Canada's Share of U.S. Product Markets: Dissecting the 1998-2006 Trends

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Abstract: The decade of the 2000s saw an erosion of Canada's position in the U.S. market. At the macroeconomic level, this was manifested in a three percentage point fall in Canada's share of total U.S. imports. At the firm level, this was reflected in exiting firms outnumbering new entrants, reducing the total number of Canadian exporters serving the U.S. market. This paper examines this development at the product level, evaluating Canada's market share in over 16,000 products imported by the United States (HS 10-digit level), classified by level of sophistication. Competitor countries are identified by product. The paper finds that Canada's market share decline reflected a fall in product penetration (the share of product categories in which Canada exports to the United States) from 73 to 70 percent; this reflected a failure of new product entries to offset product exits. Market share erosion was thus in good measure at the extensive margin and may reflect weak innovation performance. China's competitive pressure in the form of new product entries in a wide range of areas, including in knowledge-intensive sectors, implies that the observed structural shift of Canada's product palette towards higher-unit-value products was more due to product exit at the low end than to product up-grading. I conclude that the action was at the extensive margin but may shift to the intensive margin. The key issue for Canada is innovation to sustain competitive product entry.

Key words: Canada, trade, products, exit, entry, extensive margin
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1. Introduction

The United States is the world's single largest destination for global merchandise exports. Capturing and preserving U.S. market share is thus a priority for trade-dependent countries. This is especially true for Canada, which historically was the largest goods supplier to the U.S. market until being surpassed in 2007 by China. Does Canada's slide into second place amongst U.S. goods suppliers amount to no more than a loss of bragging rights? Or does it merit the concerns that have been expressed in policy circles and in some of the public policy commentaries?

Canada' share of U.S. imports has waxed and waned over the years, reflecting a wide range of developments. It rose in the 1990s helped by the preferential access gained in the U.S. market through the Canada-U.S. FTA and the extended period of low valuation of the Canadian dollar in the latter part of the 1990s and early 2000s. Canada's share fell back in the 2000s in a context of rising cross-border trade costs following 9/11 and the steep appreciation of the Canadian dollar post-2002.

Developments elsewhere also impacted on Canada's share of U.S. imports. Canada's preferences in the U.S. market were eroded by U.S. FTAs with third parties, the most notable being Mexico through the NAFTA. Mexico almost doubled its share of the U.S. import market from 5.8 percent in 1990 to 10.2 percent in 1998, although its share has stagnated since (rising marginally to 10.6 percent in 2007). And of course the massive expansion of China's exports that vaulted it into first place in goods exports globally in December 2009 had a pervasive effect on import market shares worldwide and most particularly in the United States where China's market share (which reached 17 percent in 2007) was almost double its global share (8.7 percent in 2007). The China factor is of course complicated. It reflects in part the expansion of China's exports of products typically supplied by low-income countries based on comparative advantage in the form of abundant cheap labour. In part it also reflects China's improved market access following its WTO accession in 2001, and the vast improvement in its trade

infrastructure over the years. However, it also reflects China's role as final stage of assembly of technologically advanced products developed by multinational firms based in Japan, Europe and the United States[1].

Accordingly, it is not a straightforward matter to gauge the significance of the changes in Canada's share in the U.S. import market. To shed some light on this issue, this paper approaches it from the perspective of product dynamics—product penetration, product churning (replacement of old product lines with new over the product life cycle) and product overlap (which Canadian products compete with which other country's products?). This complements the firm-level analysis of the same issue by Chen and Yu (2010), providing additional insights into the role of trade dynamics at the extensive margin (in this case trade expansion due to introduction of new products or contraction due to exit of established products) versus the intensive margin (trade expansion—or decline—due to changes in the value of sales or market shares of established products). Dissecting the market share decline in this manner may yield insights of relevance to economic policy in Canada.

The rest of the paper is organized as follows. Section 2 briefly describes the data. Section 3 discusses the various methodological issues involved in measuring product dynamics. Section 4 examines product dynamics in terms of product penetration and product churning, using various alternative approaches to identifying the extent of head-to-head competition between Canada and other exporters to the U.S. market, including product overlap, export similarity indexes and various measures based on export unit values. Section 5 concludes.

[1] An often-cited example is the iPod, which Apple assembles in China for its worldwide markets. As noted by Linden, Kraemer and Dedrick (2007; at p. 10), "trade statistics can mislead as much as inform. For every $300 iPod sold in the U.S., the politically volatile U.S. trade deficit with China increased by about $150 (the factory cost). Yet, the value added to the product through assembly in China is probably a few dollars at most." Accordingly, China's market share in terms of value added is substantially smaller than its share of gross value of traded products.

2. Overview of the data

To examine product dynamics in the U.S. import market, I draw on data on U.S. imports by country and industry at the Harmonized System (HS) 10-digit level[2] from the University of California Davis' Center for International Data directed by Robert Feenstra[3]. Just to provide some sense of how detailed the data are at this level of disaggregation, the dataset has six types of ladies' shawls, seven types of men's ties, 13 types of cheese, 11 types of air-conditioners, 12 types of mowers, six types of sewing machines, and seven types of bicycles. These data are thus at a sufficiently fine level of detail to make it reasonable to assume that they represent individual products.

Working at the 10-digit level minimizes the inevitable aggregation bias faced when dealing with higher orders of aggregation. This is especially important in comparing unit prices of products across countries as a means of assessing the level of sophistication of the products. Unit price comparisons at more aggregate levels can be completely misleading.

The 2002 revision of the Harmonized System (HS 2002), one of a regular series of updates to take into account changes in the composition of international trade due to the emergence of new products, creates an issue for this study since the original U.S. import data for 1998, the base year, were collected under the previous version of the code, HS 1996, while the 2006 data were collected under HS 2002 codes. To permit direct product line comparisons over time, the 1998 data are converted to HS 2002 definitions using the concordance developed by Pierce and Schott (2009). Some products have different HS 10-digit numbers in two years; these have to be concorded using family

[2] The Harmonized System has 21 sections (1-digit), 96 chapters (two-digit), more than 1,200 headings (four-digit), over 5,000 subheadings (6-digit) and over 16,000 products at the 10-digit level. The World Customs Organization assigns 6-digit codes for general categories and countries adopting the system then define their own codes to capture commodities at more detailed levels.

[3] http://cid.econ.ucdavis.edu/

ID. Since a family ID could have more than one HS 10-digit product, the total number of products used for computing product exit and entry rates is lower than the total number of HS 10-digit products that serve as the basis for calculating initial penetration rates. For example, Canada exported 11,864 products to the United Sates in 1998; however, the count for the entry/exit figures is 8,983. Similarly, whereas Canada exported a total of 11,869 products to the United States in 2006, the count used for the entry/exit figures was 8,786. Similar proportions apply to the other U.S. trading partners.

The United States had imports in 16,326 product categories in 1998, a figure which rose to 16,968 products in 2006. The chemical industry had the highest product count in 2006, with 2,147 products or about 13 percent of the total, followed by the clothing industry which had 1,697 products or about 10 percent of the total. The number of products was slightly larger in most industries in 2006 compared to the situation in 1998, except for a slight fall in the mining and oil and gas industry and, surprisingly, in the computer and electronic industry as well[4].

