CHANGES IN CANADA-U.S. TRADE IN INTERMEDIATE VERSUS FINAL GOODS: IDENTIFICATION AND ASSESSMENT

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EXECUTIVE SUMMARY

A conventional view of Canada-U.S. economic integration is one of the two countries "making things together" rather than simply selling final goods and services to each other. Indeed, one of the major concerns expressed by business leaders and some politicians about security-related border initiatives implemented post-9/11 was that the initiatives would disrupt cross-border supply chains, particularly for industries where just-in-time parts delivery was critical for efficient production. The development and implementation of programs to facilitate faster cross-border commodity flows, such as Free and Secure Trade (FAST), were promoted by multinational companies, especially the automobile com-

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panies, to reduce delays of inter-affiliate shipments with their attendant costs.

Despite its prominence in the public policy debate surrounding border security and clearance initiatives, there has been relatively little research on the magnitude and nature of bilateral trade in intermediate goods. In particular, there is virtually no statistical evidence on the behavior of intermediate goods trade in the post-9/11 period. This study attempts to fill in the knowledge gap by creating and analyzing time series data on U.S. intermediate goods trade with Canada over the time period 1990-2011. It also provides some analysis of the determinants of the changes observed in bilateral intermediate goods trade.

Contrary to the popular premise that bilateral supply chains are becoming more integrated, we find that bilateral trade in intermediate goods as a percentage of total bilateral trade was lower in 2011 than in 1990. Most of the decline occurred between 1990 and 2002. This was followed by a modest recovery in the percentage from 2003 to 2008. The severe recession of 2008-2009 was associated with another decrease in the percentage followed by a recovery. In short, there has certainly been no increase in the intermediate goods intensity of bilateral trade pursuant to the implementation of the Canada-U.S. Free Trade Agreement in 1989. This result is broadly consistent with studies done by the Conference Board of Canada which examined a shorter time period.

Our analysis also identifies divergent time series patterns for intermediate goods intensities of imports and exports. Specifically, the two time series are mirror images. U.S. imports of intermediate goods from Canada as a share of total U.S. imports from Canada decreased from 1990 to 2002 and then increased for most of the

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The University of Toronto Press published Professor Globerman and Storer's *The Impacts of 9/11 on Canada-U.S. Trade* in 2008.

subsequent time period. The opposite pattern is observed for U.S. intermediate goods exports as a share of total exports to Canada. We identify the extent to which changes in overall intermediate goods import and export trade intensities are functions of changes in the relative importance of individual industries in bilateral trade versus changes in the intermediate goods trade intensities of individual industries. The relative importance of each phenomenon varies over the sample time period. Specifically, both phenomena contribute to observed changes in import and export intermediate goods trade intensities for approximately the first half of the sample time period. In the second half, changes in intermediate goods trade intensity for imports are almost entirely due to changes in industry mix, while changes in the intermediate goods trade intensity for exports are virtually entirely due to decreases in the intermediate goods trade intensities of individual export industries.

The different time series patterns for intermediate goods exports and import intensities, as well as the varying contributions of changes in industry trade mix versus changes in the intermediate goods trade intensities of individual industries, suggest that there is no single explanation for the overall behavior of bilateral intermediate goods trade. We find some evidence of bilateral intermediate goods trade intensities being reduced by increased vertical production integration between the U.S. and Mexico, as well as between the U.S. and China. There is also evidence of changes in the Canada-U.S. exchange rate affecting intermediate goods import and export intensities which is consistent with a hypothesis that "pass through" of exchange rate change is weaker in the case of intermediate goods than final goods.

INTRODUCTION

It has been argued that trade integration between Canada and the United States is an increasingly important policy issue as bilateral integration becomes more about "making things together" than "selling things to each other."[1] An equivalent way of describing the phenomenon of making things together is that bilateral trade is primarily characterized by exports and imports of intermediate goods used in further production, rather than by exports and imports of final goods. Hence, the thickening of the Canada-U.S. border in the wake of post-9/11 enhanced security initiatives raised particular concerns about disruptions to trade in intermediate goods (Gold-

farb, 2007; Hart, 2010). Indeed, the design and implementation of customs pre-clearance programs, such as Free and Secure Trade (FAST), largely reflects political priorities in the two countries to address border security-related disruptions to vertically integrated supply chains, particularly in the motor vehicle industry, where timely cross-border shipments of intermediate goods is critical to efficient production (Globerman and Storer, 2011).

