of a product to be vertically differentiated, their mean unit values should be statistically significantly different from each other. We do not go so far as to claim that products failing to satisfy this condition are horizontally differentiated but simply use the criterion to rule our vertical differentiation.

Table 5 presents the results of our test. It shows the total number of products traded in both directions, those showing statistically significantly different (at 10 percent level of significance) unit values of export and import vectors and those failing this test. Consistently, only approximately one-third of the products traded in both directions exhibit statistically different means across export and import unit value vectors while two-thirds exhibit similar means. The former give the upper bound on products that can

qualify as vertically differentiated and the latter those that can pass muster as horizontally differentiated.

Finally, in Table 6, we report the GL index for the products with similar mean unit values of export and import vectors at 10, 8, 6 and 4 digit HS classification. Going by the calculations at the 10-digit classification, the non-vertical intra-industry trade has fluctuated around 15 percent between 1989 and 2001. An interesting point to note is that intra-industry trade in products ruled out to be vertically differentiated is not very sensitive to the level of aggregation. This is probably due to the fact that while increased aggregation by itself pushes the index towards increased value by reducing within-product trade imbalance, fewer products meet the test of equality of mean unit values of export and import vectors as we aggregate more and more disparate products.

8 Conclusions

Contrary to Schott (2004), we find that across-product specialization remains the dominant form of specialization for the United States. The United States does not export Two thirds of the products it imports and does not import one-third of the products it exports. Based on the traditional Grubel-Lloyd index of intra-industry trade, only 21 percent of the United Sates trade in value terms was within product with the remaining 79 percent being across product. We also find that no more than approximately one-third of the products subject to two-way trade in the United States can qualify as being subject to vertical differentiation. Given its unequal income distribution, large size and diverse resource base, home demand bias implies that the United States produces and exports many 10-digit products of quality levels ranging from very low to very high.

Our conjecture is that our conclusion of across product specialization will remain valid and, indeed, hold with greater potency for other countries. Smaller countries such as Singapore, Hong Kong, Belgium, Norway and Switzerland are likely to specialize in and export extremely few products. In contrast they are likely to import a vast number of products they do not export. While this implies a smaller within product trade, such trade is more likely to exhibit vertical differentiation. This is because smaller countries will likely not produce and export a product along a large spectrum of quality.

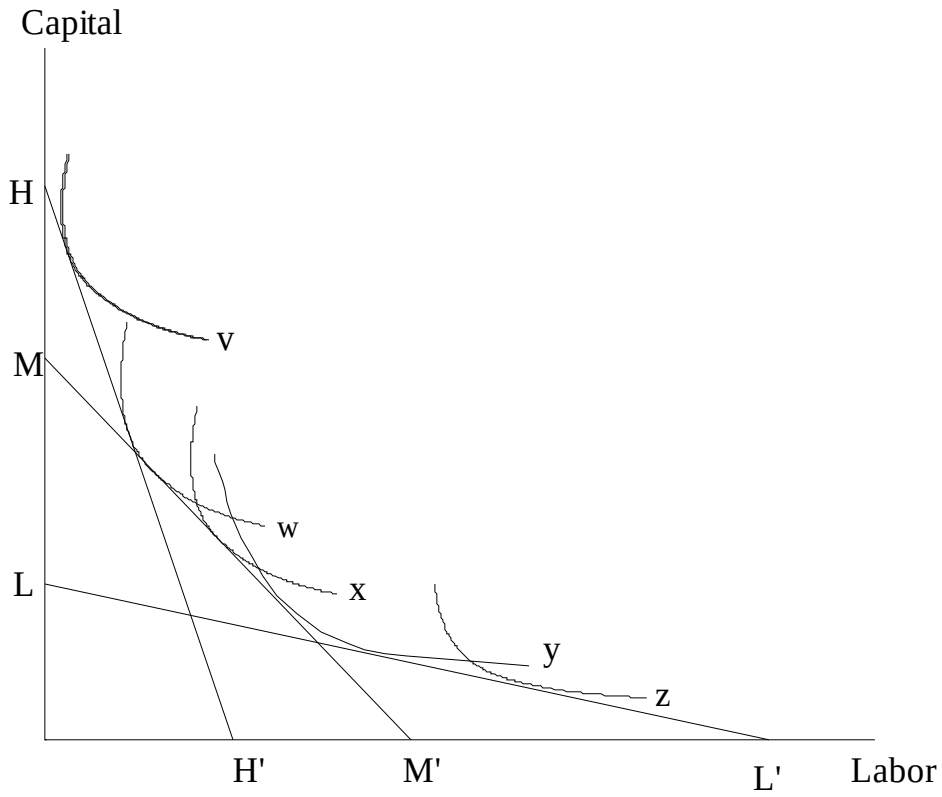

Figure 1: Specialization Cones: Inter- versus Intra-industry Specialization

Table 1: Inter-industry Specialization

Year	Exported	Imported	Traded Two-way	Percent of Import Products not Exported	Percent of Export Products not Imported
1	2	3	4	5	6
1989	6688	12474	4589	63.2	31.4
1990	6727	13034	4452	65.8	33.8
1991	6834	13203	4556	65.5	33.3
1992	6846	13233	4546	65.6	33.6
1993	6907	13377	4584	65.7	33.6
1994	6996	13721	4479	67.4	36.0
1995	7273	14367	4579	68.1	37.0
1996	7533	14601	4811	67.1	36.1
1997	7539	14947	4885	67.3	35.2
1998	7547	14855	4852	67.3	35.7
1999	7571	14882	4881	67.2	35.5
2000	7580	14946	4870	67.4	35.8
2001	7571	14919	4853	67.5	35.9

