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CANADA AND ITS COMPETITORS IN THE U.S. IMPORT MARKET: A MIXED REPORT CARD FOR OPTIMISTS

Ram Acharya, Industry Canada
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Working Paper 2010-04

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Abstract

This paper examines Canada's trade performance in the U.S. market compared to that of China, Mexico, Japan, the EU15, and other countries. In particular, the study uses a product level assessment to evaluate Canada's market share in over 16,000 products imported by the United States. The paper finds that Canada's market share declined and this reflected a fall in product penetration (the share of product categories in which Canada exports to the United States) from 73 to 70 percent. Moreover, the fall in penetration is due to a failure of new product entries to offset product exits. Market share erosion was thus, in good measure, a sign of weak innovation performance in Canada. The key issue for Canada is innovation to sustain competitive product entry.

Key words: trade, market share, innovation

Résumé

Cette étude se penche sur les résultats commerciaux du Canada aux États-Unis, comparativement à ceux de la Chine, du Mexique, du Japon, de l'Union européenne des Quinze et d'autres pays. Plus précisément, elle examine la part de marché du Canada dans les importations américaines de plus de 16 000 produits. Le document permet de constater que la baisse de la part de marché du Canada correspond à une diminution de la pénétration de produits (c.-à-d. la part des catégories de produits exportés aux États-Unis par le Canada) de 73 % à 70 %, diminution attribuable à une non-compensation des sorties de produits par les entrées de nouveaux produits. L'érosion de la part de marché témoigne donc fidèlement de la faible performance du Canada en matière d'innovation. Le principal enjeu pour le Canada est de soutenir les entrées de produits concurrentiels par l'innovation.

Mots clés : commerce, part de marché, innovation

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Storyline: Summary

The United States is the most dynamic, innovative and single largest destination country for global merchandise exports. So, capturing US market is a priority for all countries in the world, and especially so for a neighboring country Canada, which is highly integrated with the US in terms of product and factor markets. Hence, the dynamics created by major trading partners in the US and their consequences is a matter of interest for both academics and policymakers. There has not been a single comprehensive study that evaluates the performance of all major trading partners in the US, and this study aims to fulfill this research gap by using the most disaggregate product level US import data.

Altogether we analyzed the performance of ten units: four countries (Canada, China, Mexico, Japan) and six country groupings (EU-15, other east Asian countries (OEACs), oil exporting countries (OECs), other low income countries (OLICs), other middle income countries (OMICs), and other high income countries (OHICs)). The low, middle and high income countries are defined based on per capital gross domestic product in year 2007, and the list of countries in each group and sub-group is given in Appendix A. For some parts of the study, we will be considering all the above 10 countries/regions in the analysis, but the main focus of the paper will be on four countries (Canada, China, Mexico and Japan—the largest four supplier countries to the US market) and two regions (EU-15 and OEACs). The four countries and two regions together supplied three-quarters of US merchandise imports in 2007.

Some of the questions that this study tries to provide answers are as follows: (1) What is the relative performance of all these trading partners in the US import market (2) What is the role of product dynamics (penetration, churning and overlap) in their relative performance? (3) Which are the closest pairs of countries in terms of export similarity? (4) What is the role of unit-

value, a proxy for vertical quality of the product, in the relative performance of major exporters to the US? (5) Are countries converging in unit value over time? (6) Which are the most similar pairs of countries in unit-value distribution? In tackling these queries we evaluate the performance of all major exporters to the US with particular focus to Canada, the one time largest US merchandise supplier.

The study is carried out at the Harmonized System (HS) 10-digit, the most disaggregate level of import data that US has. The record at this level is very disaggregated with about 16,000 products imported to the US. The competition seems to be so tough that even at that level of detail classification, only less than 7% (less than 1,000 products) of the products and about 0.3% of US import value have a single supplier; all other products are supplied by at least two countries, and in many cases there are several suppliers of a product.

Using these detail product level data by country, we develop several trade performance indices and present results by summing up at the aggregate level or in some cases for 14 North American Industrial Classification System (NAICS) industries. Among them, one is agriculture related industry, one is mining related industry and 12 are manufacturing industries. Among manufacturing industries, five are relatively medium-and high-tech (MHT) and seven are low-tech (LT) industries.[1] The study is carried out for two time periods. For the part of the paper based on industry level data, we use data for 1998 and 2007. For the product analysis, we use data for years 1998 and 2006 (the last year that product level data were available at the time of writing the paper).

[1] There are total of nine LT industries: (1) Agriculture, Forestry, Fishing and Hunting (2) Mining and Oil and Gas Extraction (3) Food; Beverage and Tobacco (4) Textile; Clothing; Leather (5) Wood; Paper; Printing (6) Petroleum and Coal Products (7) Plastics and Rubber; Non-metallic Mineral (8) Metal (primary and fabricated) Product and (9) Furniture and Related; Miscellaneous industries. The MHT industries are: (1) Chemical (2) Machinery (3) Computer and Electronic Product and (4) Electrical Equip., Appliance and Component and (5) Transportation Equipment industries.

Results show that compared to the situation in 1998, Canada has lost its share of US imports by about three percentage-points in 2007, leveling at about 15.7%. The loss was reported across all major industries except for agriculture, and it was more pronounced in MHT than in LT industries, as the share of MHT industries in Canada's total exports to the US fell from 51% in 1998 to 40% in 2007. This has happened despite the fact that the share of MHT industries in total US imports has remained more or less stable over time at about half of the US imports. As it stands, Canada remains major supplier of US markets mainly in LT industries (agriculture, mining and wood related industries) with one exception of transport equipment industry.

The biggest story of US import market is generated by China, whose export growth in the US market has been phenomenal. Over the period of one decade between 1998 and 2007, China's share of US imports more than doubled, with share of 17% in 2007. Consequently, China has taken over Canada's long standing role of the largest merchandise supplier of the US. China has increased its export share across all industries and more so in the MHT industries. China is the largest supplier of not only textile and clothing industries, but also of computer and electronic products, electrical equipment and appliance industries in the US. In each of these two industries, one-third of US imports are supplied by China. Quite surprisingly, the share of the MHT industries in China's total exports to the US increased from 36% in 1998 to 49% in 2007. It turns out that for every dollar of China's exports to the US, about 50 cents is earned in MHT industries, whereas for every dollar of Canada's exports only 40 cents is earned in these industries.

Mexico's share of US imports increased in the early 1990s, but remained stable in the last ten years at about 11%. Even though, Mexico earns about two-third of what Canada earns in total merchandise exports to the US market, Mexico earns 4.5 times more in computer and electronic

product industry and 3.4 times more in electrical equipment industry than does Canada. Even in transport industry, Mexico earns almost 60% of what Canada earns. As a result whereas Canada's share in US imports in LT industries is double the share of Mexico, the two countries occupy almost the same share of US imports in MHT industries, at around 13%.

In terms of market share loss, the largest losers were Japan and OEACs whose shares of US imports fell by 5.8 and 3.7 percentage-points, respectively between 1998 and 2007. EU-15 lost its market share by 2 percentage-points. The OEACs lost about half of its market share of US imports in LT industries and about 30% in MHT industries. Similarly, Japan lost its market share in LT by about 56% and in MHT by about 35%. Despite, Japan's exports to the US are mainly at MHT industries, with only 15% being in LT industries. The loss for EU-15 was only in LT industries. The remaining G-7 countries (Germany, France, UK and Italy) also lost the US market share somewhat. Except China, the other market share gainers in the US have been some OMICs, whose combined share rose by 5 percentage-points during 1998 and 2007.

The export value of a country depends on three components: (1) number of exported products, (2) quantities of each exported product and (3) unit value of each exported product. So, the market share loss in the US could be the outcome of either complete substitution (number of product drop), or partial substitution (quantity) or price discount (unit value). We evaluate each major trading partner's performance in terms of number of products and unit price, leaving the quantity of product as a residual.

On the number of products, we find that in Canada's case product penetration rate (share of number of product a country exports to the US in total number of products imported to the US) has fallen from 73% (out of 16,326 products imported to the US) in 1998 to 70% (out of 16,326 products) in 2006. Canada lost the penetration rate almost across all industries, except for

negligible growth in a couple of industries. The loss was highest in food and textile industries (at 6 percentage-points) followed by transport and petroleum industries (5 percentage-points each).

The dynamics of penetration rate depend on product churning (a combination of new product adding rate and old product dropping rate). Results show that Canada is not only slow in introducing new products compared to other competitors, but also that its products have exited from the US market in larger intensity. For example in 2007, only 87% of the products that Canada exported to the US in 1998 continued to make into the US market (continuity rate). The remaining 13% exited the market (dropping rate), most likely as a result of competition from other countries. The adding rate (the share of number of products that were new in 2006 to the total number of products exported in 1998) was only 11%. Among the major exporters to the US, the adding rate of Canada was the lowest, except for EU-15 in which case it is not surprising as EU-15 already has very high penetration rate. So, for Canada, the disappearance of its products from the US market and slowness in introducing new products in more recent years should have contributed to the loss of Canada's market share in the US. Canada's churning rate was not different between the LT and the MHT industries.

The Chinese story was almost opposite to that of Canada. China's penetration rate rose from 57% in 1998 to 77% in 2006; China became the country with the largest number of products exporting to the US in 2006, with count of 13,123, an increase of about 5,000 products from 1998.[2] The increase in penetration rate was across all industries; the increment ranged from 11 percentage-points in computer industry to 28 percentage-points in chemical industry. In four (out of 14) industries, China's penetration rate was more than 90%. The annual about 2.5

[2] The numbers of products that China exports to the US are more than that of Canada in six out of 14 industries, and theses six industries included three of the five MHT industries. In the remaining two MHT industries, in machinery industry, the difference in the number of products supplied by Canada and China is small and in transport equipment

percentage-points increase in China's penetration rate is due to the fact that China kept on adding new products without losing its old products in the US market. China's product continuity rate was very high at 96%; so was its product adding rate (40%).

China is not only exporting what Canada used to export; it is introducing products that Canada does not sell to the US. The product overlap computation (the number of same products exported by two countries) shows that Canada used to exports 80% of the products that China used to export to the US in 1998, and it has declined to 75% in 2006. On the other hand, China used to export only 62% of Canadian products in 1998 and in 2006 it has increased to 83%.

For Mexico, even though the continuity rate at 81% was lower than that of Canada but the adding rate (19%) was almost double of Canada's.

Despite all these seemingly zero-sum outcomes between Canada and China, China is still the most dissimilar country for Canada at export similarity index (ESI) that looks at the similarity of product-wise contribution in each country's total export value. The more similar is the contribution of each product in two countries, the higher is the ESI, indicating higher similarity between theirs trade patterns. Mexico, on the other hand, is the most similar country for Canada's exports, indicating that Mexico competition might have been another factor for Canada's lower performance. In 2006, Japan, EU-15 and OMICs were the most and equally dissimilar traders for Canada in the US market. Canadian exports have become more similar with all countries/regions (including with OLICs and OHICs) in 2006 than in 1998, indicating that the competition might be getting tougher, except slightly growing dissimilar with the EU-15.

So far we discussed the issue related to product counts in exports. On the unit value, the second part of the three components of exports, the result for Canada is neither completely bleak

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too, China has started to pick up quickly (its penetration in this industry increased by 16 percentage-points in 2006 compared to the situation in 1998).

nor something to celebrate. Comparing commonly exported product-wise unit price for a pair of countries, we find that Canada has higher unit value (vertically superior product) in more number of products compared to China, Mexico and OEACs and in less number of products compared to Japan and EU-15 in both 1998 and 2006. Over time, the share of superior products vis-à-vis all major competitors (China, Mexico, Japan, EU-15 and OEACs) is rising. For example, in 1998 compared to China, Canada had higher unit value in 71% of the common set of products and that increased to 77% in 2006. With respect to Japan, in 1998 Canada had higher unit value in 39% of the common products, which increased to 42% in 2006. If unit value is considered as the measure of quality, it means that Canada is selling relatively larger number of vertically superior—higher quality—products.