For expositional purposes, some results are presented by industry for 14 industries, either individual North American Industrial Classification System (NAICS) merchandise industries at the 3-digit level, or aggregations of 3-digit NAICS industries[5]. Among the 14 industries, one is agriculture-related, one is mining-related and 12 are manufacturing industries. Among the 12 manufacturing industries, 6 are individual NAICS 3-digit industries while the other 6 are aggregations of the remaining 15 NAICS 3-digit manufacturing industries, with

[4] Note that product count changes is not identical to the net of new product introductions and old product disappearances since the HS codes updates involve some families of products expanding and others shrinking over time as the statistical agencies change the product definitions (see Pierce and Schott, 2009, on the growing and shrinking of product trees).

[5] Altogether there are 29 NAICS 3-digit merchandise industries: 8 in agriculture, fishing, forestry and mining and 21 in manufacturing.

the sorting based on similarity of production technology[6]. These industries are listed in Table 1. See Appendix 1 for details.

For analytical purposes, the 12 manufacturing industries are in turn grouped into two categories: five are considered to be medium-and high-technology industries (MHT) and seven are considered to be low-technology industries, along with agriculture-related and mining-related industries.

Table 1: Product sectors by Technology Level

Low-technology Sectors	**Medium- to High-Technology Sectors**
Agriculture, Forestry, Fishing and Hunting	Chemical
Mining and Oil and Gas Extraction	Machinery
Food; Beverage and Tobacco	Computer and Electronic Product
Textile; Clothing; Leather	Electrical Equipment, Appliance and Components
Wood; Paper; Printing	Transportation Equipment
Petroleum and Coal Products	
Plastics and Rubber; Non-metallic Mineral	
Metal products (primary and fabricated)	
Furniture and Related industries and Miscellaneous industries.	

Source: Aggregation by the author..

[6] Four of them combine two NAICS 3-digit industries each (respectively 311-312; 326-327; 331-332, and 337 and 339); one combines three NAICS 3-digit industries (321-323), and one combines four NAICS 3-digit industries (313-316). The relative individual importance of these combined industries in terms of export values is small. In 2007, among NAICS 311-312 group of industries, food (311) had a share of 1.9 percent and beverage and tobacco (312) had share of 0.9 percent. In the 313-316 group, textiles mills products (313) had a share of 0.5 percent, textile mills (314) had 0.7 percent, clothing (315) had 4.1 percent and leather and allied products (316) had 1.5 percent. Similarly, plastics and rubber (326) and non-metallic mineral (327) had shares of 1.8 percent and 1.1 percent respectively. In metal industries, primary metal (331) had a relatively large share of 4.6 percent, while fabricated metal products (332) had 2.6 percent. In the last category, 337 & 339, the share of furniture and related industry (337) was only 1.4 percent, while the miscellaneous category (339) accounted for 5.3 percent of which 4 percent was antique products.

Competitor countries are classified into three groups defined on the basis of per capita gross domestic product (GDP): these include 87 low income countries (LICs) with per capita GDP up to 40 percent of the 1987 global average; 68 medium income countries (MICs) with per capita GDP as high as 3 times the world average; and 31 high income countries (HICs). This approach sheds light on the extent to which observed changes in market share for Canada reflect the magnitude of competition that Canada is facing from low wage countries.

The major U.S. trading partners are broken out from these groups. These trading partners are: the EU15 and Japan from the HICs, Mexico from the MICs and China from the LICs. I also further subdivide for analytical purposes the HICs group into other East Asian countries (OEACs) and other high income countries (OHICs); and the MICs into oil exporter countries (OECs) and other middle income countries (OMICs); the LICs excluding China are labelled other low-income countries (OLICs). Hence, altogether there are nine competitors for Canada in the U.S. market: Japan, EU15, Mexico, China, OEACs, OHICs, OECs, OMICs and OLICs. The list of countries in each group and sub-group is given in Appendix 2.

The degree of competition in the U.S. import market is brought out by the fact that very few products have a sole supplier. For example, in 2006, Canada was sole supplier of only 1.8% of the products imported in the United States, and the value of imports in these categories constituted only 0.29 percent of total U.S. total imports from the world. Altogether only 6.6 percent of the products imported by the United States had a sole supplier; these accounted for only 0.34 percent of total U.S. imports.

3. Methodological issues: measuring product dynamics

Product dynamics are discussed in terms of three concepts: product penetration, which measures the breadth of a country's export palette; product churning, which decomposes changes in product penetration into the exit of previously exported products out of, and the entry of new products into, a given

export market; and head-to-head competition in terms of three different measures, product overlap, which measures the degree to which trading partners of a given country are head-to-head competitors on a product-line basis in a given import market, unit export price comparisons, and export similarity indexes.

I compute the product penetration rate for each trading partner in the U.S. market for the 14 industry groups for 1998 and 2006. Denoting products by *p*, county/region by *c,* industry by *i, and* time period by *t,* the product penetration rate P_{cit} is computed as:

$$(1) \qquad P_{cit} = \frac{N_{cit}}{\sum_{c} N_{cit}} \times 100,$$

where N_{cit} is the number of products that the United States imports from country/region *c* in industry *i* at time period *t*.

Product churning decomposes the product penetration rate into the net of exit of previously supplied products and entry of new products. Arithmetically, the number of products exported by any country in two time periods (*t* and *t+1*) are related in following way (industry subscript is suppressed):

$$(2) \quad N_{ct+1} = N_{ct} - D_{ct+1} + \mu_{ct+1},$$

where N_{ct+1} is the total number of products exported in year *t+1* (2006 in our case); N_{ct} is the number of products exported in year *t* (1998); D_{ct+1} is the number of products that were exported in year *t* but were dropped in year *t+1*, and μ_{t+1} is the number of new products that were not exported in year t but were exported in year *t+1*. N_{ct} - D_{ct+1} gives the total number of continuing products in the sense that they were exported in both periods, *t* and *t+1*. Hence, equation (2) can be written as:

$$(3) \quad N_{ct+1} = C_{ct+1} + \mu_{ct+1},$$

where C_{ct+1} is the number of continuing products. Dividing by the total number of products exported by each U.S. trading partner in 1998 gives the rate of survival of product lines for

that partner in 2006 compared to 1998 and its rate of introduction of new products into the U.S. market.

Product overlap is simply the number of same products sold by two competitors and thus measures the extent to which two countries are direct competitors at the product line level. For a pair of countries *c* and *c'*, the product overlap of country *c'* with respect to exports of country *c* is defined as follows:

$$(4) \qquad O_{ct} = \frac{N_{pcc't}}{N_{pct}} \times 100$$

where O_{ct} is product overlap; $N_{pcc't}$ is the number of products that both countries *c* and *c'* sell in the target market, and N_{pct} is the total number of products sold by country *c* in the target market. Note that product overlap can be calculated from the perspective of country *c'* by making the denominator in the above expression the total number of products sold by country *c'* in the target market.

Another way to approach the issue of head-to-head competition between various trade partners in a given market is Finger and Kreinin's (1979) export similarity index (ESI). This index incorporates information about both market share and product penetration; in principle, it captures the effect of comparative advantage and has been widely used to assess the scope for trade diversion due to regional integration and industrial convergence[7].

[7] Pomfret (1981) used it to test the similarity of export patterns of new entrants to the European Economic Community to those of established community members. In a similar application, Derado (2008) applied it to test the impact of EU expansion for Croatia. Pearson (1994) and Xu and Song (2000) applied the index to examine the patterns of industrialization of East Asian emerging economies. It has also been used by Schott (2006) to assess the implications of China's industrialization for U.S. product markets. Kellman and Schroder (1983) carried out basic tests on the index for aggregation bias (index values rise systematically with higher levels of aggregation) and structural stability on the index (generally found to be stable).