Despite the importance policy-makers have placed on improving the efficiency of cross-border supply chains, particularly in the aftermath of border-thickening, security-related developments post-9/11, there has been relatively little published research documenting changes over time in the relative importance of intermediate goods trade in the overall bilateral trade relationship. Nor has much attention been paid to the possible determinants of intermediate goods trade as a share of total bilateral trade. The purpose of this study is to provide some additional evidence and insights into these issues.

The paper proceeds as follows. In the second section of the paper, we review a number of relatively recent empirical studies of trade in intermediate goods. A particular focus is on studies of intermediate goods trade between Canada and the U.S. The bilateral trade experience is then compared with the trade experiences of other regions of the world. Section Three discusses a set of factors that have been identified as influencing trade in intermediate goods. In Section Four, we present and discuss our own estimates of the intermediate goods trade intensity of bilateral trade. One main finding is that the behavior of total bilateral intermediate goods trade as a share of total bilateral trade obscures prominent differences between imports and exports. Indeed, intermediate goods imports as a share of total imports follow a mirror-image pattern to intermediate goods exports as a share of total exports over our sample time period 1990-2011. Specifically, the import share decreases over the decade of the 1990s and then increases post-2002. The opposite pattern is observed for the export share.

Section Five presents evidence on the contribution of changes in the industrial composition of exports and imports to the observed changes in intermediate goods' share of bilateral trade. Changing industry trade weights indirectly contribute to changes in the share of bilateral trade accounted for by intermediate goods trade. We also report changes in the share of trade accounted for by interme-

diate goods holding industry-level trade weights constant. This is a direct measure of the changing importance of intermediate goods trade at the industry level. We find that the behavior of bilateral intermediate goods trade for imports over the period 1990-2001 reflects the combined impacts of changes in the relative importance of individual importing industries, as well as changes in the ratio of intermediate goods imports as a share of total imports within industries. On the other hand, the behavior of overall intermediate goods imports as a share of total imports primarily reflects changes in the industrial mix of imports over the period 2001-2011. Changes in industrial mix are relatively unimportant as an explanation of the observed changes in the behavior of intermediate goods exports as a share of total exports, particularly over the period 2001-2011.

In Section Six, we consider possible explanations of the time series patterns described in Section Five. The most distinctive attribute of the intermediate goods bilateral trade experience over the sample period is the marked decline in U.S. exports of intermediate goods as a share of total U.S. exports to Canada from 2001 to 2011. While post-9/11 border security developments may have influenced this variable in the short run, the main factor at work seems to be the substantial growth in motor vehicle assembly activity in Mexico, with some possible secondary influence from shifts of machinery assembly to China. The primary result is that shipments of vehicle parts made in the United States were redirected towards Mexico and away from Canada. Another impact of increased auto assembly activity in Mexico is reduced U.S. vehicle imports from Canada, which indirectly increased the intermediate goods share of total imports. We also find evidence that exchange rate changes may have influenced the share of bilateral trade accounted for by intermediate goods. The final section of the paper provides a short summary and a brief discussion of policy implications.

TRADE IN INTERMEDIATE GOODS: EMPIRICAL STUDIES

Two relatively recent studies by the Conference Board of Canada identify and assess patterns of trade for different types of goods in the North American context (Goldfarb and Chu, 2008; and Hodgson, 2008). Since the two studies are very similar in their methodologies and findings, it is sufficient to summarize only one of those studies.

Goldfarb and Chu report growth rates of Canada's trade in primary, intermediate and final goods for the years 1990, 2000, 2003 and 2006. Specifically, they classify Canada's top twenty-five imports and exports into three broad categories: entry-stage, middle-stage, and final or end-stage. The classification is done at the 4-digit level of the harmonized system of trade (HST), although they report their empirical results at the 2-digit level. They consider all raw materials as entry-stage products. In addition, goods that have been processed but enter an importer's supply chain at an early point are also considered entry-stage. Middle-stage goods comprise components, parts and other manufactured inputs. The remaining top imports and exports are classified as end-stage. Goldfarb and Chu convert trade data from nominal values to real values by using import and export price deflators closely associated with each traded good.