On the contrary, China has less percentage of products with higher unit value in 2006 (compared to 1998) with respect to all trading partners. It seems to be the case that compared to 1998, as China increased its penetration across all industries in 2006, it started supplying disproportionately large number of relatively cheaper products vis-à-vis other competitors. It could be the indication of technological convergence taking place in China as its production functions shift further out than those of developed countries, thereby making it possible for providing relatively more discounts on its products over time. For both years, Japan was the country that had the higher share of superior products with respect to all partners. EU-15 stood at the second position followed by Canada.

Next we looked at the unit value distribution across products for each pair of countries, constructing unit value similarity index (UVSI). The way it is defined, the index is higher (lower) if the overall distribution of unit value across products between a pair of countries is more similar (dissimilar). Between 1998 and 2006, we find that Canada's unit value distribution

is converging with respect to that of China, Mexico, Japan and OEACs and diverging with respect to that of EU-15. Mexico which is the most similar country to Canada in terms of ESI is also the most similar country in terms of UVSI at 0.62. China is the second similar country. And Japan, EU-15 and OEACs are the least and equally similar country/region for Canada.

Compared between 1998 and 2006, Canada's composition of exports has moved from low-end products toward medium- and high-end products. For example, in 1998, the share of export value earned by products that commanded less than one-quarter of the highest unit value (HUV) in the same product—the low-end products —declined from 30% in 1998 to 20% in 2006. At the other end, Canada's export value earned by products that commanded either HUV or three-quarters of the HUV in the US—the high-end products—increased from 24% in 1998 to 28% in 2006. The share of middle range products—priced at 25-75% of the HUV— increased from 46 to 52%. On the contrary, China sold mostly low end products, and remained so throughout. In 2006, 43% of China's export value was earned from products that were sold below 10% of the HUV of similar products. Only 4% of total export revenue of China was earned by products with HUV. The magnitude of discount factor for China would have been even larger if one factors out the transport costs which, due to distance, are higher for Chinese than for Canadian products.

It appears that the move of Canada's trade bundle towards more high-end products while examined in its *own export criterion* is not something we can celebrate fully. If we look from the US total import market side, Canada's share in high-end US imports, has fallen faster than Canada's share in total US imports. So what is really happening is that Canada is losing US market share in low-end products a lot faster than its share in total US imports; it is losing US market share in high-end products slightly faster than total US imports, and it is gaining market

share in medium range products. Japan, which still is supplying predominantly high-end products, is also moving relatively towards medium range products over time. Interestingly, Mexico has become a larger supplier of high-end products in the US, as its market share in these products increased phenomenally from 7% in 1998 to 17% in 2006 (despite Mexico's almost stable share in total US imports). The other group that increased its relative position in high-end products is OEACs; their share of high-end US imports doubled in 2006 despite the fact that their total share fell by one-third.

China is advancing in all range of products at the same pace; it has not increased its share of US market in high-end products despite its phenomenal growth in exports to the world and to the US. In that sense, China's competitive pressure is very high in low-end products but the speed of change in competitive pressure from China is constant across all products. On the other hand, Mexico and OEACs are taking increasingly larger US market in high-end products. These two forces are putting lot of pressure in Canada's exports, and as a result, Canada is losing its US market share more on low-end and high-end products over time.

Among the three components of exports, the factors behind Canada's loss in US market share are higher churning rate and higher substitution rate (quantity) but not the price discount or movement toward lower value products. The product churning is equally important for both types of industries and hence is not a factor in explaining Canada's performance differences between LT and MHT industries. The larger fall in Canada's share in MHT industries (compared to the low tech industries) could have been the outcome of more numbers of competitors and larger substitution possibility across suppliers on products in those industries.

I. Introduction

The United States is the most dynamic, innovative and single largest destination country for global merchandise exports. So, capturing US market could be a priority for all countries in the world, and especially so for a neighboring country, Canada, which is highly integrated in terms of product and factor market. In the past the gravitas (income level, distance, language, culture, institutions and policy) were such that Canada used to be the main supplier of the US market. However, recently the massive manufacturing network and low wages in China have more than compensated the other advantages that Canada have in the US market, making China the largest supplier since 2007. The trade numbers are such that as China is gaining its market share in the US at increasing pace, all other major trading partner countries including Canada are losing theirs.

Understanding the dynamics created by major trading partners in the US and their resulting consequences is a matter of interest for both academics and policymakers. There has not been a single comprehensive study that evaluates the performance of all major trading partners in the US. An exception is Schott (2008) which includes all trading partners in the analysis, but the focus is China's performance and what has happened to other countries is not modeled explicitly. There are few studies evaluating Canada's performance in the US, but most of them are at more aggregate industry level (Acharya, Sharma and Rao, 2004). In a more recent paper, Acharya (2009) evaluates Canada's comparative advantage using product data. But again the level of aggregation is at Harmonized System (HS) 2-digit with only total of 96 products. To address this research gap, this paper study the US import markets from all major exporting countries' perspectives, with special emphasis to Canada's performance, by using the most disaggregate product level US import data.

In the policy circle, there is a great concern on Canada's recent relatively weak export performance in the US market, especially the falling market share in the US. In order to evaluate this concern and understand the factor behind this outcome, the following are some of the research questions that the paper tries to answer:

- What is the relative performance of low income, middle income and high income countries and major individual countries in the US imports?
- What is the role of product dynamics (penetration, churning and overlap) in the relative performance of major US exporters?
- Which are the closest pairs of countries in terms of export similarity index?
- What is the role of unit-value, a proxy for vertical quality of the product, in the relative performance of major exporters in the US? Are countries converging in unit value over time? Who are the most similar pairs of countries in terms of product unit-value?

Broadly, this study builds on three major groups of countries defined on per capital gross domestic product (PCGDP): low income countries (LICs), medium income countries (MICs) and high income countries (HICs). Since income is a good proxy for income, by focusing on international trade performance by country grouping of similar income, we would understand the magnitude of competition that Canada is facing from low wage countries. For country grouping, we use PCGDP in 2007. Countries with 40% of world average PCGDP are grouped as LICs; countries within 40 to 300% of world average income are considered as MICs and all other countries are considered as HICs. Based on this scheme, we have 87 LICs, 68 MICs and 31 HICs, with total of 186 countries that exported to the US in 2007. The average world PCGDP in 1997 was US$8,257. Hence countries with less than US$3,300 PCGDP are considered as LICs; countries with PCGDP in the range of US$3,300 -US$25,000 are MICs, and countries with more

than US$2,500 of PCGDP are HICs. Put differently, we classify countries as low, middle, and high income if their PCGDP is in the zero to fifth percentile, from the fifth to thirty-second percentile, and from thirty-second to one hundredth percentile, respectively.

Since we want to study the performance of major supplier countries and groups of countries in the US market, relying on econometric study and using average coefficients may not serve the purpose well. Instead, we need to adopt a methodology that can carry salient features of the most important US trading partners separately, yet making the presentation tractable. For that, we take out some of the countries or regions from these three broad income groupings as separate units while leaving others together. For example, among the LICs we make China as a separate unit, and the other remaining LICs are termed as other low income countries (OLICs). Among MICs, we make Mexico separate and the remaining MICs are further sub-grouped into two: Oil exporter countries (OECs) and other middle income countries (OMICs). Among high income countries, we have five sub-groups: Canada, Japan EU-15, other east Asian countries (OEACs) and other high income countries (OHICs).

Hence, altogether we have 10 units of analysis with four countries and six country groupings: China, Mexico, Canada, Japan, OLICs, OECs, OMICs, EU-15, OEACs and OMICs. The list of countries in each group and sub-group is given in Appendix A. For some parts of the study, we will be considering all the above 10 countries/regions in the analysis, but the main focus of the paper will be on the relative performance of four countries (Canada, China, Mexico and Japan—the largest four supplier countries to the US market) and two regions (EU-15 and OEACs). The four countries and two regions together supplied three-quarters of US merchandise imports in 2007.

The study is carried out at the HS 10-digit, the most disaggregate level of import data that US has. The record at this level is so disaggregate that there are about 16,000 products imported to the US, and in many cases with multiple supplier countries. Using these detail product level data by country, we develop several trade performance indices and present results by summing up at the aggregate level or in some cases for 14 North American Industrial Classification System (NAICS) industries. Among them, one is agriculture related industry, one is mining related industry and 12 are manufacturing industries. Among manufacturing industries, five are relatively medium-and high-tech (MHT) and seven are low-tech (LT) industries.[3] The study is carried out for two time periods. For the part of the paper based on industry level data, we use data for 1998 and 2007. For the product analysis, we use data for years 1998 and 2006 (as data for 2007 were not available at the time of writing the paper).

The rest of the paper is organized as follows. In Section II, we briefly describe the data. In Section III, we provide aggregate and industry level share analysis. In Section IV, measurement of product dynamics using product penetration, product churning and product overlap is presented. In Section V, we provide export similarity index. In Section VI, we provide analysis on unit value including unit value dissimilarity index, and range distribution of unit value. Finally, Section VII concludes the paper.

[3] There are total of nine LT industries: (1) Agriculture, Forestry, Fishing and Hunting (2) Mining and Oil and Gas Extraction (3) Food; Beverage and Tobacco (4) Textile; Clothing; Leather (5) Wood; Paper; Printing (6) Petroleum and Coal Products (7) Plastics and Rubber; Non-metallic Mineral (8) Metal (primary and fabricated) Product and (9) Furniture and Related; Miscellaneous industries. The MHT industries are: (1) Chemical (2) Machinery (3) Computer and Electronic Product and (4) Electrical Equip., Appliance and Component and (5) Transportation Equipment industries.

II. Data

The paper uses data from World Trade Organization, World Bank, US International Trade Commission (USITC) and Robert Feenstra's webpage[4]. The per capital gross domestic product (PCGDP) data are taken from the World Bank. Information on global trade is taken from World Trade Organization. Aggregate and industry level US import data are taken from the website of United States Trade Commission (USITC). The major part of the work on this paper is based on US imports by country and industry at Harmonized System (HS) 10-digit from Feenstra's database.[5] The International agencies such as United Nations and OECD carry such data by HS codes but only at 6-digit level. The HS coding has 21 sections (1-digit), 96 chapters (two-digit), more than 1200 headings (four-digit), over 5000 subheadings (6-digit) level and over 16,000 products at 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 detail levels.

In the US, the most detailed level of imports disaggregation is at HS 10-digits. Just to have some sense of how detail the data are at HS 10-digit level, the dataset have 14 types of ladies' shawls, 12 types of men's ties, 94 types of cheese, 11 types of air-conditioners, 10 types of sewing machines and parts, and 26 types of bicycles and parts. So, data are at the finest level of detail and in the paper, we refer these 10-digit codes as "products" or "good" categories.

The study is carried out using data at the HS 10-digit level. But for part of the paper, we sum the results up at the aggregate level and in some cases at 14 industries. For the remaining part, we compute several indices using detail product level data to avoid the inevitable

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

[5] An official version of the HS, was instituted in 1988 (HS 88). The HS has been revised in 1996 (HS 1996) and in 2002 (HS 2002) to take into account new trends in the composition of international trade. Since 2002, data are

aggregation bias. The industry categories are based on North American Industrial Classification System (NAICS). Among the 14 industries that are used in providing results in the paper, one is agriculture related industry, one is mining related and 12 are manufacturing industries. Among the 12 manufacturing industries, 6 are at NAICS 3-digit level and other 6 are combination of other 15 NAICS 3-digit industries. We combine more than one NAICS 3-digit industries into one if they are smaller in terms of imports value for the US as well as smaller from Canada's export market perspective. We combine reasonably similar industries in terms of production technology (the only purpose of combing more than one industries is to make the presentation tractable).[6]

The study is carried out for two time periods. For the first part of the paper where the analysis is at the industry level, we use data for years 1998 and 2007. However, for the product analysis, we use data for years 1998 and 2006, as at the time of writing the paper the last year of product data were for year 2006. To check the consistency of the two sets of data, the product level data at 2006 were aggregated at the industry level and compared with industry level data. The record match was perfect. At the product level, in some case, since same product might have different HS 10-digit across years, the data for year 1998 and 2006 were concorded using the concordance developed by Pierce and Schott (2009).