For any two U.S. trading partner countries, *c* and *c'*, in year *t*, Finger and Kreinin (1979) define the ESI as follows:

$$(5) \quad ESI_{cc't} = \sum_{p} \min\left(s_{pct}, s_{pc't}\right),$$

where s_{pct} is product *p*'s share in country *c*'s exports in year *t.* Similarly, $s_{pc't}$ is the corresponding share of country *c'*. Using this formula, we compute the *ESI* between each U.S. trading partner and each other U.S. trading partner. This bilateral measure is computed using all products and is bounded by zero and unity. If country *c* and *c'* have no products in common in year *t,* then $ESI_{cc't} = 0$. On the other hand, if their exports are distributed identically across products, then $ESI_{cc't} = 1$. To compute a region's *ESI*, we use regional total exports (across all countries in the region)[8]. Since we will be using most disaggregate product category (comparing more than 16,000 product shares for each pair of country/region), the results do not suffer from aggregation bias, a well-known problem with the ESI, and so provide a clear picture of the export similarity for each pair of competitors in the U.S. import market.

The measures we discuss so far look only at the U.S. import patterns in terms of number of products and market shares. Next, we develop measures that take into account the quality dimension using the unit values of the products that each of the major competitors commands in the U.S. market to see whether Canada's products tend to compete on price (lower unit values) or quality (higher unit values).

A number of cautions must be observed when using unit values as a proxy for product prices and differences in these proxy prices as an indicator of quality differences or product sophistication. As noted by Silver (2007), "Bias in unit value indices is mainly attributed to changes in the mix of the heterogeneous items recorded in customs documents, but may

[8] This index can also be computed on an industry-specific basis. In either case, it is bounded by zero and unity. Here, we present results using all products and aggregating at one level only (industry-specific results are not presented).

also arise from the poor quality of recorded data on quantities. The former is particularly important given the increasing differentiation of products and turnover of differentiated products that is a feature of modern markets." Silver adds that "Significant unit value bias arises within strata defined at levels of detail well beyond that available in customs systems." Thus, if several firms in both countries sell a particular commodity such as flat panel monitors and the monitors vary in size, and therefore unit value, although not necessarily in quality, then differences in the mix of sizes between the two countries (or within a country's exports over time) result in changes in unit value that would be (incorrectly) interpreted as quality differentials.

The advantage of Feenstra's dataset is that it provides data collected by one customs agency at the most disaggregate level of the HS classification, which at least minimizes the biases to which the unit value measure is subject. Further, we use the unit value data in three ways and thus do not rely on one particular comparison based on this statistic. First, we compare Canada's unit values by product to other countries. For a particular product, the country with the higher unit value is deemed to have the superior product in terms of quality. Second, we compute the pair-wise unit value dissimilarity index. As far as we are aware, this measure is new to the literature; it has not been used before. Third, we examine the distribution of unit values for major U.S. trading partners.

The unit value is calculated as follows:

$$(6) \quad U_{pct} = V_{pct} / Q_{pct} ,$$

where V measures value and Q measures the quantity. For some countries and products the quantity data are not available and as a result the unit value cannot be computed. For our sample countries/regions, the unit value was computable for about 83 to 90 percent (depending on the country/region) of the products in both years (1998 and 2006)[9].

[9] For Canada, we could calculate unit values for 89 percent of the products in both years; for China, 87 percent in 1998 and 90 percent

The first application we make of the unit value index is to calculate a product superiority measure. For any two countries/regions *c* and *c'*, the share of superior products of country *c* compared to the situation with country *c'* at time *t, S_{ct},* is simply:

$$S_{ct} = \frac{N_{pct}^{higher}}{N_{pcc't}} \times 100, \quad (7)$$

where N_{pct}^{higher} is the number of products for which country *c* has a higher unit value compared to country *c'* and $N_{pcc't}$ is the set of common products that are exported by *c* and *c'* for which we have information on both value and quantity. By construction, the superiority measure for country c' will be 100 minus the superiority measure of country c.

The product superiority index is limited in that it does not incorporate information on the size of the gap between the unit values being compared: a product with a small advantage in unit value contributes equally to the index as a product with a big advantage. To incorporate information on the gaps between unit values by country pair, we compute a unit-value dissimilarity index (UDI). For countries/regions *c* and *c'* that export to the United States, the UDI is computed as follows:

$$UDI_{cc't} = \sum_{p} \left\{ \left[m_{pt} \right] \times \left[\frac{\max\left(U_{pct}, U_{pc't}\right) - \min\left(U_{pct}, U_{pc't}\right)}{\max\left(U_{pct}, U_{pc't}\right)} \right] \right\}, \quad (8)$$

where U_{pct} is the unit value of product *p* in country *c* in period *t*; $U_{pc't}$ is the corresponding value for country *c'*; and, which is product *p*'s share in total U.S. imports, is given by:

$$m_{pt} = \sum_{c} M_{pct} \Big/ \sum_{c} \sum_{p} M_{pct},$$

products in 2006; for the EU15, 90 percent for both years; for Mexico, 87 percent for both years and for the OEACs 88 percent for each year.

where $\sum_c M_{pct}$ represents U.S. imports of product p from the world (sum across all countries) in period t, and $\sum_c \sum_p M_{pct}$ is total U.S. imports (sum across all products and countries). The fraction m_{pt} is used to provide a set of weights to sum the UDI across products on a weighted basis.

The second component on the right-hand side needs some explanation. This fraction is the percentage difference in unit value of a given product between two countries evaluated from the perspective of the country with the higher unit value. The numerator of this term is the difference of unit value between two countries and the denominator normalizes it by the higher of the two unit values so that the outcome is a positive fraction, unless the two countries have the same unit value, in which case the result is zero. The larger the percentage differences between the unit values of the two countries, the larger the value of this term and the larger the implied quality differential. Once this fraction is computed for all common products between two countries, the UDI is obtained by summing across all products using the share of that product in US total imports as a weight[10]. To our knowledge this particular index has not been previously used in the literature.

Finally, we also consider a third alternative approach to identifying quality differentials across U.S. trading partners vis-à-vis Canada. First, we select the highest unit value (HUV) for each product p by comparing unit value of the product across all exporting countries to the United States: $U_{pt}^{\max}$. Second, for each product from each country, we compute the ratio of its unit value to HUV for that product. Based on that ratio, we break the total products of each country/region into five groups: less than

[10] This weighting scheme gives greater importance to price differences in products that are important to the United States but might represent only a small share of the export base of the two countries being considered. Alternative weighting schemes could be considered (e.g., simple averages or the weights derived from the combined exports of the two countries being compared).

10 percent of HUV, 10-25 percent of HUV, 25-75 percent of HUV, greater than 75 percent of but less than HUV, and HUV. This is described by equation (9):

$$(9) \qquad \frac{u_{pct}}{u_{pt}^{\max}} = \{< 0.1;\ 0.1 - 0.25;\ 0.25 - 0.75;\ 0.75 - 1;\ 1\}$$

In this scheme, a country which sells mainly low-end products in terms of unit value will have higher share of its product counts and revenue in the lower groups. By the same token, a country/region that sells more expensive products will have the larger share towards the last range of distribution.

4. Product Dynamics

Based on the methodology described above, we consider Canada's product dynamics in the U.S. import market in three ways. First we examine product penetration to gauge the extent of Canada's representation in individual U.S. product markets. Then we consider product churning, the rate at which Canadian products break through into new product categories versus the rate at which Canadian exports drop out of U.S. markets. Finally, we consider a range of measures that bear on the extent of head-to-head competition in U.S. product markets between Canada and other U.S. trading partners.