For purposes of our analysis, the changing pattern of Canada's trade with the United States is of particular interest. In fact, Goldfarb and Chu report results for Canada's trade with the United States and Mexico combined, as well as with all trading partners.[2] Since the United States accounts for over 95 percent of Canada's trade within North America, the reported results for North American trade can be safely inferred to reflect the pattern of bilateral trade.[3] In this regard, Goldfarb and Chu find that the share of Canada's middle-stage exports with its North American partners was actually higher in 1990 (32 percent) than in 2006 (29 percent). The share of middle-stage imports was the same in both 1990 and 2006 (41 percent). The decrease in the share of middle-stage exports took place between 1990 and 2000, while middle–stage imports increased modestly between 1990 and 2000 and then decreased.[4] The implication is that while bilateral trade volumes increased significantly between 1990 and 2006, the portion of trade that might be considered to reflect integrated production was essentially unchanged over that period.

It might be noted that Goldfarb's and Chu's classification of traded goods into the three categories was based on the authors' judgment, although they assert that most classifications were "straight-forward." The main point here is that their middle-stage imports and exports are unlikely to correspond precisely to definitions of intermediate goods based upon conventional classification approaches to be discussed in a later section. Furthermore, their focus on the top twenty-five imports and exports might mean that

their findings are different from those based on total bilateral goods trade.[5]

Several other studies examine trade in intermediate goods for world trade using alternative definitions of intermediate goods. For example, Bridgman (2010) uses the Bureau of Economic Analysis' end use nomenclature for goods. He finds that the share of trade in intermediate goods is roughly unchanged over the period 1972 to 1997; however, there is a shift in the composition of intermediate goods. Namely, intermediate goods trade shifts from being dominated by raw materials to being dominated by manufactured parts. Equivalently, the share of trade characterized in the literature as vertical specialization trade (VST) increased substantially over the period 1972 to 1997, while the share of trade in raw materials such as ores and lumber decreased dramatically. This finding is similar to that reported in Chen, Kondratowicz and Yi (2005) for a comparable time period. They also found that trade in intermediate goods as a share of total world trade did not increase, although the share of trade in vertical specialized goods did increase. The implication is that trade in raw and semi-processed materials decreased over the period.[6]

Miroudot, Lanz and Ragoussis (2009, p. 7) define an intermediate good as an input to the production process that has itself been produced and, unlike capital, is used up in production. Hence, they include goods such as ore and lumber in their definition of intermediate goods. As such, their intermediate goods category is arguably broader than the VST category of traded goods described above. They find that while the growth rate of trade in intermediate goods was substantial over the period 1995-2006 for OECD countries as a whole, it was no different from the growth rates of finished consumption and capital goods. As a consequence, trade in intermediate goods as a share of total trade was essentially unchanged over the sample period.

Finally, Sturgeon and Memodovic (2011) divide trade data from the U.N.'s COMTRADE database into three categories: capital goods, intermediate goods, and consumption goods. Intermediate goods are initially defined as parts and components used as inputs in the production of manufactured goods. They combine capital and consumption goods into a single "final goods" category and look at the growth of intermediate versus final goods for total world trade over the period 1962-2006. The share of intermediate goods in total

world imports falls from around 71% in 1962 to around 57% in 1990. It declines to 52% in 1992, and then slowly increases to around 56% in 2006. Thus, the share in 2006 is essentially unchanged compared to 1990.

Sturgeon and Memodovic take a closer look at the intermediate goods category. They divide it into intermediate goods that require relatively little processing and those that require explicit coordination between the supplier and the user. They identify the first set as "generic" intermediate goods, and the second set as "customized" intermediate goods. Combined, the two sets are called manufactured intermediate goods (MIGs). Sturgeon and Memodovic then separate the top fifty MIGs into customized and generic categories based on their impressions of the products involved.[7] They find that the share of customized intermediate products increased from two-thirds of total MIG trade in the top 50 products in 1998 to more than three-quarters in 2006. A similar increase is found for the set of customized products in the top 50 MIGs as a share of total MIG trade: around 22% in 1998 versus 31% in 2006.