III. Role of Major Trading Partners in the US Markets

Before analyzing the US import markets, first we provide a brief discussion on the role of major trading countries and regions in the global market. For the US markets, we cover, (1) the composition of US imports by industries, (2) share distribution of US imports by trading

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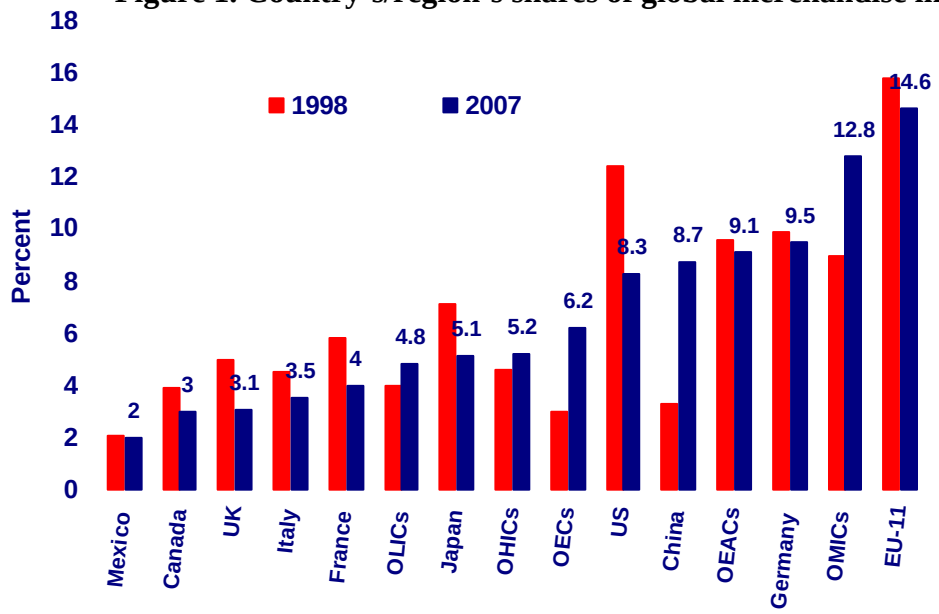
collected according to the HS 2002 and then converted to older classifications, which might affect the allocation of some commodities. To be consistent and use the more recent data, we have used HS 2002 data in this paper.

[6] Note that even carrying out NAICS 3-digit industries would be too many for presentation purpose as there are total of 29 NAICS 3-digit merchandise industries: 8 in agriculture, fishing, forestry and mining and 21 in manufacturing.

countries/partners, (3) industry composition of major trading countries/regions' exports to the US, and (4) any difference in the performance of the US trading partners in terms of relatively medium- and high-tech (MHT) and low-tech (LT) industries.

Figure 1. Country's/region's shares of global merchandise imports (percent)



Source: World Trade Organization

In 2007, world total merchandise exports were worth US$14 trillion, an annual increase of 17% from total global exports of US$5.5 trillions in 1998. US was the largest exporter country occupying about 12% of world's merchandise exports in 1998 when China's share was meager to 3% (Figure 1). In 2007, the situation has changed drastically. Germany and China became the first and the second largest suppliers of world merchandise, pushing US at the third place. Canada's share of global imports has fallen by 1 percentage-point (from 3.9% in 1998 to 3% in 2007), a share drop by about 25%. All other G-7 countries, Italy, UK and France and Japan have also lost their shares in the range of 1-2 percentage-points. The only exception is German whose share dropped only slightly from 9.9% to 9.5% during this period. The other global export share gainers have been OHICs and OMICs. In 2007, China was the second largest player in the world after Germany, even surpassing the US.

III. 1. Market share in the US

Turning to the US market, in 2007, with total merchandise imports of US$14.3 trillion, US consumed about 15% of the world imports. Capturing the US, the single largest export and the most dynamic market in the world, could be a priority for trading countries. However, due to various domestic and international factors, the importance of different countries as suppliers of US imports have changed over time, as shown in Table 1, where we provide the countries/regions' shares of US imports for three years (1990, 1998 and 2007).

The LICs have increased their shares by 16 percentage-points, from 8% in 1990 to almost 24% in 2007. However, almost all of this increase (close to 90%) is due to China, whose share of US imports increased by 14 percentage-points in 2007 compared to the situation in 1990, a 445% increase. Even though China's had stellar performance at the global export market as seen in Figure 1 above, its export performance in the US was even stronger. In 2007, China's share in the US import market (17%) was just double its share in the world imports (8.7%). China was the single largest supplier country to the US in 2007, whose market share in US imports was almost as high as that of EU-15.

During the period 1990 to 2007, as a group, the MICs gained US market share by 6 percentage-points, and the increase was mainly from Mexico. The increase occurred in the 1990s whereas since 1998 Mexico's share in the US, as in the world market, has stagnated. Since LICs and MICs together gained total of 22 percentage-points share of the US market, the loss was incurred by HICs. All five sub-groups in HICs (Canada, Japan, EU-15, OEACs and OHICs), lost their market shares, and the largest losers were OEACs. Canada's share has fallen by two

percentage-points in 2007 compared to the situation in 1990 and by three percentage-points compared to the situation in 1998.

Table 1. Countries-regions' shares in US imports (percent)

	Shares			Share changes from 1990 to 2007	
Country/region	**1990**	**1998**	**2007**	**Absolute**	**Percent growth**
Low Income Countries	**8.2**	**13.7**	**23.8**	**16**	**190**
China	3.1	8.0	16.9	14	445
Other low income countries	5.1	5.7	6.9	2	35
Middle Income Countries	**21.6**	**22.9**	**27.9**	**6**	**29**
Oil Exporters	3.7	1.7	3.9	0	5
Mexico	5.8	10.2	10.6	5	83
Other middle income countries	12.1	11.0	13.4	1	8
High Income Countries	**70.1**	**63.1**	**48.3**	**-22**	**-31**
Canada	17.9	18.8	15.7	-2	-12
Japan	17.4	13.2	7.4	-10	-57
EU-15	19.9	19.3	17.4	-3	-13
EU-11	5.2	5.1	5.8	1	12
France	2.6	2.6	2.1	-1	-19
Germany	5.5	5.4	4.8	-1	-13
Italy	2.6	2.3	1.8	-1	-31
UK	4.0	3.8	2.9	-1	-28
Other east-Asian countries	11.9	9.4	5.7	-6	-52
Other high income countries	2.9	2.3	2.0	-1	-31
Total	**100**	**100**	**100**	**-**	**-**

These shares are computed aggregate data on country's US imports from United States International Trade Commission (USITC), as it has data on 2007. To check the consistency of the product level data, we computed these shares using HS 10-digit product level data for year 2006 (the most recent year that these data are available), and compared those shares with USITC's 2006 aggregate data, the shares were similar whether using aggregate or product level data. That means that the data at product level that we will be using later are consistent with the aggregate data.
Source: US International Trade Commission Database

The percentage-point share drop has been quite dramatic for Japan from 17.4% in 1990 to 7.4% in 2007. The share of EU-15 has also declined slightly, and the four members of EU-15 that are shown in the table (France, Germany, Italy and UK) and other EU-11 countries have followed the similar patterns. The share drop of Japan and OEACs in 2007 compared to their situation in 1998 is larger than 8.9 percentage-points share increase of China during the same period.

III. 2. Industry and country/region composition of US imports

Next, we look at the industry importance in US imports in Table 2 by 14 industries. Among them the first and second industries represent the agriculture and mining sector, respectively. The remaining 12 are manufacturing industries. Among them, six are NAICS 3-digit industries (those with 3-digit entries in the first column). The remaining six industry groups combine total of 15 NAICS 3-digit industries. Four of them combine two NAICS 3-digit industries each (with entries of 311-312; 326-327; 331-332, and 337 and 339 in the first column); one combines three NAICS 3-digit industries (with entries of 321, 322 and 323), and one combines four NAICS 3-digit industries (with entries of 313, 314, 315 and 316). The relative individual importance of these combined industries in terms of export values is small.[7] In 2007, four NAICS 3-digit industries (mining, oil and gas; transport; computer; machinery; chemical) constitutes more than half (55%) of US total merchandise imports.

There is some industrial restructuring in the sense of value of imports in two time periods. There are two industries whose share has increased substantially in 2007 compared to the situation in 1990. The share of mining and oil and gas extraction industry increased by 5.2 percentage-points, and that of chemical industry increased by 3.5 percentage-points. The industry that has declined its importance in terms of imports is transport equipment, whose share has fallen by 4.2 percentage points from 19.3% in 1990 to 15.1% in 2007. The share of petroleum

[7] In 2007, among NAICS 311-312 group of industries, industry 311 (food) had share of 1.9% and 312 (beverage and tobacco) had share of 0.9%. In the 313-316 category, 313 (textiles mills products) had share of 0.5%, 314 (textile mills) had 0.7%, 315 (clothing) had substantial share of 4.1% and NAICS 316 (leather and allied products) had share of 1.5%. Similarly, in 326 (plastics and rubber) and 327 (non-metallic mineral), the respective shares were 1.8% and 1.1%. In metal industries, 331 (primary metal) had the larger share of 4.6% compared to 2.6% of 332 (fabricated metal products). In the last category, 337 & 339, the share of 337 (furniture and related industry) was only 1.4%, the share 5.3% was from 339 (miscellaneous) and 4% is antique products.

and coal products in total US imports also declined by 2.8 percentage points during the same periods.

Table 2. Distribution of US imports by NAICS industries – 1990 & 2007 (in percent)

NAICS – 3 digit	NAICS – 3 digit Description	1990	2007	2007 minus 1990
11	Agriculture, Forestry, Fishing and Hunting	3.2	2.2	-1.0
21	Mining and Oil and Gas Extraction	11.0	16.2	5.2
311-312	Food; Beverage and Tobacco	3.6	3.1	-0.5
313-316	Textile; Clothing; Leather	9.5	7.6	-1.9
321-323	Wood; Paper; Printing	4.1	2.9	-1.2
324	Petroleum and Coal Products	7.3	4.5	-2.8
325	Chemical	4.9	8.4	3.5
326-327	Plastics and Rubber; Non-metallic Mineral	3.0	3.2	0.2
331-332	Primary Metal; Fabricated Metal Product	7.3	8.0	-0.7
333	Machinery	8.6	10.0	1.4
334	Computer and Electronic Product	15.0	14.8	-0.2
335	Electrical Equipment, Appliance and Component	3.1	4.0	0.9
336	Transportation Equipment	19.3	15.1	-4.2
337 and 339	Furniture and Related; Miscellaneous	10.3	12.0	1.7
	Total	**100**	**100**	**0**

Source: US International Trade Commission Database

Table 3 provides trading country/region's share of US imports by industry. Among the seven countries/regions reported in the table, Canada is the largest US supplier in five (group of), industries as indicated by bold entries. In group of industries (wood, paper and printing), Canada supplies almost half (47.6%) of the US imports. The remaining share is contributed by other countries, such as (16.9%) by China, 14.3% by rest of the world (ROW) etc. China is a largest supplier of the same number (group) of industries including computer and electrical equipment (again indicated by bold entries) industries. In each of these two industries, one-third of US imports are supplied by China. In textile-clothing and leather, China supplies 42% the US imports. China is the second largest US supplier in machinery. For all the remaining four (group of) industries that Canada and China are not the largest suppliers, EU-15 was the largest supplier.