4.1 Product penetration

The aggregate levels of product penetration in the U.S. market for 1998 and 2006 are shown in Table 2. In both years, the EU15 had the highest penetration rates at 89 percent in 1998 and 87 percent in 2006. Canada had the second highest penetration in 1998 at 73 percent but in 2006 China claimed that position with a 77 percent rate, while Canada fell to third with a 70 percent rate. Over the period of eight years, China's penetration rate increased by 20 percentage points. In total product counts, China's exports increased from 9,249 in 1998 to 13,123 products in 2006. China's product counts were the largest of any single supplier country to the United States.

Table 2: Product penetration in the U.S. market by trading partner, 1998 and 2006, percent

	Percent of U.S. tariff lines in which imports were registered	
	1998	2006
Canada	73	70
China	57	77
EU15	89	87
Japan	60	59
Mexico	52	52
OEACs	63	64
OHICs	36	37
OMICs	69	75
OLICs	68	72

Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu

Of the major U.S. trading partners, Canada experienced the largest (3 percentage points) drop in its product penetration rate. Japan and the EU15 saw lesser declines while other high income countries increased their penetration rates. The major gainers in terms of increased product penetration rates were the middle and low income countries.

From the perspective of product penetration, a decline for a higher income country is not actually unusual. A "stylized fact" of economic development is that countries first diversify their export product palette but, beyond a certain level of per capita GDP, tend to reduce the range of products they export. As Imbs and Wacziarg (2003) conclude: "Poor countries tend to diversify, and it is not until they have grown to relatively high levels of per capita income that incentives to specialize take over as the dominant economic force. This non-monotonicity is a very robust feature of the data". Thus, the decline in Canada's product penetration rate in the U.S. market is not *per se* a source of policy concern. Indeed, it is worth recalling in this context the finding of Trefler (2004) that free trade with the United States led to a considerable degree of narrowing of product lines at the firm level basis, which would be consistent with a narrowing on a product line basis, reflecting increased specialization and with it higher levels of productivity.

Table 3: Product penetration by industry, 1998/2006 (percent)

Industry	Canada	China	Mexico	Japan	EU15	OEACs	OLICs	OMICs
Agri., Forestry, Fishing & Hunting	72/69	30/44	41/37	23/21	54/48	29/27	52/49	61/64
Mining and Oil and Gas Extraction	71/70	36/56	40/43	26/23	66/67	29/23	50/58	65/62
Food; Beverage and Tobacco	67/62	27/41	34/36	23/23	70/68	32/33	50/57	62/70
Textile; Clothing; Leather	64/59	60/85	54/52	42/47	93/91	67/70	76/82	70/79
Wood; Paper; Printing	88/87	51/79	50/45	44/43	82/83	55/54	64/65	69/72
Petroleum and Coal Products	98/94	17/32	52/41	50/54	88/88	50/44	58/62	72/71
Chemical	56/55	49/77	38/37	70/65	95/90	41/47	61/68	54/61
Plastics and Rubber; Non-metallic Mineral	84/84	80/96	79/76	82/79	98/98	82/84	78/81	83/87
Primary Metal; Fabricated Metal	83/81	57/81	58/60	78/73	96/95	69/71	60/68	73/80
Machinery	86/87	56/82	53/57	87/86	98/98	77/81	68/72	71/80
Computer and Electronic Product	68/68	81/92	56/62	89/87	93/92	87/86	82/82	78/77
Electrical Equip., Appliance & Component	89/91	84/96	79/80	86/83	99/97	91/94	80/82	79/90
Transportation Equipment	91/86	51/67	64/60	69/68	90/92	63/66	52/56	65/73
Furniture; Miscellaneous; Antiques	84/79	83/90	71/68	73/71	95/94	87/87	84/86	86/89
Total	**73/70**	**57/77**	**52/52**	**60/59**	**89/87**	**63/64**	**68/72**	**69/75**

Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu.

At the industry level, the fact that Canada improved or maintained its product penetration rate in machinery, computers and electronic products, and electrical machinery and equipment, three of the more knowledge-intensive sectors, also tends to mitigate concern about the overall slide in product penetration rates (see Table 3).

That being said, it is noteworthy that China not only increased its product penetration rates across the board but made vast strides in the knowledge-intensive sectors, including in transportation equipment, a sector in which Canada had a fairly steep decline in product penetration (from 91 to 86 percent) and in chemicals, a sector in which Canada had a minor decrease (from 56 to 55 percent). China's product penetration rates were more than 90 percent for the electrical equipment, appliances and component sector (96 percent) and computer and electronic products (92 percent). In three of the five industries that are considered relatively medium- and high-tech, the number of products that China exports to the United States surpassed that of Canada. In the remaining two (transportation equipment and machinery), the difference in the number of products supplied by Canada and China was reduced to minimal levels by 2006. While China's value-added may account for only a small part of the overall value of its exports, the competitive challenge to Canadian-based producers remains significant. What matters is the competitiveness of the global value chain that culminates in products assembled in China. If Canadian firms are not part of these chains, they compete with them.

4.2 Product churning

The changes in the overall product penetration rates for Canada and its competitors discussed above can be analyzed as the outcomes of each country's product churning in the U.S. market—its ability to sustain its presence in existing product lines and its ability to add new products to its export palette. Table 4 shows the continuity rate and adding rate for Canada's major competitors in the U.S. import market.

Table 4: Product churning, 2006 versus 1998 (percent)

	Canada	China	Mexico	Japan	EU15	OEACs
Initial Penetration	73	57	52	60	89	63
Exit rate	13	4	19	15	5	12
Adding rate	11	40	19	15	5	16

Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu

As a general observation, it is important to note the very high negative correlation between the initial product penetration rate and the rate of product additions. If we exclude China as an interesting special case, the simple correlation coefficient between the initial product penetration rate (from line 1 in the table) and the rate of product adding by 2006 (line 3 in the table) is -0.99. For the EU15 which registered exports in 89 percent of the U.S. tariff lines, there is limited scope to add new product lines. The rate of innovation in Europe might still be high in that, for example, a French product might displace a German model, or a new German product might displace an existing German product in the same tariff line. In either case, the EU15 would not register a product introduction in this statistic.

The data show that, for Canada, 87 percent of the products that were exported to the United States in 1998 survived in 2006 while 13 percent were either driven out or became obsolete. By comparison to the competitors, the rate of continuation of products is not out of line—it is little different from the rates achieved by Japan and the other East Asian advanced economies. The EU15 and China, however, had significantly higher rates of product survival at 95 and 96 percent respectively, although given the different stages of development and the bases of competitiveness of these two economies, one would anticipate that these similar rates were achieved on the basis of rather different strengths.

The third observation on Table 4 is in respect of new product entry. In Canada's case, the rate of addition of new products to the export palette was only 11 percent, the second lowest in the

group, significantly below the rates achieved by Japan and the other more advanced East Asian economies, and well below the rates achieved by Mexico and China. Canada did have a higher rate of product introductions than the EU15, although this edge must be qualified by consideration of the very high rate of product penetration that the EU15 had in the U.S. import market to start with—as noted, there are few manufactured products that the EU15 does not export to the United States and so adding new lines is rather difficult. So, at the aggregate level, the main takeaway point from the "product adding" data in Table 4 is the outlying nature of China's performance.

The fourth observation on these data concerns the difference between the dropping and adding rates by country. Whereas China and to a lesser extent the Other East Asian high income countries had higher rates of product addition than of product disappearance, and the others in the table broke even, Canada had a higher rate of product disappearance than introduction.