In summary, the relative constancy of the share of intermediate goods in total bilateral trade over the period 1990-2006 identified by Goldfarb and Chu is not dissimilar to patterns identified for trade between other developed countries, as well as for overall world trade. Namely, traded intermediate goods as a share of traded non-primary goods were relatively unchanged from around 1990 through the mid-2000s. What might be different is the bilateral trade experience in vertical specialized goods compared to the trade experiences of other regions of the world. The results reported by Goldfarb and Chu for the growth in the share of middle-stage goods in total bilateral trade might be taken as an approximation to the growth in the share of bilateral vertical specialized goods. If so, the bilateral experience seems different from results reported above for world trade. Specifically, the share of bilateral trade represented by middle-stage goods was no higher in 2006 than in 1990, whereas the share of world trade represented by vertical specialized goods was higher in 2006 than in 1990.

Since the definition of vertical specialized goods is not identical across studies, it is not possible to conclude with confidence that the bilateral intermediate goods trade experience differs from that of the other regions of the world. In a later section of this study, we focus on the experience of individual industries that Sturgeon and

Memodovic identify as being particularly "vertical specialization" intensive, namely autos and machinery, to compare the bilateral experience to the pattern reported in Sturgeon and Memodovic's analysis. We also provide updated estimates of the share of intermediate goods in total bilateral trade to assess whether adding post-2006 data modifies existing assessments. Before doing so, we summarize some explanations that have been provided for the relatively constant share of overall intermediate goods trade in total trade that has been identified for Canada-U.S. trade post-1990.

DETERMINANTS OF INTERMEDIATE GOODS TRADE

Hodgson (2008) identities and briefly assesses a number of factors that might explain the lack of significant growth in integrative bilateral trade over the past two decades. One possibility he raises is that the gains from North American integration under the Canada-U.S. Free Trade Agreement (CUSTA) implemented in 1989, as well as from the North American Free Trade Agreement (NAFTA) implemented in 1994, were essentially fully realized by 2000.[8] However, as we shall report in the next section, the share of overall intermediate goods trade in total bilateral trade declined from 1990 to about 2002, and it was actually higher in 2008 than in 2002. This pattern is inconsistent with a gradual exhaustion of the benefits of integrative trade created by CUSTA and NAFTA.

Hodgson also raises the possibility that "border costs" have increased, and that this development particularly discouraged bilateral trade in intermediate goods. In this regard, Hodgson argues that the primary source of border thickening in recent years has been misaligned regulatory standards and not increased border security in the post-9/11 period. He bases this conclusion on findings reported by Burt (2009), although Burt's conclusions were challenged by Globerman and Storer (2009).

Blank (2013, p. 3) characterizes the North American economy in the early 1990s as "deeply integrated continental systems of supply chains structured by networks linking production centers and distribution hubs across the continent." The practical manifestation of this deep integration was that the cross-border movement of goods increasingly consisted of intermediate rather than finished products; however, he argues that the process of integration slowed markedly by the late 1990s. Blank, like Hodgson, identifies "dysfunctional regulations" as a source of border thickening and also

suggests that the initial gains from tariff reductions had largely been internalized. He offers as additional possible explanations the erosion of critical transportation and energy infrastructure and inadequate border facilities that stressed integrated production systems.

While Hodgson and Blank suggest possible reasons for border thickening in recent years, they do not explain why the sources of border thickening should have specifically discouraged trade in intermediate goods relative to final goods. Conversely, Bridgman (2010) and Sturgeon and Memodovic (2011) identify how the tariff reduction process might have influenced the composition of international trade. They argue that raw materials production tends to depend upon local geographic conditions in a way that manufacturing does not. Geography is also important for agricultural and forestry goods. Conversely, manufacturing is much less tied to geographic conditions. Therefore, if trade costs decline, trade in manufactured goods will be more responsive. Furthermore, tariff reductions under the Kennedy Round were deeper for manufactured goods than for raw materials. This development would further contribute to a growth of trade in manufactured goods relative to raw materials, agricultural and forestry goods.

It is less clear why a decrease in tariffs would encourage increased trade in intermediate manufactured goods relative to final manufactured goods. The explanation would appear to be that tariffs are calibrated on the total value of goods crossing borders rather than on the value added created in the originating country. Consequently, goods whose value added is created primarily, or entirely, in one country will incur lower effective tariff rates than goods whose value added is intensively created using integrated cross-border supply chains. As a consequence, a decrease in tariffs is likely to promote the use of integrated cross-border supply chains and, therefore, an increase in manufactured intermediate goods relative to final manufactured goods.