Table 3. Country's/region's share of US imports by industry, 2007 (percent)

NAICS – 3 digit Description	Canada	China	Mexico	Japan	OEAC	EU-15	ROW[1]	Total
Agri., Forestry, Fishing and Hunting	**19.6**	5.8	15.5	0.7	0.9	4.1	53.4	100
Mining and Oil and Gas Extraction	**22.4**	0.2	10.8	0.0	0.0	1.0	65.6	100

Food; Beverage and Tobacco	18.9	5.2	9.9	0.7	1.1	**30.0**	34.2	100
Textile; Clothing; Leather	1.9	**42.4**	4.9	0.4	4.3	6.2	39.9	100
Wood; Paper; Printing	**47.6**	16.9	3.3	1.5	3.4	13.0	14.3	100
Petroleum and Coal Products	15.6	0.4	4.0	1.6	7.0	**27.2**	44.2	100
Chemical	15.4	4.5	2.4	5.4	4.6	**51.3**	16.4	100
Plastics and Rubber; Non-metallic Mineral	17.0	**29.5**	8.9	6.0	6.9	17.2	14.5	100
Primary Metal; Fabricated Metal Product	**21.7**	15.4	8.5	4.6	6.4	17.0	26.4	100
Machinery	8.8	22.7	8.2	16.5	5.4	**25.8**	12.6	100
Computer and Electronic Product	3.5	**32.3**	16.3	8.5	15.1	8.4	15.9	100
Electrical Equip., Appli. & Component	6.9	**34.1**	23.6	6.9	6.6	13.5	8.4	100
Transportation Equipment	**26.7**	3.0	15.6	22.9	5.5	22.0	4.3	100
Furniture and Related; Miscellaneous	12.4	**28.6**	8.9	3.9	5.1	19.5	21.6	100
Total	**15.7**	**16.9**	**10.6**	**7.4**	**5.7**	**17.4**	**26.3**	**100**

[1]ROW stands for rest of the world
Source: US International Trade Commission Database

To examine whether there is a change in country/region's market share over time, we provide information in Table 4 using change in market shares between 1998 and 2007. But instead of providing information on all 14 industries, we combine them into two groups. Group 1 contains mainly agriculture, mining, metal and petroleum and textile related industries. They can be characterized as high natural resource content, relatively more labor intensive and low R&D intensive industries. Group 2 includes industries such as machinery, computer, electrical equipment, chemical and transportation equipment. These are the industries which are more R&D intensive and probably have higher value added. The set of industries in Group 1 is considered as LT, whereas the set of industries in Group 2 are considered as MHT.

The first three columns are constructed based on the same data that were used for Table 3 (the third column is the last row in Table 3). Results show that in 2007 Canada had US import market share of 17.8% in group 1 and 13.4% in group 2, with aggregate share of 15.7%. The next panel of three columns shows what changes were seen in 2007 based on the data in 1998. For example, the entry of negative 4.1 percentage-points (fourth column) means in 1998 Canada had US import share of 17.5 (=13.4 + 4.1) in Group 2. In total Canada's loss of US market share was 2.8 percentage-points as given in the last column. Hence, Canada not only lost market share

in the US market in both groups (actually the loss was across all 14 industries except for agriculture), the loss was larger in Group 2 industries.

Table 4. Country-region's gain and loss in market shares in 2007 from 1998

	2007			Difference between 2007 and 1998		
	Group 1*	**Group 2***	**Aggregate**	**Group 1***	**Group 2***	**Aggregate**
Canada	17.8	13.4	15.7	-1.9	-4.1	-2.8
China	16.1	17.7	16.9	5.1	12.4	8.9
Mexico	8.5	12.9	10.6	-0.1	1.3	0.4
Japan	2.0	13.5	7.4	-2.6	-7.1	-5.8
OEAC	3.6	8.1	5.7	-3.4	-3.3	-3.7
EU-15	12.6	22.9	17.4	-3.0	0.4	-1.9
ROW	39.4	11.4	26.3	5.9	0.3	5.9
Total	**100**	**100**	**100**	**-**	**-**	**-**

[1]ROW stands for rest of the world.
* Group 1 includes (1) Agriculture, Forestry, Fishing and Hunting (2) Mining and Oil and Gas Extraction (3) Food; Beverage and Tobacco (4) Textile; Clothing; Leather (5) Wood; Paper; Printing (6) Petroleum and Coal Products (7) Plastics and Rubber; Non-metallic Mineral (8) Metal (primary and fabricated) Product and (9) Furniture and Related; Miscellaneous industries. Group 2 includes (1) Chemical (2) Machinery (3) Computer and Electronic Product and (4) Electrical Equip., Appliance and Component and (5) Transportation Equipment industries.

Source: US International Trade Commission Database

The case of China was just the reverse; it gained US market share across all 14 industries, and the gain in Group 2 was much larger. In period of ten years, China's share gain in the US was 8.9 percentage-points and that was achieved by 12.4 percentage-points share increase in Group 2 and 5 percentage-points share increase in Group 1. Looking at Mexico, even though its share of US import market, at the aggregate, increased by only marginally, its share in US imports in MHT industries rose by 1.3 percentage-points.

The market share loss of OEACs was almost symmetric between two groups of industries, whereas Japan's loss was highly concentrated in Group 2 industries. On the other hand, the loss of EU-15 in the US market share was confined mainly on group 1 industries.

Interestingly, out of four industries in Group 2, in three industries (machinery, computer and electronic products and electrical equipment, appliances and component), Canada, Japan, EU-15 and OEACs lost their market shares to China. Mexico sustained its market share in two

industries with a slight gain in computer industry. In transport sector the share gains were recorded for China, Mexico and OEACs.

III. 3. Composition of suppliers' exports to the US

The above two tables provided information on country/region performance from the US side. In the next two tables, we present information looking from the source country's total exports. In other words, we evaluate what structural changes a country has been through in terms of its industry composition in its exports to the US. The results for 2007 are given in Table 5. For example, transport equipment industry occupies the largest (22.8%) share in Canada's total exports to the US followed by 20.6% by mining and oil and gas extraction industry, with two industries' combined share of 45%.

In terms of its own composition, China's major supplies to the US are from cloth related, machinery and computer industries. Interestingly, one-quarter of US imports from China is in computer industry (the industry contributes less than 3% of Canada's total exports to the US). We saw from Table 2 that computer industry is one of the biggest US importers (14.8% of total US imports). In this industry, Mexico's performance is also impressive; in every five dollar of US imports from Mexico, one dollar is in computer industry. However value wise, US imports from China in this industry is almost double of that from Mexico. The computer industry constitutes more than one-third of US imports from OEACs.

For EU-15, the largest industry share of US imports is on chemical (22%), followed by transport equipment (17%) and machinery industry. Almost half of Japan's exports to the US (41.6%) are in transport equipment industry. The other industries that are important for Japan's exports are machinery and computer and electronic product industries.

Table 5. Industry distribution of US imports by trading partners, 2007 (percent)

NAICS – 3 digit Description	Canada	China	Mexico	Japan	OEAC	EU-15
Agriculture, Forestry, Fishing and Hunting	2.5	0.7	2.9	0.2	0.3	0.5
Mining and Oil and Gas Extraction	20.6	0.2	14.9	0.0	0.0	0.8
Food; Beverage and Tobacco	3.3	0.8	2.6	0.3	0.5	4.8
Textile; Clothing; Leather	0.8	17.0	3.1	0.4	5.1	2.4
Wood; Paper; Printing	7.7	2.6	0.8	0.5	1.5	1.9
Petroleum and Coal Products	4.0	0.1	1.5	0.8	4.9	6.2
Chemical	7.4	2.0	1.7	5.5	6.0	22.1
Plastics and Rubber; Non-metallic Mineral	3.1	5.0	2.4	2.3	3.5	2.8
Primary Metal; Fabricated Metal Product	9.9	6.5	5.7	4.5	8.1	7.0
Machinery	5.0	12.0	6.9	19.8	8.5	13.2
Computer and Electronic Product	2.9	25.3	20.4	15.1	35.0	6.4
Electrical Equip., Appliance and Component	1.6	7.3	8.1	3.3	4.2	2.8
Transportation Equipment	22.8	2.4	19.8	41.6	12.9	17.0
Furniture and Related; Miscellaneous	8.5	18.2	9.0	5.6	9.6	12.0
Total	100	100	100	100	100	100

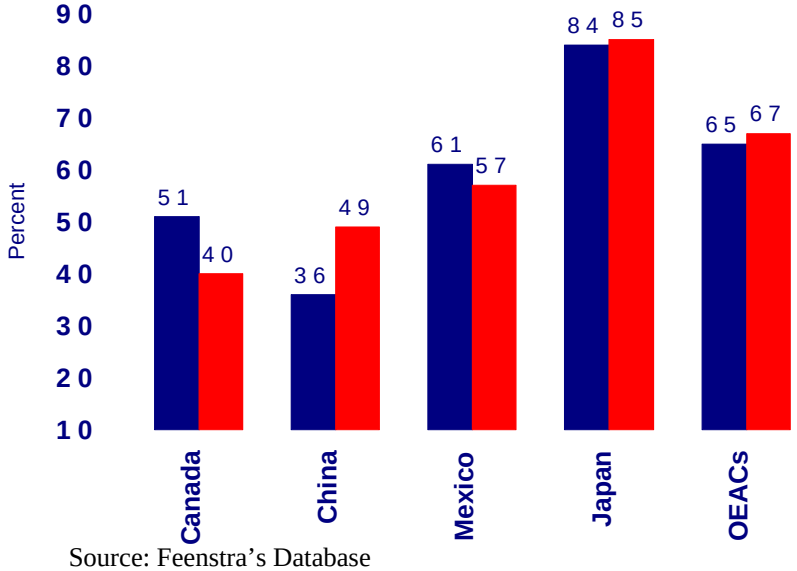
Source: US International Trade Commission Database

Has there been any change in the industry composition of partner country's exports to the US? We provide that information in Figure 2, where we provide the share of Group 2 industries for two years. In Canada's total exports to the US, these industries used to contribute 51% in 1998 and fell to 40% in 2007, an 11 percentage-points restructuring from Group 2 to Group 1. Hence between 1998 and 2006, Canada's export composition turned from majority being in MHT industries to majority being in LT industries. Almost all industries, except the chemical in Group 2 experienced the share losses in 2007. The biggest share loss was in transportation equipment industry (8.7 percentage-points), as the share of this industry in Canada's total exports fell to 22.8% in 2007 from 31.5% in 1998. The other industry that has substantial share loss in 2007 was at computer and electronic product industry; it lost the share by 3.4 percentage-points. Among Group 1 industries, the share of mining and oil and gas extraction increased by 13.3 percentage points. The other industry that saw increase in share is petroleum and coal product industry.

On the other hand, for China's exports to the US, the share of group 2 industries increased from 36% in 1998 to 49% in 2007. It turns out that for every dollar of China's exports

to the US, about 50 cents is earned in MHT industries, whereas for every dollar of Canada's exports only 40 cents is earned by these industries. China's major share increase in 2007 compared to the situation in 1998 was reported in machinery (7.5 percentage-points) and computer and electronic products (5.2 percentage-points). Interestingly, despite massive increase in China's exports in textile and clothing related industries in 2007, the share of this group of industries fell by 8.6 percentage-points in 2007 compared to the situation in 1998 as a result of larger increase in China's exports in other industries.

Figure 2. Share of Group 2 industries in total exports to the US (percent)



Source: Feenstra's Database

The share of transportation equipment in Japan's total merchandise export to the US increased by 11.6 percentage-points and that of OEACs increased by 8.2 percentage-points in 2007, compared to the situation in 1998. These are the only two partners whose shares rose substantially in this industry. It appears to be the case that the share increase of Japan was due to Japan's weaker performance in exports to the US in other industries rather than its increased market share in the US in this industry. Data shows that Japan's constituted about 23% of US imports in this industry in both 1998 and 2007. On the contrary, in case of OEACs, they were

able to increase their market share in the US imports in transport equipment industry, the share increased from 2.6% in 1998 to 5.5% in 2007.

The share of computer and electronic product industry in each country's/region's total exports to the US fell in 2007 (from 1998) for all partners except for China, in which case the share of this industry increased by 5 percentage-points.