This last observation takes on more significance when we compare the remarkably high rate of product churning evidenced in these data. The way concepts like comparative advantage and competitive advantage manifest themselves in products bought and sold in the international market place is clearly fluid. This underscores the importance for an economy of maintaining innovative capacity to maintain a steady flow of product introductions to replace the products squeezed out by emerging competition or becoming technologically obsolete.

Table 5 provides the product churning comparisons at the industry level for Canada, China and Mexico. For some industries, Canada's product disappearance rate is in the 20 percent range (mining and oil and gas extraction and chemicals at 22 and 20 percent respectively). At the same time, product introduction rates are high as well in the same industries (25 and 19 percent respectively), pointing to a rapidly changing industrial product landscape.

Table 5: Product churning by industry, Canada, China and Mexico, 2006 versus 1998 (percent)

	Canada		China		Mexico	
NAICS – industries	Exit	Entry	Exit	Entry	Exit	Entry
Agriculture, Forestry, Fishing and Hunting	10	11	12	60	21	14
Mining and Oil and Gas Extraction	22	25	12	55	22	25
Food; Beverage and Tobacco	15	10	10	66	25	31
Textile; Clothing; Leather	19	13	2	51	22	20
Wood; Paper; Printing	4	8	1	46	20	20
Petroleum and Coal Products	2	16	27	127	26	30
Chemicals	20	19	6	59	27	24
Plastics and Rubber; Non-metallic Minerals	7	8	1	14	12	9
Primary Metal; Fabricated Metal Products	7	7	4	38	16	18
Machinery	7	7	5	46	18	24
Computer and Electronic Products	15	11	4	12	12	23
Electrical Equip., Appliance & Components	6	7	1	15	7	9
Transportation Equipment	8	5	4	26	18	12
Furniture and Related; Miscellaneous	11	6	3	9	15	12

Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu

Two observations may be made on the data in this table. First, at the industry level, the rate of product turnover is very high, with China in particular registering phenomenal numbers in terms of product entry. Second, in the medium- and high-technology sector, Canada had a lower rate of product entry than exit in three of the industries, matched the exit rate in one and marginally exceeded the exit rate in one. Looked at through the prism of product churning, there is some evidence pointing to a weak Canadian innovation record in terms of Canadian higher technology sectors being unable to introduce new products into international trade at a sufficiently high rate to replace older products being driven out of the international market.

4.3 Product overlaps

We now consider the issue of product overlap – the extent to which Canada competes head-to-head with particular

competitors in the U.S. import market. The results for the assessment are presented in Table 6.

Table 6: Product overlap in the U.S. import market, Canada and major competitors, 1998 and 2006, percent

	Canada	China	Mexico	Japan	EU15
					1998
Canada	100	80	87	81	75
China	62	100	72	70	61
Mexico	63	67	100	63	56
Japan	66	74	72	100	65
EU15	92	96	95	97	100
					2006
Canada	100	75	86	81	73
China	83	100	89	90	83
Mexico	64	60	100	65	56
Japan	67	68	73	100	65
EU15	91	93	95	97	100

Note: This table is computed using the full HS 10-digit product groups. For Canada, the total number of products exported in 2006 was 11,869; China exported 9,858; Mexico exported 7,586; Japan exported 8010, and EU15 exported 10821. In 1998, the total number of products that Canada exported was equal to 11,864.
Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu

The economy with which Canada's exports in the U.S. market overlap to the greatest extent in this comparison is the EU15. Looking at the column "Canada", in 1998, the EU15 exported 92 percent of the product lines that Canada was exporting. At that time, China was selling to the United States products in 62 percent of the tariff lines in which Canada was selling. In 2006, the Canada-EU overlap was almost unchanged but China was selling in 83 percent of the individual product markets in which Canada was also active. The overlap with Mexico and Japan was lower and changed little between 1998 and 2006.

Accordingly, to the extent that tougher foreign competition explains Canada's revealed inability to introduce new, globally competitive products at a sufficient pace to maintain its overall market share in the all-important U.S. import market, that competition appears to have come predominantly from China, whether due to indigenous value-added activities or because of its role as the final stage of global supply chains that compete with Canadian domestic production.

4.4 Export similarity index

The export similarity index (ESI) results for Canada, China, Mexico, Japan, and the EU15 for the years 1998 and 2006 are given in Table 7. The table is to be read by column. The first two columns provide, for 1998 and 2006 respectively, Canada's ESI readings with respect to the U.S. trading partners listed in the row-headings. Similarly, the ESI readings for China for 1998 and 2006 are provided in the third and fourth columns[11].

Table 7: Export similarity index

Countries/ Regions	Canada		China		Mexico		Japan		EU15	
	1998	2006	1998	2006	1998	2006	1998	2006	1998	2006
China	0.12	0.14	-	-						
Mexico	0.31	0.33	0.20	0.22	-	-				
Japan	0.27	0.29	0.19	0.20	0.24	0.24	-	-		
EU15	0.30	0.29	0.17	0.19	0.25	0.25	0.34	0.34	-	-
OEACs	0.19	0.24	0.32	0.37	0.26	0.26	0.31	0.36	0.25	0.29
OHICs	0.20	0.25	0.08	0.08	0.14	0.20	0.12	0.10	0.20	0.21
OMICs	0.22	0.29	0.24	0.26	0.30	0.34	0.21	0.16	0.25	0.25
OLICs	0.16	0.20	0.25	0.21	0.23	0.19	0.17	0.12	0.23	0.20
OECs	0.09	0.13	0.03	0.02	0.06	0.06	0.03	0.01	0.07	0.08

Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu

Note, this table was constructed using the full sample of un-concorded data for each of 1998 and 2006.

[11] Note that for each country pair, the ESI is symmetric; hence, we report only the figures below the diagonal.

Among the individual countries and regions considered in the table, the most similar country to Canada in terms of the range of exports to the United States is Mexico, with an ESI value of 0.33 in 2006, followed by Japan the EU15 and the OMICs, all with ESI readings of 0.29. The relation of Canada's exports to the US with those of OEACs and OHICs are not much different. At the other end of the spectrum, we find the oil exporters and China with ESI readings of 0.13 and 0.14 respectively in 2006.

Comparing the 2006 and 1998 readings, the similarity between Canada and other higher income countries/regions generally increased, including with Japan, the OHICs and the OEACs. The notable exception was the EU15 in which case the ESI reading edged down from 0.30 in 1998 to 0.29 in 2006. Strikingly, the greatest increase in similarity was with the other middle income countries, in which case the ESI rose from 0.22 to 0.29 to match the major high income countries/regions. The increase in similarity with Mexico is also noteworthy as is the fact that, from Mexico's point of view, Canada ranks amongst the most similar countries to it (slightly less than OMICs).

China's ESI rose with respect to developed countries and fell with respect to LICs and OECs. It rose with respect to Canada, Japan, the EU15, OEACs and OMICs. It remains the same with respect to OMICs. China's ESI is most similar with respect to OEACs at 0.37; moreover, the OEACs is the group with which China registered the greatest increase in similarity over the period studied, from 0.32 in 1998.

For Japan, the most similar trading bloc is the EU15 and for the EU15 it is Japan.