Table 2: Within-product Trade as Percentage of Total Trade (Grubel Lloyd Index)

Year	10-digit	8-digit	6-digit	4-digit
1989	21.1	24.1	24.7	28.5
1990	17.9	21.0	21.6	25.2
1991	18.4	21.3	21.9	25.9
1992	18.2	21.0	21.6	25.9
1993	18.4	21.3	21.8	26.3
1994	16.5	18.3	18.8	22.2
1995	18.2	21.3	21.7	25.6
1996	20.0	22.6	23.5	29.5
1997	20.6	24.2	25.0	31.1
1998	20.0	23.4	24.3	29.3
1999	20.5	24.0	24.6	29.1
2000	21.3	24.8	25.4	29.8
2001	21.3	24.1	24.7	29.1

Table 3: Characteristics of Export unit Values of a Random Sample of Products

Product	Number of Recipient Countries	Mean unit Value	Standard Deviation	Coefficient of Variation	Minimum Unit Value	Maximum Unit Value	Maximum/Minimum
1	2	3	4	5	6	7	8
Product 1	45	10883.6	11230.6	1.0	1269.0	58750.0	46.3
Product 2	43	13601.1	27700.6	2.0	719.0	150000.0	208.6
Product 3	6	1906.4	1070.7	0.6	254.6	3401.0	13.4
Product 4	16	2600.2	2305.8	0.9	600.0	8479.3	14.1
Product 5	10	2004.7	1044.0	0.5	657.1	4334.5	6.6
Product 6	14	2367.3	2629.6	1.1	500.0	8431.5	16.9
Product 7	10	1627.2	1175.0	0.7	472.2	4170.0	8.8
Product 8	12	1288.2	1090.8	0.8	252.4	4089.0	16.2
Product 9	18	515.0	327.2	0.6	217.1	1165.4	5.4
Product 10	3	172.4	123.1	0.7	33.7	268.6	8.0
Product 11	6	402.3	323.1	0.8	118.8	890.4	7.5
Product 12	4	289.2	466.4	1.6	39.8	988.2	24.8
Product 13	9	735.5	1276.0	1.7	42.6	4000.0	93.9
Product 14	40	3.0	1.8	0.6	0.6	6.2	11.1
Product 15	54	4.6	4.0	0.9	0.3	15.9	51.6

Table 4: Comparison of Coefficients of Variation (CoV) of Unit Values of Exports and Imports of Two-way Traded Products, 2001.

Measure	Imports	Exports
Mean	169.7	167.62
Standard Deviation	105.95	121.43
Minimum CoV	0.504	0.0013
Maximum CoV	647.71	911.31

Table 5: Comparing Mean Unit Vales of Exports and Imports

Year	Traded Two-Way	Different Mean Unit Values		Similar Mean Unit Values	
	Absolute Number	Absolute Number	As % of Two-Way	Absolute Number	As % of Two-Way
1	5			7	8
1989	4589	1588	34.6	3001	65.4
1990	4452	1531	34.4	2921	65.6
1991	4556	1603	35.2	2953	64.8
1992	4546	1605	35.3	2941	64.7
1993	4584	1640	35.8	2944	64.2
1994	4479	1586	35.4	2893	64.6
1995	4579	1620	35.4	2959	64.6
1996	4811	1625	33.8	3186	66.2
1997	4885	1726	35.3	3159	64.7
998	4852	1681	34.6	3171	65.4
1999	4881	1733	35.5	3148	64.5
2000	4870	1719	35.3	3151	64.7
2001	4853	1759	36.2	3094	63.8

Table 6: Within-product Trade Not Classified as Vertically Differentiated

Year	10-digit	8-digit	6-digit	4-digit
1989	15.6	18.0	17.8	18.5
1990	12.3	13.3	13.8	13.8
1991	13.2	12.6	13.0	15.0
1992	12.6	12.5	13.0	9.9
1993	12.5	12.2	12.9	15.0
1994	12.1	12.5	12.4	11.1
1995	12.9	12.5	12.7	11.7
1996	14.9	14.0	14.3	15.0
1997	14.9	13.8	13.9	15.5
1998	14.7	12.8	12.4	14.4
1999	15.0	12.8	13.3	11.1
2000	14.2	12.9	12.8	15.7
2001	14.6	13.0	12.7	11.5

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