To sum up, the biggest story of US import market is generated by China. It has increased its share in US imports on almost all industries and more so in MHT industries. Canada is losing its market share over time, and the loss is more pronounced in MHT industries. This has happened despite the fact that the share of MHT industries in total US imports has remained more or less stable over time at about half of the US imports. As it stands, Canada remains a major US supplier mainly in LT industries such as mining, agriculture and wood related products except for transport equipment, a MHT industry. All other major trading partners also have lost their market shares in the US, as Chinese products drove them out of US markets. China' exports growth in the international market, and especially in the US, has been phenomenal. China is the largest supplier of not only the most expected textile and clothing industries, but also of computer and electrical equipment and appliance industries in the US.

IV. Decomposing Export Value into Quantity and Price

So far, we concentrated at the aggregate industry level data. In this section, we take the advantage of the disaggregate data that we have. One of the novelties of the paper is that it uses the US imports from all partner countries in the world at the most detail HS 10-digit level. There are very few papers (with the exception of Schott, 2004 and 2009) that use such detail data. Schott uses this dataset to study the product specialization and China's relative performance in

the US market, respectively. For the product level analysis, we base our study for years 1998 and 2006 (the last year that HS 10-digit product level data were available while writing the paper). In the above analysis, we saw that many countries including Canada lost their market shares in the US. The share of a country in a foreign market falls if the exports of that country are not rising as fast as those of its competitors. For country *c* at year *t*, its total export (*X*) to the US can be decomposed into following three components:

(1) $$X_{ct} = \sum_{p} \left(N_{cpt} \times Q_{cpt} \times U_{cpt} \right)$$

where *p* denotes product; *N* is number of products exported by country *c*; *Q* is the quantity of each exported product, and *U* is the unit price of each exported product. And the share of a country in the US imports is given by $X_{ct} \Big/ \sum_{c} X_{ct}$. Now if the numerator is not increasing in the same proportion as the denominator, then county *c* loses its market share at the benefit of other competitors. Hence, the fall in market share of a country can be decomposed to the contributions of *N*, *Q* and *U*. Over time, the number of products that a country exports in foreign market, *N*, depends on number of old products it continues selling and the number of new products it introduces. If a country is facing market dropping for some of its old products and is not able to introduce as many new products as its competitors, then it loses the market share unless the loss if fully compensated by higher sale of other products or higher unit value of the unit sold. Hence, in what follows we investigate what has been the performance of the major US trading partners in terms of this quantity-price decomposition. We analyze the number of products and the unit price but leave the third component, the quantity of products, out of the discussion. The reason for this exclusion is that as we will be dealing with about 16,000 products imported in the US each year, and most of these products have different units of measurement. Hence, it is not

possible to develop any aggregate index to measure the change in the quantity of the products in two time periods. However, the good news is that using the residual concept, anything not explained by the number of products and the unit price can be automatically subscribed to the quantity. First we start product dynamics which is measured by (1) product penetration, (2) product overlap and (3) product churning (product dropping and adding) between pair of countries.

IV. 1. Product penetration

As shown in Appendix B, at the HS 10-digit level, there were total of 16,326 products in 1990 and 16,968 products in 2006 that were imported in the US.[8] The HS 10-digit is the most disaggregate level of import records available for the US. As we see from the product example column in the Appendix, these are fine level of detail entries. Looking by industry, the largest number of product counts (about 13%) is in chemical industry, with 2147 products in 2006. As is the case with total product counts, the numbers of products have increased slightly in all industries in 2006 compared to the situation in 1998, except for slight fall in mining and oil and gas industry and computer and electronic industry. However, the difference between numbers of product counts between two years may not be equal to new products as the HS codes reporting are updated so that some families of the products expand and others shrink over time as the statistical agencies change the product definitions (see Pierce and Schott (2009) on growing and shrinking nature of product tree).

Each of these about 16,000 products could have been imported to the US either from one or more than one trading partner. At this level of detail, imports of a particular product (at HS

[8] Here we provide number of products for all 21 NAICS 3-digit manufacturing industries separately, instead of combining them into 12 industries, as is done for the rest of the paper.

10-digit level), from each country can be regarded as vertically different variety in that product category, which might be substitutable but not perfectly as quality (price) differs by source country.

Based on these data, we compute product penetration rate of each country/region in the US market for 1990 and 2006. For county *c*, industry *i* (we have 14 of them) in time period *t*, product penetration rate, p_{cit}, is computed as:

(2) $$p_{cit} = \frac{N_{cit}}{\sum_c N_{cit}} \times 100,$$

where N_{cit} is the number of products US imports from country/region *c* in industry *i* at time period *t*, and $\sum_c N_{cit}$ is the total number of products that US imports from the world in industry *i* in year *t*. To compute penetration rate for a region, the numerator would be the sum of the number of products across countries in the region. The result by industry for all US trading partners is given in Appendix C. The aggregate levels of penetration for 1998 and 2006 are reproduced in the first two columns of Table 6.

In both years, EU-15 had the largest penetration rate at 89% in 1998 and 87% in 2006. Canada had the second highest penetration in 1998 (73%), implying that out of the total product counts of 16,326 imported in the US at HS 10-digits level, 73% of them were also exported by Canada. In 2006, Canada's second highest position in terms of penetration rate was taken over by China with 77% (compared to 70% for Canada). 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 products in 1998 to 13,123 products in 2006, making China as the supplier of largest product counts to the US compared to any other countries in the world.

Table 6. Product penetration rate in the US market, by trading partners (percent)

Country/region	Penetration		Share of sole supplied products			
			Number		US Import value	
	1998	2006	1998	2006	1998	2006
Canada	73	70	1.8	1.8	0.16	0.29
China	57	77	0.3	0.7	0	0
EU-15	89	87	2.7	1.9	0.17	0
Japan	60	59	0.2	0.1	0	0
Mexico	52	52	0.3	0.4	0.01	0.01
OEACs	63	64	0.2	0.2	0	0
OHICs	36	37	0.2	0.2	0	0.02
OMICs	69	75	0.4	0.6	0.01	0.02
OLICs	68	72	0.6	0.7	0.58	0
Total	**-**	**-**	**6.7**	**6.6**	**0.93**	**0.34**

Source: Feenstra's Database

The penetration rate of OMICs and OLICs also increased substantially but not as much as that of China. The change in product penetration for OEACs and OHICs were minimal (but at the positive side). Among the major trading country/region, Canada was the country which experienced the largest (3 percentage-points) drop in its penetration rate. The loss for the EU-15 was 2 percentage-points and that for Japan, one percentage-point.

Using the penetration rates for two periods given in Appendix C, we can calculate the change in penetration rate by industry in year 2006 from year 1998. It is quite remarkable that China has increased its product penetration across-the-board. The increment ranges from 11 percentage-points in computer industry to 28 percentage-points in chemical industry. As a result, China's product penetration rates were more than 90% for the following four industries in 2006: (1) plastics and rubber (96%) (2) electrical equipment, appliances and component (96%), computer and electronic products (92%) and (4) furniture and related; miscellaneous; antiques (90%). The three industries textile-clothing and leather combined had penetration rate of 85%.

Hence one of the reasons for the massive increase in China's exports to the US at the industry level analysis (above) was the introduction of new products by China. China has massively increased its penetration rate, by about 2.5 percentage-points each year. If pace continues, China's penetration rate would reach the level of EU-15 by 2010. Canada, on the

other hand, lost the penetration rate almost across all industries, except for negligible growth in a couple of industries. The loss was highest in food and textile industries (at 6 percentage points) followed by transport and petroleum industries (5 percentage-points) each. So, for Canada, the disappearance of its products from the US market in more recent years should have contributed to the loss of Canada's market share in the US.

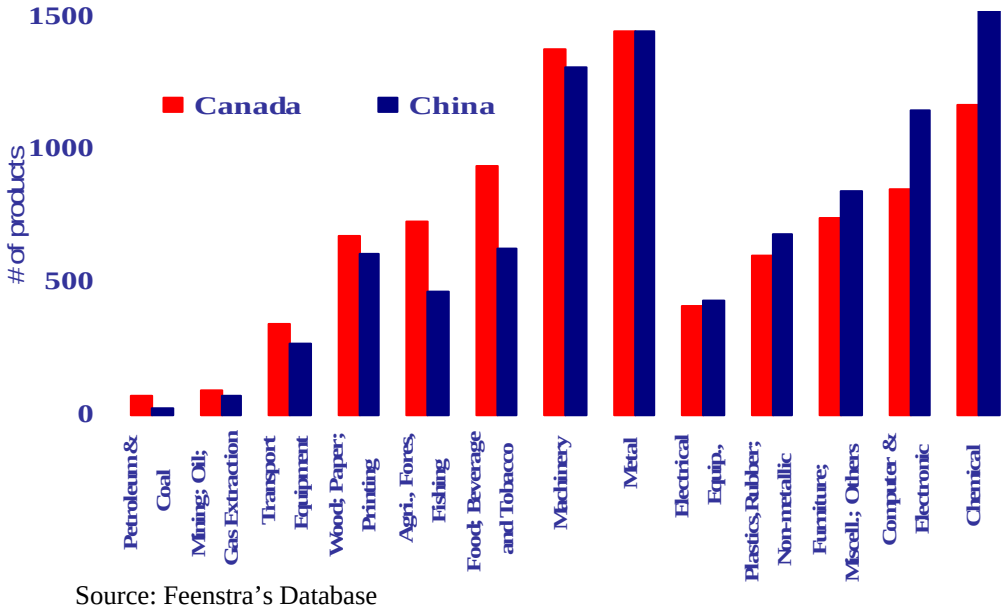
To have a comparative picture of Canada and China, in what follows, we compare the number of products that two countries exported to the US in 2006 (Figure 3). We have excluded textile; clothing and leather industries, which have very large number of products for China, to make the message of the graph clearer.[9] Except for the textile; clothing and leather industries, the numbers of products that China exports to the US are more than that of Canada in the right most five industries. Note that in three of the five industries that are considered relatively MHT China's numbers of products have surpassed that of Canada. In the remaining two MHT industries, the difference in the number of products supplied by Canada and China in machinery is minimal and in transport too, China has started to pick up quickly (its penetration in this industry increased by 16 percentage-points in 2006 compared to the situation in 1998).

Somewhat different way of looking at the penetration rate is to examine the product counts that are solely supplied, single supplier of a product. In the second panel of Table 6 we present the share of product counts by sole suppliers and the share of these products in total US import value. Only very few products have sole supplier. For example, in 2006, Canada was a sole supplier of only 1.8% of the number of products imported in the US, and it constituted only 0.29% of total US import amount from the world. Altogether only 6.6% of the product counts

[9] We have excluded textile; clothing and leather industries, which have very large number of products supplied from China, to make the message of the graph clearer. The combined number of product counts in these industries was 3528 for China (and 2419 for Canada). The absolute large number of product counts in these industries vis-à-vis the

were supplied by sole supplier, and they constituted only 0.34% of the total US imports. The finding that there are only very limited number of products by sole supplier even at such a disaggregate level of data means that the competition in the US market is tough, as several countries are supplying varieties (close substitutes).

Figure 3. Number of products sold in the US markets in 2006



Source: Feenstra's Database

IV. 2. Product churning

The low penetration rates for Canada and high for China in 2006 compared to their respective situations in 1998 are the results of each country's product churning in the US market measured by dropping (exit) of previously supplied products and adding (entry) of new products. In this sub-section, we present results for product churning for year 2006 based on the situation in 1998. The number of products exported by any country in two time periods (*t* and *t+1*) are related in following way:

counts of other industries make the graph less revealing for other industries if these industries are included in the graph.

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

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_{ct+1} is the number of new products that were not exported in year *t* but were exported in year *t+1*. The numbers of products given by $N_{ct} - D_{ct+1}$ are continuous products in a sense that they were exported in both *t* and *t+1*. Hence, equation (3) can be written as:

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

where C_{ct+1} is number of continuous products. The higher the number of continuous products for a country, it larger are the number of products that survived in the US market over time. And similarly, higher the number of new entry, the larger is the product-space the country is taking in the US market. Diving by total number of products exported by each country/region in 1998 to the number of continuous and new products in 2006, we present results in Table 7 under continuity rate and adding rate, respectively. Since some of the HS 10-digit products are listed under different product numbers, we use concordance developed by Pierce and Schott (2009), so that all products are aligned in both years.