4.5 Unit value analysis

We now consider the quality dimension. Table 8 compares the unit values of the products exported by Canada, China, Mexico, Japan and the EU15 (column headings) with respect to each other and with the OEACs (row headings). Thus the entry of 71 in column "Canada" and row "China" means that in 1998, among the products that both Canada and China were exporting

to the United States, Canada had a higher unit value than China—i.e., Canada's products are "vertically superior"— in 71 percent of the cases. Note that the data above the diagonal are symmetrically 100 less the data below the diagonal. For example, in column "China" and row "Canada", we have the entry 29, which is the share of products for which China has a higher unit value compared to Canada. Note that the number of products for which we could compute unit values varied by year and country pair. The bottom panel of Table 8 gives the number of products for which the calculation was possible for 2006. Thus, for example, in 2006, unit value comparisons for Canada and China were possible for 7,999 products.

Table 8: Share of higher unit value (superior) products (percent)

	Canada	China	Mexico	Japan	EU15
	1998 Superior Product Percentage				
Canada	-	29	35	61	60
China	71	-	59	81	80
Mexico	65	41	-	71	73
Japan	39	19	29	-	45
EU15	40	20	27	55	-
OEACs	66	38	52	77	76
	2006 Superior Product Percentage				
Canada	-	23	35	58	56
China	77	-	68	85	83
Mexico	65	32	-	72	70
Japan	42	15	28	-	45
EU15	44	17	30	55	-
OEACs	69	31	54	78	76
	2006 Number of common products				
China	7,999				
Mexico	6,086	6,257			
Japan	6,635	7,283	5,099		
EU15	9,073	10,283	6,848	8,060	
OEACs	7,077	8,268	5,749	6,692	8,704

Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu

Canada had higher unit values for a majority of products compared to China, Mexico and the OEACs but for a minority of products compared to Japan and the EU15 in both years. Comparing the figures for 2006 versus 1998, Canada's relative position in terms of the share of products that command higher unit value strengthened in 2006 from the situation in 1998 with respect to all competitors, except for Mexico in which case the results did not change.

A particularly remarkable observation may be from Table 8 by comparing the entries for China for 2006 versus 1998. China had a lower percentage of products with higher unit value in 2006 compared to 1998 with respect to all trading partners. There are two interpretations, not mutually exclusive, that can be made of this development: first, that China's expansion at the extensive margin in terms of number of export products has been accomplished on the basis of lower prices, even though its expansion has been into higher technology sectors; second, the expansion of lower price goods has outpaced China's product upgrading of existing product lines to command higher unit values.

A further observation is that China's percentage of superior products with respect to Canada is higher than with respect to Japan and the EU15. For both years, Japan is the country that has the highest share of superior products with respect to all partners (reading down the "Japan" column, the entries are more than 50 percent in all rows). The EU15 ranks second in this regard with a higher share of superior products than every country/region except Japan. The inference from these data is that Canada is not as advanced in product quality as Japan and the EU and thus more exposed to competition from China.

To get some indication of the size of the unit value differences between the different country pairs, we turn to the unit-value dissimilarity index. Table 9 reports the values for this index for 1998 and 2006. The figures in this table have the straightforward interpretation of measuring the average percentage difference in unit value between the set of products exported to the United States by a country pair. Thus, a figure of 50 means the average unit value difference was 50 percent.

Table 9: Unit-value dissimilarity index

Countries/ Regions	Canada		China		Mexico		Japan		EU15	
	1998	2006	1998	2006	1998	2006	1998	2006	1998	2006
China	0.58	0.44	-	-	-	-	-	-	-	-
Mexico	0.45	0.38	0.47	0.40	-	-	-	-	-	-
Japan	0.62	0.50	0.59	0.60	0.50	0.54	-	-	-	-
EU15	0.44	0.50	0.57	0.47	0.47	0.43	0.42	0.42	-	-
OEACs	0.63	0.50	0.40	0.73	0.42	0.42	0.50	0.52	0.51	0.52

Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu

Note: For computation of UDI, the products that have no unit value for either of the pair countries/regions above have been excluded. For the number of products used in computing this table see the bottom panel of Table 8.

The first thing to note in this table is that the average differences between unit values across countries are large; the range in this table is from 38 percent between Canada and Mexico in 2006 to 73 percent between China and the Other East Asian High Income Countries, also in 2006. The average difference across all the country pairs recorded in the table was 50 percent in 1998 and 49 percent in 2006.

Our second observation is that vis-à-vis the two trading partners that had a superior product quality mix according to the comparison made on the basis of the Product Superiority Index, the unit value wedge narrowed (quite sharply) against Japan but widened (to a lesser degree) against the EU15. Since Japan had a superior product mix to the EU15, there is no consistent way to interpret these changes over time in terms of a narrowing or widening of quality. This underscores the limitations of unit value indices as discussed earlier.

The third observation is that the greatest degree of narrowing was observed vis-à-vis China. Unfortunately, the gap between China and the other East Asian High Income Countries widened from 40 percent to 73 percent; given that the gap between Canada and this latter group narrowed, there is again no

consistent reading of developments in terms of price/quality convergence that can square these various observations.

We next consider the distribution of total export value by product groups with unit values falling into different categories defined by the distance from HUV. The results are given in Table 10. Note that in this table row sums equal 100, save for rounding error.

Table 10: Share distribution of country/region's export value by unit value categories

	<10% of HUV	10-25% of HUV	25-75% of HUV	75-100% of HUV	HUV
			1998		
Canada	16	14	46	12	11
China	45	32	20	3	1
Mexico	19	30	40	9	2
Japan	20	16	40	14	11
EU15	17	14	34	16	19
OEACs	39	25	32	2	2
			2006		
Canada	10	10	52	18	10
China	43	34	20	2	1
Mexico	18	18	36	24	5
Japan	16	13	47	15	9
EU15	15	10	32	17	26
OEACs	24	32	33	10	2

Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu

Note: For this table, products on which there is no information on unit value were dropped. For the number of products used in computing this table see the bottom panel of Table 8.

First, as a general observation, the most prominent feature in this table is European domination of the HUV category and China's of the low end. Europe had a wide margin of export revenues from HUV products over the next nearest in 1998 (Canada and Japan) and an even wider margin in 2006. China meanwhile had 77 percent of its export values derived from products in the lowest two categories, in both years.

The second observation is the relative evenness of the distribution of export values across categories for most

countries. Countries tend to have products that successfully hold market share across a very wide range of relative unit values: for example, Europe generated almost as large a share of export values from product categories in which its products were at 25 percent or less of HUV as from products that were at HUV. This heterogeneity of implied product qualities by individual exporting country/region may be the result of the aggregation biases associated with unit values below even the finest level of disaggregation recorded by customs offices; however, it is consistent with the established fact that firms with widely ranging productivity levels co-exist in markets.

China is an exception in having generated virtually no export revenues from products in the upper two categories, in either year. Given the significant portion of China's exports that are generated by foreign multinationals using China as the final stage in the production chain, and given that China's share of U.S. imports in the medium- and high-technology product groups rose substantially between 1998 and 2006, this is at least somewhat surprising. However, it is not inconsistent with the idea that the products that multinationals tend to produce in China are those that have entered the commodity stage of the product life cycle and no longer command premium prices. China's most direct competitors would seem to be the OEACs which also derived their export revenues disproportionately from products in the last two value groups (64 percent in 1998 and 56 percent in 2006).

In terms of the inter-temporal pattern, most country/regions increased export revenue generation from products in the higher value groups (the last two groups). The biggest shifts were recorded by Mexico (from 11 to 29 percent), EU15 (from 35 to 43 percent), and the OEACs (from 4 to 12 percent). China again stands apart, with virtually no change in its distribution. This latter observation accords with intuition that countries that rely on low-prices are at risk from Chinese competition given that the results are consistent with China expanding its international market presence through lower-priced goods.

The Canadian results are consistent with these general features. In 1998, of Canada's total export earnings in the U.S.

market, 30 percent was obtained by products with unit value less than one-quarter of HUV, while 23 percent was generated from products in the upper two categories, including 11 percent from products commanding the HUV. Between 1998 and 2006, Canada's distribution of source of export earnings moved toward medium and higher unit value products, with the result that in 2006 Canada had the highest share of its export earnings coming from products in the upper three categories (80 percent) of any of the major competitors, including the EU15, which had a corresponding figure of 75 percent.

Another way to examine the distribution of export earnings by products with differing relative unit values is by industry group. For expositional tractability, I consider only two categories for unit values—more than half of HUV and 50 percent or less of HUV. Table 11 provides the share of export value contributed by products whose unit values were more than half of HUV by country/region and industry.

Canada does well in this particular comparison at the aggregate level with the highest share of exports (over 62 percent) accounted for by products with unit values more than half of HUV, although Japan (over 59 percent) and the EU15 (over 58 percent) are not far behind, and Mexico (48 percent) has a fairly high ratio as well. China again stands out: almost 95 percent of its export value is derived from products with unit values less than half of HUV.

Industry-wise, there is quite a bit of variation. Notably, in all five medium- and high technology (MHT) industries, Canada's ratio of export value derived from higher unit products is less than at the aggregate level and in two of these industries it is particularly low: the chemical industry at 28 percent, and electrical equipment at 32 percent. In these two sectors as well as in the transportation equipment industry (56 percent), the leading countries/regions are Japan and the EU15. In transportation equipment, Japan and the EU15 have very high ratios at 83 and 85 percent respectively. However, in machinery and computer and electronic product industries, it is Canada that

has the highest share of export revenues contributed by higher value products evaluated across competing exporters[12].

Table 11: Export value share of products with unit value higher than half of HUV (percent)

NAICS Industries	Canada	China	Mexico	Japan	EU15
Agriculture, Forestry, Fishing and Hunting	79.1	43.8	49.2	89.2	49.4
Mining and Oil and Gas Extraction	98.5	75.4	99.1	37.0	97.7
Food; Beverage and Tobacco	34.3	32.5	48.5	77.3	64.5
Textile; Clothing; Leather	32.5	2.7	6.3	56.7	61.8
Wood; Paper; Printing	36.1	8.7	32.8	54.8	34.0
Petroleum and Coal Products	82.7	28.6	97.1	92.4	65.1
Chemical	28.3	14.5	28.4	45.3	53.4
Plastics and Rubber; Non-metallic Minerals	35.3	13.1	21.8	66.3	41.5
Primary Metal; Fabricated Metal Products	61.2	19.6	43.9	40.1	52.8
Machinery	50.0	3.0	33.6	40.5	41.0
Computer and Electronic Product s	61.9	1.2	36.5	19.9	24.0
Electrical Equip., Appliances & Components	32.4	5.3	9.1	12.2	39.6
Transportation Equipment	56.3	9.2	43.3	82.6	84.6
Furniture and Related; Miscellaneous	59.1	2.4	9.6	28.2	61.2
Total	**62.1**	**5.6**	**48.0**	**59.4**	**58.2**

Source: Author's calculation based on Robert Feenstra's database, http://cid.econ.ucdavis.edu.

It is also noteworthy that Canada tends to have higher unit values in some relatively low-tech industries, including mining,

[12] The same comparison done in terms of product counts rather than export revenues yields broadly similar results, although there are some noteworthy differences, which reflect differences in quantities shipped per product. Canada's shares of product counts and export value in 2006 were quite similar for high end products (unit value of over 75 percent of HUV, including products with HUV) at 32 and 28 percent respectively. For the intermediate group (25 to 75 percent of HUV), the value share (52 percent) was significantly higher than the product count (30 percent). For the lowest group (less than 25 percent of HUV), the reverse was true: value share (20 percent) was significantly lower than the product count (38 percent). The interpretation suggested by these figures is that, in Canada's case, the low end and high end products are sold in smaller quantities, as their product count shares are higher than their respective export value shares. On the other hand, middle range products are sold in larger quantities since their export value share is higher than their product count. In contrast to Canada, the export value share of high end products is higher than product counts for Japan and EU15. In China's case the export value share of high end products at 3 percent is lot smaller than the product count share of 22 percent.

oil and gas extraction (98.5 percent of products with unit values equal to more than half of HUV), petroleum and coal products (83 percent), and agriculture and related industries (79 percent).

China has a particularly high concentration of export earnings from lower unit value products in four industries: textile, clothing and leather; machinery; computer and electronic products; and furniture related and miscellaneous. In these sectors, over 95 percent of China's export value comes from products with unit values less than half of HUV.

5. Conclusions

This paper has examined Canada's trade performance in the U.S. market compared to that of China, Mexico, Japan, the EU15, and other groups of countries classified by income levels, through the lens of product dynamics—product penetration, product churning as evidenced by U.S. market entry and exit of products, and degree of head-to-head competition by product group between the various suppliers to the U.S. market.

Using Harmonized System (HS) 10-digit data, the most detailed (disaggregate) level of import data recorded by the U.S. customs service, the value, quantity and unit price of about 16,000 products imported by the United States in 1998 and 2006 from each of the countries/country groups was computed. This level of detail affords the closest possible correspondence between tariff line trade data and individual product data. Recognizing the various caveats, multiple approaches were used to triangulate on some conclusions that could be drawn with some semblance of confidence.

Our results suggest that the number of products that Canada sold in the U.S. market fell between 1998 and 2006. This is inferred from the fact that Canada's product penetration rate declined from 73 to 70 percent of U.S. import tariff lines.

At least some of the explanation for this decline can be attributed to the fact that product introductions lagged product exits. Put differently, Canada was either not able to keep its foothold in individual U.S. product markets to the same extent as competitors, in particular China, or was not able to introduce

new products into that market at a sufficient pace to offset the loss of old product niches due to technological obsolescence or intensified global competition. Given that Canada exited 13 percent of the product lines in which it exports to the United States over a period of less than a decade while adding new product lines at the rate of 11 percent of the base year total indicates the importance of on-going export market product development. At the product level, comparative and competitive advantage change rapidly. Put another way, much of the action in trade market shares is at the extensive margin, in terms of product entry and exit.

Concern about the slide in Canada's U.S. market share is mitigated by three considerations. First, at the industry level, Canada improved or maintained its product penetration rate in three of the medium- and high-technology (MHT) sectors, namely machinery, computers and electronic products, and electrical machinery and equipment and lost little ground in a fourth MHT sector, chemicals. The biggest slide was in the transportation sector which is dominated by the troubled automotive industry. Second, Canada is at that stage of development where the normal tendency is to increase specialization and thus to reduce lines of export production. Third, since the observed rates of product introductions vary inversely with the product penetration rate, Canada's relatively high rate of product penetration in the base year may mask a stronger innovation dynamic at the firm level (with one firm's products displacing another's within the same tariff classification) than suggested by the data assessed here.

Given the fact that Canada did lose market share, the paper considered the following question: to which country market share was ceded? The greatest degree of product overlap between Canada and other U.S. trading partners is with the EU15, which ships products in over 90 percent of the tariff lines in which Canada ships. The greatest degree of increase in product overlap, however, came from China, which expanded its presence in product lines that Canada occupies from 62 percent in 1998 to 83 percent in 2006. Examining the same issue through the lens of the Export Similarity Index (ESI), which takes into account the

distribution of market share as well as product overlap, it can be seen that, while the similarity between Canada's and China's export palettes did increase between 1998 and 2006, the increase was much more muted than suggested by the increase in product overlap. This suggests again that most of the action in that period was at the extensive margin—product entry and exit. It is important to note, however, that in due course increased initial penetration leads to increased action at the intensive margin—in terms of convergence of market shares by product, which would drive increases in the ESI between Canada and China. In this sense, the ESI can be interpreted as a lagging indicator of competitive pressure while changes in the product overlap measure are leading indicators of such competitive pressures. In other words, the greater impact of China's exports to the United States on Canadian products is yet to come.