For Canada, only 87% of the products that were exported to the US in 1998 survived in 2006; 13% of the products were driven out (dropping rate) in 2006. On the other hand, China not only carried 96% of the products in 2006; it added 40% new products compared to the number of products it exported in 1998. In Canada's case, only 11% products were added in 2006. So, the dropping rate was relatively high, and the adding rate was relatively low for Canada, whereas the opposite was true for China. Except for EU-15, the product-adding rate was the lowest for

Canada among the group of country/region shown in Table 7. Hence, the lower penetration rate for Canada in 2006 compared to the situation in 1998 seen above has been contributed by high product-dropping and low product-adding.

Table 7. Share of product churning between 1998 and 2006 (percent)

	Canada	China	Mexico	Japan	EU-15	OEACs
Continuity rate	87	96	81	85	95	88
Adding rate	11	40	19	15	5	16

Note: Since those products that have different HS 10-digit numbers in two years have to be concorded using family ID rather than at HS 10-digit, and one family ID could have more than one HS 10-digit products, the number of products used for computing this table are slightly lower than the total HS 10 digit products that were exported by the country to the US. For example, for Canada, instead of total number of products 11,864 that Canada exported to the US in 1998, the count for this table were, 8,983. Similarly, compared to the total number of products 11,869 that Canada exported in the US in 2006, the counts used for this table were 8,786. Similar proportion applies to other country/region as well.

Source: Feenstra's Database

A similar computation by industry is given in Table 8. For some industries, Canada's product continuity rate is as low as 78%, indicating high product-dropping rates. For example, the dropping rate for mining and oil and gas extraction industry was 22%; that for chemical industry, it was 20%, and for computer and electronic products industry, it was 15%. For two of these three industries, the adding rates were also high but for computer and electronic product industry, the adding rate was not high either; it was only 11%. For China, the adding rates are quite high in all industries, and higher than those of Canada in all industries. In transport equipment industry where Canada's strength in the US market is weakening, China's both continuity rate and adding rate were higher. For Mexico, both dropping rate and adding rate are higher than that of Canada for most of the industries.

Table 8. Share of product churning rates between 1998 and 2006 by industry (percent)

NAICS – industries	Canada		China		Mexico	
	Continuity	**Adding**	**Continuity**	**Adding**	**Continuity**	**Adding**
Agriculture, Forestry, Fishing and Hunting	90	11	88	60	79	14
Mining and Oil and Gas Extraction	78	25	88	55	78	25
Food; Beverage and Tobacco	85	10	90	66	75	31
Textile; Clothing; Leather	81	13	98	51	78	20
Wood; Paper; Printing	96	8	99	46	80	20
Petroleum and Coal Products	98	16	73	127	74	30
Chemical	80	19	94	59	73	24
Plastics and Rubber; Non-metallic Mineral	93	8	99	14	88	9
Primary Metal; Fabricated Metal Product	93	7	96	38	84	18
Machinery	93	7	95	46	82	24
Computer and Electronic Product	85	11	96	12	88	23
Electrical Equip., Appliance & Component	94	7	99	15	93	9
Transportation Equipment	92	5	96	26	82	12
Furniture and Related; Miscellaneous	89	6	97	9	85	12
Total	**87**	**11**	**96**	**40**	**81**	**19**

Source: Feenstra's Database

IV. 3. Product overlaps

The other concept related to product penetration and product churning is product overlap: the number of same products sold by two competitors. 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) $$O_{ct} = \frac{N_{cc'pt}}{N_{cpt}} \times 100$$

where O_{ct} is product overlap; $N_{cc'pt}$ is the number of products that both countries *c* and *c'* sell in the US, and N_{cpt} is the total number of products sold by country *c* in the US. This measure provides the share of products that country *c'* is able to overlap with the products sold by country *c*. The higher the number for this measure, larger are the number of products that country *c* is competing with products of country *c'*, hence higher the competition between these two countries. The product overlap of Country *c* with respect to country *c'* is obtained with the same

numerator but the denominator being the total products sold by country *c'* in the US. We present the results in Table 9.

In 1998, China exported 62% (entry in column "Canada and row "China" under 1998) of the product that Canada was exporting. At that time, the trading region with highest common products with Canadian exports was EU-15; 92% of the products that Canada was selling were also sold by EU-15. Comparing the entry in row "China" for two years, one could see that China has increased its product overlaps with respect to all four groups by about 20 percentage-points. In case of Canada, 83% of Canada's export products were overlapped by China (an increase of 21 percentage-points) in 2006. Canada, on the other hand, used to export 80% of the products that China was selling in 1998 (see the entry in row "Canada" and column "China") which fell by about five percentage-points in 2006 at 75%. Canada's product overlaps with other three countries/regions remain more or less the same (reading through row "Canada" for two years).

Table 9. Product overlap rate (percent)

	1998					**2006**				
	Canada	**China**	**Mexico**	**Japan**	**EU-15**	**Canada**	**China**	**Mexico**	**Japan**	**EU-15**
Canada	***100***	80	87	81	75	***100***	75	86	81	73
China	62	***100***	72	70	61	83	***100***	89	90	83
Mexico	63	67	***100***	63	56	64	60	***100***	65	56
Japan	66	74	72	***100***	65	67	68	73	***100***	65
EU-15	92	96	95	97	***100***	91	93	95	97	***100***

Note: Since this table did not require concordance between two yeas, it is computed using total number of products each country/region exported to the US (out of those about 16,000). For example, in case of Canada in 2006, the total number of products it exported was 11,869 and among them, China exported 9,858; Mexico exported 7,586; Japan exported 8010, and EU-15 exported 10821. In 1998, the total number of products that Canada exported was equal to 11,864.

Source: Feenstra's Database

To sum up, the number of products sold in the US market fell for Canada in relative sense as its product penetration rate declined over time. At least some of the explanation for Canada's declining share of US import markets can be attributed to its product dropping and not so much success in product adding/entry. Put differently, Canada is being able neither to retain some of its

products in the US market (as competitors, mainly China and to some extent Mexico and other countries, are driving them out) nor to introduce new products. As a solution, it appears that Canada has either to lower the cost of its products to be competitive or has to introduce new products that are not produced by its competitors. The bottom line is that Canada has to win the market by being more innovative (either process or product). If Canadian companies cannot perform relatively better than other competitors in product and process innovation, Canada's share in the US market will continue to fall. The process has just started and will deepen in the future.

Despite the fact that most of the countries/regions are increasing their penetration and overlap rates in the US market, are they becoming more similar in terms of their trade patterns? Which are the countries with more similar trade patterns in the US? We will deal with these issues in the following section.

V. Export Similarity Index

In this section, we will discuss Canada and its competitors' similarity in the US market by using countries' or regions' export bundle overlap via Finger and Kreinin's (1979) export similarity index (ESI). This index combines the information about both product overlaps between two countries and importance of a product in each country's export bundle. This index is also used by Schott (2006) to compute China's ESI. For any two US trading partner countries, *c* and *c'*, in year *t*, Finger and Kreinin define it as follows:

(5) $$ESI_{cc't} = \sum_{p} \min\left(s_{cpt}, s_{c'pt}\right)$$

where s_{cpt} is product *p*'s share in total exports of country *c* in the US in year *t*. Similarly, $s_{c'pt}$ is the same share of country *c'*. Using this formula, we compute ESI for any country/region that trade with the US with all other remaining US trading partners. 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 export revenue is 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) rather than each country's exports in the region. This index can be computed using either all products or products by industry. Here, we present index at the aggregate using all products (industry-wise results are not presented). Since we will be using most disaggregate product category (comparing more than 16,000 product shares for each pair of country/region), the results have no aggregation bias, and they provide a clear picture of the export similarity for each pair of competitors in the US.

The ESI results for Canada, China, Mexico, Japan, and EU-15 for years 1998 and 2006 are given in Table 10. The table could best be read through column-heading, from the top to the bottom. The first two columns measure Canada's ESI with respect to all countries/regions listed as row-headings. Similarly, the measure for China is provided in third and fourth columns. Since, for a pair of country, the ESI will be the same whether read through column or row, we have not repeated the entry at the upper part of off-diagonal for the number of countries that show up as column headings (note that we have more number of rows than columns, as we want to measure ESI for less number of countries/regions with respect to all 10 countries/regions).

It is interesting to note that in 1998, among group of countries and regions, Canada's exports to the US were most dissimilar with respect to oil exporting countries (OECs) at 0.09

followed by China (0.12). In 2006, China still remained the most dissimilar country to Canada's export pattern to the US with ESI of only 0.14. Canada's similarity with OECs, although at the lowest level, increased by about 50% and reached 0.13. That abode well with Canada's increased share of petroleum products exports to the US in 2006. Among the individual countries and regions considered in the table, the most similar country for Canada in terms of exports to the US was Mexico, with value of 0.33 in 2006. Canada's second similar ranking country/region as exporters to the US were Japan, EU-15 and OMICs, all with ESI of 0.29. The relation of Canada's exports to the US with those of OEACs and OHICs are not much different.

Table 10. Export similarity index

Countries/ Regions	Canada		China		Mexico		Japan		EU-15	
	1998	2006	1998	2006	1998	2006			1998	2006
Canada	-	-								
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	-	-		
EU-15	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

Note: This table was computed using total number of products that were imported to the US. As given in Appendix Table A2, there were 16,326 products in 1998 and 16,968 products in 2006. For all countries, the number of observations was the same, as even the products that were not exported by a particular country were included in the computation.

Source: Feenstra's Database

Comparing the results in two time periods, we see that Canada has become more similar with all countries/regions in 2006, except showing a slight dissimilarity with EU-15. In percentage term, the similarity index has increased the most with respect to the OMICs, 7 percentage-points increase. The OHICs and OLICs also became more similar to Canada as the ESI index rose to 0.25 and 0.20, respectively.

China's ESI rose with respect to developed countries (except for OMICs in which case it remained the same) and fell with respect to LICs and OECs. China's ESI was most similar with respect to OEACs at 0.37% (an increase of 4 percentage-points). Even for Mexico's exports to the US, Canada is almost the most similar country (slightly less than OMICs). For Japan, the most similar trading block is EU-15, and for EU-15 it is Japan.

From Canada's perspective, even though it is the case that Canada is losing market share as a result of Chinese competition in the US, Canada's exports are one of the most dissimilar with that of Chinese while compared product-to-product contribution in each country's exports to the US. It means that the bigger impact of China's exports to the US on Canadian products is yet to come. When the product sets between two countries and their relative contribution in each country's exports become more similar, as China's specialization catches that of Canada through time, the Chinese competition would be more direct. Looking at the pace that China is progressing in the US market, the occurrence is not that far. China will be encroaching more and faster into the subset of the products that Canada is exporting to the US.

So far, we looked only at the number of product counts and their trade patterns, the quantity side. In the following section, we will cover the second important part of export value, the quality of product or the unit value of the product that each of the major competitors are commanding in the US markets, the price side.

VI. Unit Value Analysis

The advantage of Feenstra's dataset is that it includes both value and quantity of US imports for a large number of products and countries, making it possible to calculate the unit value by product, partner and year. The most disaggregate level of HS 10-digit data that we will be using

are the most appropriate ones for comparing unit value across countries (cross-sectional comparison) or across time (inter-temporal comparison). Unit values are computed as:

(6) $$U_{cpt} = V_{cpt} / Q_{cpt} ,$$

where U is unit value; V is value of product and Q is quantity of product. As for some products (for some countries/regions) quantity data are not available, unit value cannot be computed. For our sample countries/regions, the unit value was computable for about 83 to 90% (depending on country/region) of the products in both years.[10] We will be studying the unit value data from different dimensions. First, we compare the relative position of each pair of countries/regions in terms of their number of products that carry higher unit value. For a particular product, the country with higher unit value (compared to the country with lower unit value) is called the country with superior product. Second, we compute 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 value for major US trading partners.

VI. 1. Unit value superiority

As a first step, we compute product superiority measure. For any two countries/regions c and c', the share of superior products of country c compared to the situation of country c' is given by the following measure:

(7) $$S_{ct} = \frac{N^{higher}_{cpt}}{N_{cc'pt}} \times 100 ,$$

[10] For Canada, we could calculate unit value for 89% of the products in both years; for China, 87% in 1998 and 90% products in 2006; for EU-15, 90% products for both years; for Mexico, 87% products for both years and for OEACs 88% products for each year.

where S_{ct} is the superiority measure; N_{cpt}^{higher} is the number of products that country *c* has higher unit value compared to unit value of country *c'* and $N_{cc'pt}$ is the set of common products that are exported by both *c* and *c'* (it was also used as numerator in product overlap measure). Hence for this measure, we compare the unit value that each of these two countries' products receive in the US market and count the number of products that each of these two countries have higher unit value compared to the other. Then the number of products that country *c* has higher unit value is taken as percentage of the total number of common products between two countries. By construct, the superiority measure for country *c'* will be 100 *minus* the superiority measure of country *c*.

The results are given in Table 11, where the first panel is for 1998, and the last panel is for 2006. We compare the unit values of Canada, China, Mexico, Japan and EU-15 (column headings) with respect to each other and with OEACs as well (row headings). Canada's comparison of unit value with other partners can be read through column "Canada"). 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 US, Canada has higher unit value compared to that of China in 71% of the common products (i.e., Canada had 71% of the products that were vertically superior in quality, and China had the remaining 29% products that were superior). Reading one part of off-diagonal element would suffice as the entries above the diagonal can be computed using the entries below the diagonal. For example, in column "China" and row "Canada", we have entry of 29, which could be read directly from entry 71 as 29 is equal to 100 *minus* 71.

Results show that Canada had higher unit value in more number of products compared to that of China, Mexico and OEACs and in less number of products compared to that of Japan and EU-15 in both years. Hence, more numbers of Canadian product were ranked superior compared

to those of China, Mexico and OEACs and less compared to those of Japan and EU-15. Looking across time, Canada's relative position in terms of the share of products that commanded higher unit value strengthened in 2006 from the situation in 1998 with respect to all competitors, except for Mexico in which case the situation did not change.

Table 11. Share of superior products (perecent)

	1998					2006				
	Canada	**China**	**Mexico**	**Japan**	**EU-15**	**Canada**	**China**	**Mexico**	**Japan**	**EU-15**
Canada	-	29	35	61	60	-	23	35	58	56
China	71	-	59	81	80	77	-	68	85	83
Mexico	65	41	-	71	73	65	32	-	72	70
Japan	39	19	29	-	45	42	15	28	-	45
EU-15	40	20	27	55	-	44	17	30	55	-
OEACs	66	38	52	77	76	69	31	54	78	76

Note: For the computation of this table, the number of products used varied by pair and year. For example, in 2006, the numbers of products while pairing Canada with other partners were as follows: Canada-China, 7999; Canada-Mexico, 6086; Canada-Japan, 6635; Canada-EU-15, 9073, and Canada-OEACs, 7077. Similarly, the product counts of China with other partners were: China-Mexico, 6257; China-Japan, 7283; China-EU-15, 10283, and China-OEACs, 8268. In case of Mexico it has 5099 common products with Japan, 6848 with EU-15 and 5749 with OEACs. For Japan-EU-15, the numbers of product counts were 8060 and for Japan-OEACs they were 6692. Finally, EU-15 and OEACs have 8704 common products. In 1998 also the number of products varied by pair. Just to quote a couple of them, the count for Canada-China was 6,224; Canada-Mexico was 6,368; Canada-Japan was 6,705 and Canada-EU15 was 9,566.

Source: Feenstra's Database

In 2006, Canada had higher unit value in 77% of the products compared to China, an increase from 71% in 1998. In 2006, compared to Japan, Canada had higher unit value in 42% of Canada-Japan common set of products, an increase from 39% in 1998. Canada's share of higher unit value product increased from 40% in 1998 to 44% in 2006.

Comparing the entries in columns "China" for two years, we see that China has less percentage of products with higher unit value in 2006 (compared to 1998) with respect to all trading partners. However, China's measure of superior products with respect to Canada is higher than China's similar measure with respect to Japan and EU-15. It seems to be the case that in 2006 as China increased its penetration across all industries, it started supplying disproportionately large number of cheaper products compared to 1998. It could be the indication

of technological convergence taking place in China, as its production functions shifted further out than those of developed countries, thereby making it possible for providing relatively more discounts on its products over time.

For both years, Japan is the country that has the higher share of superior products with respect to all partners (reading through "Japan" column, the entries are more than 50% in all rows). EU-15 stands as the second group with higher share of superior products after Japan; entry under its column is lower than 50% only for "Japan" row.

VI. 2. Unit-value similarity index

The above discussion provides information on the share of higher unit value products for each partner in a pair. Although it is an important piece of information, its limitation is that it does not provide overall picture of unit value distribution of a product across countries/regions (how far apart they are), as it counts only the number of products. For this measure, a product with a small difference in unit value between two countries will contribute equally to the product that has big difference in unit value. Another useful measure to understand comparative position of a country would be to know its relative unit value distribution across all products vis-à-vis all bilateral pairs. We do that by computing unit-value similarity index (UVSI). For countries/regions *c* and *c'* that export to the US, the UDI is computed using the following formula:

$$(8) \qquad UVSI_{cc't} = \sum_{p} \left\{ \left[m_{pt} \right] \times \left[\frac{\min\left(U_{cpt}, U_{c'pt}\right)}{\max\left(U_{cpt}, U_{c'pt}\right)} \right] \right\},$$

where U_{cpt} is the unit value of product *p* in country *c* in period *t*; $U_{c'pt}$ is the same for country *c';* $m_{pt} = \sum_c M_{cpt} \Big/ \sum_c \sum_p M_{cpt}$ is the product *p*'s share in total US imports, where $\sum_c M_{cpt}$ is US imports of product *p* from the world (sum across all countries) in period *t* and $\sum_c \sum_p M_{cpt}$ is the total US imports (sum across all products and countries). The fraction m_{pt} is used as weight to sum the UVSI across products.

The second component on the right-hand side needs some explanation. The numerator of this term is the lower unit value between two countries and the denominator is the higher unit value between them so that the outcome is a positive fraction (barring same unit value for both countries). Once this fraction is computed for all common products between two countries, UVSI is obtained by summing across all products using the share of that product in US total imports as a weight.

The larger the difference in the distribution of product unit value between a pair of countries, the lower will be the UVSI between them, meaning that the product prices between these two countries are quite different. On the other hand, the more similar are two countries in terms of unit values, the higher will be the UVSI. If the unit values for each products in two countries were the same, then UVSI = 1, whereas if the unit value is close to zero for all products in a country and nonzero to other country, then UVSI is close to zero. Since unit values are neither zeros nor the same for all the products between two countries, the UVSI will be bounded between zero and unity (limit points excluded).

The results for unit-value similarity index for a pair of countries/regions are given in Table 12.[11] In 1998, Canada's UVSI was the most similar with EU-15 followed by Mexico, China and OEACs. That situation changed in 2006, when Mexico became the most similar country followed by China. Japan, EU-15 and OEACs became the least and equally similar country/region for Canada. Overall, Canada's unit value distribution became more similar with respect to China, Mexico, Japan and OEACs in 2006 and less similar with respect to EU-15 when compared to the situation in 1998. Hence, Canada's unit values are converging with respect to those of China, Mexico, Japan and OEACs and diverging with respect to EU-15. The convergence has been rapid with respect to China in which case the UVSI between Canada and China rose from 0.42 in 1998 to 0.56 in 2007.

Table 12. Unit-value similarity index

Countries/ Regions	Canada		China		Mexico		Japan		EU-15	
	1998	2006	1998	2006	1998	2006	1998	2006	1998	2006
Canada	-	-	-	-	-	-	-	-	-	-
China	0.42	0.56		-	-	-	-	-	-	-
Mexico	0.55	0.62	0.53	0.60	-	-	-	-	-	-
Japan	0.38	0.50	0.41	0.40	0.50	0.46	-	-	-	-
EU-15	0.56	0.50	0.43	0.53	0.53	0.57	0.58	0.58	-	-
OEACs	0.37	0.50	0.60	0.27	0.58	0.58	0.50	0.48	0.49	0.48

Note: For computation of UVSI, the products that have no unit value for either of the pair countries/regions above have been excluded. The number of products used in computing this table varies by pair of countries and the numbers for each pair is as reported in the note underneath Table 11. For example, in 2006, the numbers of products while pairing Canada with other partners were as follows: Canada-China, 7999; Canada-Mexico, 6086; Canada-Japan, 6635; Canada-EU-15, 9073, and Canada-OEACs, 7077. Similarly, the product counts of China with other partners were: China-Mexico, 6257; China-Japan, 7283; China-EU-15, 10283.

Source: Feenstra's Database

[11] The matrix is symmetric, as off-diagonal corresponding elements are the same. For example, the UDI between Canada (column) and China (row) will be similar with the UDI between China (column) and Canada (row). To avoid clutter, we have reported only the lower diagonal part in the table.

For China, the most similar country/region in terms of the unit value distribution in 2006 was Mexico at UVSI of 0.60, followed by Canada, EU-15, Japan, and OEACs. Finally, for both EU-15 and Japan, the most similar partner in terms of the UVSI were each other.

VI. 3. Export distribution by unit value

The UVSI, despite being a useful measure, does not shed light on how a particular country is performing vis-à-vis other competitors in terms of overall product quality in the US markets. We study this aspect below by breaking the number of total products exported by each country/region in the US into five groups based on each product's relative unit value with respect to the maximum unit value of the product in the US market. 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 US, and label it $U_{pt}^{\max}$. Second, we compute the ratio of unit value to HUV for each product and for each country/region. Based on that ratio, we break the total products of each country/region into five groups.

The first category includes all the products whose unit values are less than 10% of the HUV. The second group contains products with unit values at 10-25% of HUV. In the third group, products with unit values between one-quarter and three-quarters (0.25-0.75%) of HUV are included. In the fourth group, products with unit values higher than three-quarters (0.75-100%) of HUV are included. Finally, the remaining are the products whose unit values are the highest among all countries. The criterion for the groupings is provided in the following expression:

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

If the ratio of a product falls into two ranges, the product is included in the lower range, category, meaning that if the ratio is 0.25 then the product will be included in (0.1-0.25) category and not on (0.25-0.75). In this scheme, we label the products that falls in the first two categories (with unit value was less than one-quarter of the HUV), as low end; the product in middle (with unit value in the range of one- to three-quarters) as medium, and those that fall in the last two categories and high end products. A country/region that sells more expensive products will have the larger share towards the last two ranges of distribution. The results are given in Table 13; the first panel is for 1998 and the second panel is for 2006. The sum for a country across five ranges (in a year) equals 100.

In 1998, in Canada's total exports to the US, 30% export value was obtained low end products. The middle group of products occupied almost half (46%) of Canada's export value. Only 11% of Canada's exports were on those products that commanded the HUV. In 2006, Canada's distribution of exports moved toward medium and higher unit value range products. For example, the share of exports (in Canada's total exports to the US) earned by low end products fell from 30% in 1998 to 20% in 2006. The middle group's share increased by 6 percentage-points and the high end products raised their share to 28% in 2006 from 23% in 1998.

On the contrary, China is selling not only low unit value products it has also been able to continue its discount over time. In 1998, 45% of China's export value was earned by products which were sold below 10% of HUV. In both years, more than three-quarter of China's export revenue (77%) was earned by products that were sold below one-quarter of HUV. Only 1%

export share was earned by HUV products in both years. The discount margin that China was able to offer in 1998 remained almost the same in 2006.