The conventional wisdom that China competes on the basis of low price is supported strongly by unit value analysis. China's presence is overwhelmingly concentrated in products that have comparatively low unit values. Given the large number of new, and evidently low-unit-value product entries by China into the U.S. market, and the decline in Canadian product presence in low unit value products, the evidence suggests that the main source of new pressure on Canadian market share in the U.S. market is from China, and it is primarily felt in low-unit-value products. This suggests that the observed structural shift of Canada's product palette towards higher-unit-value products is due more to product exit at the low end than to product up-grading. Again, the action appears to be at the extensive margin.

The evidence amassed here is not conclusive, only suggestive. However, the cumulative weight of circumstantial evidence can be significant. At the product level, the bottom line is that Canada has not been able to introduce new products into the U.S. market at a sufficient rate to replace products that apparently are exiting the market. Given the rapid pace of product churn evident in the trade numbers, an important conclusion is that that Canada has to win market share *on an ongoing basis* through product innovation.

In conclusion, the evidence suggests that the important activity during the past decade has been at the extensive margin in terms of a changing mix of competitors in individual U.S. product markets; importantly, the most pervasive new presence is that of China, including in many knowledge-intensive sectors. This may be problematic for Canada. As noted by Dobson (2004), "Much of the Chinese competition is based on its position in the global value chains of foreign companies, very few of which are Canadian." Given the evidence that suggests exporters learn by exporting and thereby increase their productivity, the major action in the coming decade may be at the intensive margin—through the expansion of market share in product lines where beachheads were established in the recent past. If Canadian companies cannot perform relatively better than other competitors in product and process innovation, Canada's share in the U.S. market is at risk of continuing to fall.

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Appendix 1

Mapping NAICS industries to HS 10-digit products

	NAICS Industry description	Product Examples	Number of Products (1998 / 2006)
11	Agriculture, Forestry, Fishing and Hunting	Horses, live, purebred breeding, male; Roses, grafted or not; Octopus, live, fresh or chilled	1001/1050
21	Mining and Oil and Gas Extraction	Crude or unrefined sulfur; Pebbles and gravel, except limestone; Electrical energy	146/134
311	Food	Carcasses & half-carcasses of swine fresh, chilled; Bones, crude, steamed or ground	1359/1408
312	Beverage and Tobacco	Non-alcoholic beer; Smoking tobacco, ex/pipe tobacco, etc	113/111
313	Textile Mills	Sewing thread artificial filaments for retail sale; Rubber thread and cord; textile covered	1380/1486
314	Textile Product Mills	Textile carpeting, machine-knotted pile, cotton; Babies' diapers of cotton, not knit	377/380
315	Clothing Manufacturing	Women's or girls' vests of cotton, not knit; Men's shirts of cotton, knit	1618/1697
316	Leather and Allied Product Manufacturing	Handbags, of reptile leather; Backpacks, of man-made fiber	494/567
321	Wood Product Manufacturing	Wood in chips or particles; Insulation, coated or not coated, compressed cork	339/400
322	Paper Manufacturing	Coniferous paper, light-weight coated writing etc over 10% mech; Mechanical wood pulp	237/307
323	Printing and Related Support Activities	Dictionaries (including thesauruses); Notebooks, of paper or paperboard	68/68
324	Petroleum and Coal Products	Unleaded gasoline, reformulated; Petroleum jelly	61/79

325	Chemical	Chlorine; gold compounds	2083/2147
326	Plastics and Rubber	Floor coverings of other plastics; nursing nipples and pacifiers	278/301
327	Non-metallic Mineral	Roofing tiles, ceramic; Sinks and lavatories of porcelain or china	406/415
331	Primary Metal	Mineral tars, including reconstituted tars; Parts of axles for railway locos or rolling	1033/1060
332	Fabricated Metal Product	Caulking guns of iron or steel; Sinks and wash basins of stainless steel	704/728
333	Machinery	Poultry incubators and brooders; brewery machinery	1586/1592
334	Computer and Electronic Product	Keyboard units; Line telephone sets with cordless handsets	1289/1247
335	Electrical Equip., Appliance and Component	Electric toothbrushes; Food blenders, domestic	444/450
336	Transportation Equipment	Missile and rocket reaction engines; Motor vehicle horns	401/406
337	Furniture and Related	Seat parts of rubber or plastics; Furniture parts of wood	95/98
339	Miscellaneous	First-aid boxes and kits; Pencil sharpeners	821/843
Total			**16326/16968**

Appendix 2

Country Groups and sub-groups of countries

Low Income Countries
China
Other low wage countries: Afghanistan, Angola, Arab Emirates, Bahamas, Barbados, Benin, Bangladesh, Bolivia, Bosnia, Burkina, Burundi, Cambodia, Cameroon, Chad, Congo, Cuba, C. Africa, Djibouti, Egypt, Equatorial Guinea, Ethiopia, Falkland Islands, French Guiana, Gambia , Georgia , Ghana, Gibraltar, Greenland, Guadeloupe, Guatemala, Guinea , Guyana, Guinea-Bissau, Haiti, Honduras, India, Indonesia, Ivory Coast, Jordon, Kenya, Kiribati, Lao, Liberia, Macau, Madagascar, Malawi, Mali, Moldova, Mongolia, Morocco, Mozambique, Mauritius, Nepal, New Guinea, Nicaragua, Niger, Nigeria, Pakistan, Paraguay , Philippines, Qatar, Rwanda, Samoa, Senegal, Sierra Leone, Somalia, St. Pierre and Miquelon, Sri Lanka**,** Sudan, Switzerland, Syria, St. Helena, Tajikistan, Tanzania, Togo, Turkmenistan**,** Uganda, Uzbekistan, Vietnam, Yemen, Yugoslav, Zaire, Zambia, Zimbabwe
Middle Income Countries
Mexico
Other middle wage countries: Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Belarus, Belize, Botswana, Brazil, Bulgaria, Burma (Myanmar), Chile, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Dominica Is, Dominican Rep, Ecuador, El Salvador, Estonia, Fiji, Gabon, Greenland, Grenada Is, Hungary, Iran, Iraq, Jamaica, Kazakhstan, Kosovo, Kyrgyzstan, Latvia, Lebanon, Libya, Lithuania, Macedonia, Malaysia, Malta, Mauritius, Montenegro, Namibia, New Caledonia, Oman, Palau, Panama, Peru, Poland, Romania, Russia, Saudi Arabia, Serbia, Seychelles, Slovakia, Slovenia, South Africa, Suriname, Thailand, Trinidad & Tobago, Tunisia, Ukraine, Uruguay, Venezuela, Bahrain, Israel, Turkey,
Oil Exporters: Qatar, Russia, Saudi Arabia, United Arab Emirates, Algeria
High Income Countries
Canada
Japan
EU15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom
Other east Asian countries: Hong Kong, South Korea, Singapore, Taiwan
Other high wage countries: Australia, Bermuda, Iceland, Kuwait, Netherlands Ant, New Zealand, Norway, San Marino, Switzerland