Table 13. Share distribution of country/region's export value by unit value categories

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

Note: for the computation of this table, products that have no information on unit value for a country were dropped from the study of that country. In 2006, the product counts used for this table were as follows: Canada, 10,554; China, 11,751; Mexico, 7672; Japan, 8,691; EU-15, 13,429 and OEACs, 9,564. In 1998, the respective numbers were Canada, 10,524; China, 8,029; Mexico, 7,435; Japan, 8,517; EU-15, 13,140 and OEACs, 8,879.
Source: Feenstra's Database

It appeared that as China's penetration increased massively in 2006, it started with a lot of low unit value products. Consequently, even though the export value increased phenomenally, the relative unit value did not rise compared to other countries. China's share of US imports in MHT rose substantially, but in these industries too, it seems to be the case that China's exports were dominated by low-end products. In terms of unit value distribution, China's direct competitors seems to be the OEACs whose share of export value contributed by last two group of products was also very high at 64% in 1998 and 56% in 2006.

Looking at the composition of export revenue earned by three types of products, Canada's trade composition has moved towards the medium and high range products, whereas China's distribution across three types of products remained symmetric. The trade composition of Mexico, EU-15 and OEACs moved towards high end products. For example, the share of these products in Mexico's exports increased from 11 to 29%, in EU-15 exports from 35 to 43% and in OEACs' exports from 4 to 12% during this period. On the other hand, the share of high

end products in Japan's exports fell by one percentage-point and that of medium range products increased from 40 to 47% in 2006 compared to the situation in 1998.

We also provide industry level results for year 2006 for five trading partners in Table 14, where we report the share of export value contributed by products whose unit values were higher than half of the HUV. At the aggregate level, about 62% of export value in Canada is earned by such products. This is the highest percentage in the group of partners that we have listed. In that sense, Canada's performance is good. However, industry-wise there is quite a variation and here too the main contributors are LT industries.

In all five MHT industries, in Canada, the share of export value earned by products with unit value higher than half of the HUV is less than that at the aggregate level. In chemical industry, only 28% of Canada's exports is earned by such products (note that some of them might have been the products that Canada had highest unit value). Japan and EU-15 are the ones who earn higher shares from this group of products in this industry. In transport industry, only 56% of Canada's export value is earned by products with unit value higher than half of the HUV, whereas in case of Japan and EU-15, the respective shares are phenomenally high at 83 and 85%. In machinery and computer and electronic product industries, however, the share of exports contributed by these products is at maximum for Canada, compared to all groups in Table 14. On the remaining electrical equipment, appliances and component industry, Canada's share is below that of EU-15 but higher than that of others. On the other hand, the export value shares contributed by products whose unit values are higher than half of the HUV are very high in three LT industries: 98.5% in mining, oil and gas extraction industry, 83% in petroleum and coal products and 79% in agriculture related industry.

Table 14. Export value share of products with unit value higher than half of HUV (percent)

NAICS Industries	Canada	China	Mexico	Japan	EU-15
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 Mineral	35.3	13.1	21.8	66.3	41.5
Primary Metal; Fabricated Metal Product	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	61.9	1.2	36.5	19.9	24.0
Electrical Equip., Appliance and Component	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**

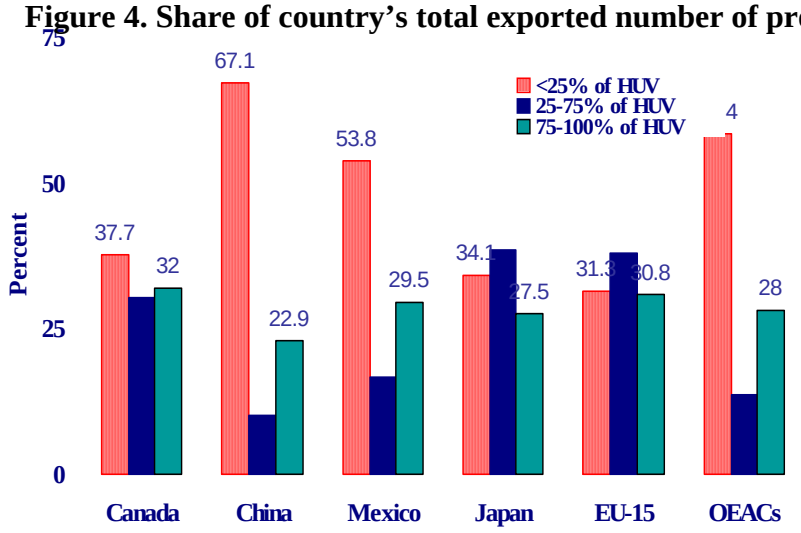
Source: Feenstra's Database

Almost all products exported by China in four industries (textile, clothing, leather; machinery; computer and electrical product, and furniture related and miscellaneous) are sold at less than half of the HUV (in more than half discount price) in the US market. In electrical equipment industry, about 95% Chinese products are sold in less than half of the HUV. And these five industries with the largest discount even by Chinese standard, contribute almost three-quarters of China's total merchandise exports to the US, as shown in Table 5. In chemical and transport industries, however, China's share of exports earned by products with higher than half of the HUV is reasonably high at 15% and 9%, respectively.

So far we were discussing about the share of export value earned by different product groups. In what follows, we compare the shares of product counts by the same three groupings: low-, medium- and high-end products. As shown in Figure 4, the country with the largest share of high-end product counts is Canada. Here the share differences among competitors range from 23% for China to 32% for Canada. More than two-thirds of China's products and more than half of Mexico's and OEACs' products fall into low-end.

One interesting thing is that Canada's shares of product counts and shares of export value are quite different across three groupings. The shares of high-, medium- and low-end product counts are 38%, 30% and 32%, whereas their shares in export value are 20%, 52% and 28%, respectively. It means that 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, the middle range products have higher share in export value, indicating that these products are sold in larger quantity. In contrast to Canada, the share of high-end products is higher larger for export value than for product counts for Japan and EU-15. In China's case, the 3% share of high-end products in export value is lot smaller than their 22% share of product counts. It indicates that the Chinese products that make at the high-end club are sold in very limited quantity.

Figure 4. Share of country's total exported number of products, 2006



Source: Feenstra's Database

The above discussion examined the change in the composition of exports from a source country's perspective. However, while examining from this angle, a movement of a country's exports towards high-end products may not necessarily be the case that the country is gaining higher market share in the US in such products. It is possible that a country's export bundles are

moving towards high-end products, but at the same time, it is losing market share in these products if the country loses market shares in total and loses more in low- or medium-end products. That is what exactly happening for Canada as given in Table 15. Canada's share in *total* US imports fell by 1 percentage-point between 1998 and 2006, but its share of low-end products fell by 5 percentage-points, that of medium-range products rose by 2 percentage-points and that of high-end products fell by 2 percentage points.

Table 15. Country's/region's share of US imports by unit value distribution (percent)

	1998				2006			
	< 25% of HUV	**25-75% of HUV**	**75-100% of HUV**	**Total**	**< 25% of HUV**	**25-75% of HUV**	**75-100% of HUV**	**Total**
Canada	18	32	29	25	13	34	27	24
China	18	5	1	10	39	11	2	20
Mexico	15	14	7	13	13	14	17	14
Japan	15	18	20	17	8	14	11	11
EU-15	17	21	40	23	15	20	40	23
OEACs	18	10	2	12	11	7	4	8
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Note: The country'/region's share of US imports in this table should not be confused with that given in Table 3. While computing share in Table 3 we considered all total imports to the US from all countries in the world, whereas here we consider imports from only Canada, China, Mexico, Japan, EU-15 and OEACs.

Source: Feenstra's Database

Japan has almost the similar story as that of Canada. Relative to Japan's own share loss in the total US imports, it is losing market share more at low- and high-end products and gaining at medium-end products. China is marching ahead in all three types of product markets at the same pace. On the other hand, Mexico has become a larger supplier of high-end products in the US. Even though during 1998 and 2006, Mexico's share in US total imports increased by only 1 percentage-point, its share of high end products rose by 10 percentage-points, taking 17% of US high-end product market in 2006 compared to only 7% in 1998. The other group that increased its relative position in high end products is OEACs; their ratio of high end product share to total share rose from 0.17 in 1998 to 0.5 in 2006.

To sum up, Canada is becoming more of a middle-end product supplier to the US. China, on the other hand, is advancing in all range of products at the same pace; but overwhelming share of low-end products. In that sense, right now, China's competitive pressure is high in low-end products but the speed of competitive pressure from China is high and constant across all products. On the other hand, Mexico and OEACs are taking increasingly larger US market in high-end products. These two forces are putting lot of pressure in Canada's exports, and as a result, Canada is losing its US market share more on low-end and high-end products over time.

Among the three components of exports (number of products, quantity of products and price of products), the factors behind Canada's loss in US market share is number and quantity of products sold but not price discount or movement toward lower value products. The declining number of products sold is reflected in higher churning rate. The larger fall in Canada's share in MHT industries (compared to the low tech industries), however, seems to be the result of larger quantity substitution that might be occurring in these industries. The product churning is equally important for both MHT and LT industries and hence is not a factor for performance differences between them in Canada. The question then is whether competition is tougher in MHT or whether the products in these industries are more substitutable remains open for another research, and is not dealt in this paper.

VII. Conclusions

We examine the merchandise export performance of major competitors in the US market by developing several trade indices. The competitors considered in the paper rare: Canada, China, Mexico, Japan, EU-15, other east Asian countries (OEACs), other low income countries (OLICs), other middle income countries (OMICs), other high income countries (OHICs) and Oil exporting countries (OECs). But the main focus of the paper is looking at the performance of

Canada, China, Mexico, Japan, EU-15 and OEACs with particular discussion carried out from Canada's perspective. Together, these four major exporter countries and two regions, supply three-quarters of US merchandise imports.

As a tool for performance measurement, we develop indices such as product penetration, product churning, product overlapping, export similarity index, unit value superiority, unit value dissimilarity index etc. For this, we use Harmonized System (HS) 10-digit data; the most detailed (disaggregate) level of import data recorded in the US. These data allow us to compare the value, quantity and unit price of about 16,000 products imported to the US each year from any single individual countries in the world. At such level of detailed classification, the product by each country can be considered as a vertically different product, which might be substitutable with same products from other countries but not necessarily perfectly. Hence the unit value differences of a product by source of country can be taken as quality differences of the product.

We confine our study for two years using data for 1998 and 2007 for part of the study and data for 1998 and 2006 for the remaining part. Some of the results are also presented at the industry level, while others are presented at the aggregate level.

Results show that Canada is losing market share in the US and more so in medium- and high-tech (MHT) industries than in low-tech industries, whereas China is gaining market shares in all industries and more so in MHT industries. In terms of US import market share, Japan is the largest loser followed by OEACs.

Using product category based on unit-price distribution across products we show that Canada’s high-end products (Canada’s products that were commanding at least 75% of highest unit value in the US) have been substituted in part or completely driven out of US market by products from Mexico, OEACs and China,. Canada’s low-end products (with unit value less than

25% of highest unit value in the US market) have been partly substituted or completely driven out mainly by China. As a result, Canada is losing US market share in low-end product rapidly and in high-end products gradually. As a result, Canadian medium-range products are increasing their share in the US market over time.

At least some of the explanation for Canada's declining share of US import markets can be attributed to its product dropping and not so much success in product adding/entry. Put differently, Canada is being able neither to retain some of its products in the US market (as competitors, mainly China and to some extent Mexico and other countries, are driving them out) nor to introduce new products. As a solution, it appears that Canada has either to lower the cost of its products to be competitive or has to introduce new products that are not produced by its competitors. Either way, the bottom line is that Canada has to win the market by being more innovative (either process or product). If Canadian companies cannot perform relatively better than other competitors in product and process innovation, Canada's share in the US market will continue to fall. The process has just started and will be continued as a trend in the future.

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Appendix A. 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
	EU-15: 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

Appendix B : Mapping NAICS industries to HS 10-digit products

NAICS	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 C. Product penetration 1998/2006 (percent)

Industry	Canada	China	Mexico	Japan	EU-15	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; Misce.; 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**

Note In the pair of two numbers with slash in the middle, the first entry is the number for year 1988 and the second entry is the number for year 2006.