Available studies also identify several other variables that can potentially influence the composition of traded goods. One such variable is the volatility of the gross domestic products of the trading partners. For example, Chen (2010) develops a model of trade which shows that intermediate goods trade is more volatile than trade in final products in response to demand shocks. The implication is that the major recession commencing in 2008, along with a

subsequent decline in overall bilateral trade, could be expected to result in a decrease in the share of total trade accounted for by intermediate goods trade, other things constant.

Exchange rate changes can also potentially influence the composition of trade flows given different rates at which exchange rate changes are passed through to changes in export prices, as well as different responses to the pass-through on the part of importers. There is no *a priori* basis for expecting that intermediate goods trade will be more strongly affected by exchange rate changes compared to trade in final goods;[9] however, the share of intermediates in total trade varies substantially across industries. Hence, to the extent that the responsiveness of trade flows to exchange rate changes varies across industries, such differences can indirectly affect the share of intermediate goods trade in total trade by influencing the industrial mix of traded goods.[10]

In the remaining sections of this paper, we present some additional statistical evidence on the behavior of intermediate goods trade as a share of bilateral trade. In particular, we update estimates provided by Goldfarb and Chu, albeit using a different methodology. We also offer some additional assessment of the factors contributing to the changing importance of intermediate goods trade in total bilateral trade over the past two decades.

MEASURING AND ESTIMATING COMPONENTS OF TRADE

Two broad methodological approaches have been used to measure trade in intermediate and final goods. One is based on input-output tables for a domestic economy. For example, Feenstra (1998) and Feenstra and Hanson (1999) construct a measure of intermediate trade in goods by using U.S. input-output tables to get each U.S. industry's purchases of specific inputs and then multiplying the estimated purchase of each input by the economy-wide import share for that input. A second approach involves dividing a country's trade flows into final goods and intermediate goods flows using the U.N.'s Classification by Broad Economic Categories (BEC). The latter distinguishes final (consumer and capital goods) from intermediate goods. Hence, the BEC is used to "map" Standard International Trade Classification (SITC) trade flows into final and intermediate goods trade flows.[11] While both approaches have their shortcomings, the fact that input-output tables are revised

only periodically is of particular concern to us. Hence, we utilize the second approach.

The primary source of data used in this study is the on-line Dataweb site maintained by the United States International Trade Commission (USITC). The USITC data bank provides values for U.S. trade (imports and exports) with Canada from 1990 through 2011along with detailed breakdowns by commodity using the SITC. We extracted data on the value of trade flows at the 5-digit SITC level and initially classified each flow into one of three categories: fuel and lubricants, non-fuel final goods (both consumer and capital goods), and non-fuel intermediate goods. We separated fuel trade from trade in other goods because of the volatility of prices for oil and natural gas. Also, most fuel imported from Canada into the U.S. travels through pipelines. Hence, border security procedures post-9/11 are unlikely to have affected this category of imports in any significant way.

The classification of SITC codes into intermediate and final goods categories was done in two steps. We first placed each SITC code into one of the UN Broad Economic Categories (BEC) by using a correspondence table downloaded from a United Nations Web site.[12] In some cases we needed to use our judgment when assigning BEC codes, because the SITC Ccodes assigned by USITC were not always consistent with Revision 3 of the SITC classification sys-

Table 1
BEC Codes Used to Measure Trade in Intermediate Goods

BEC codes	Description	Number of SITC Codes in Correspondence Table
111	Food and beverages, primary, mainly for industry	44
121	Food and beverages, processed, mainly for industry	69
21	Industrial supplies not elsewhere specified, primary	228
22	Industrial supplies not elsewhere specified, processed	1,298
42	Parts and accessories of capital goods (other than transport equipment)	202
53	Parts and accessories of transport equipment	58

tem.

Once the USITC trade data were classified by BEC code, we followed the United Nations in assigning the following BEC codes to the intermediate goods category: 111, 121, 21, 22, 42, and 53. The descriptions of these BEC codes and the number of SITC codes linked to each of them are provided in Table 1. Our analysis of total

Canada-U.S. trade includes imports and exports whatever the recorded U.S. customs district of entry or exit. However, the majority of bilateral trade is processed through customs districts that include border land ports.[13] Our secondary data source is the online U.N. COMTRADE database that is available by BEC code. When the classification in Table 1 is applied for non-fuel U.S. imports and exports in 2012, our estimated breakdown for trade is reported in Tables 2 and 3. In comparing Tables 2 and 3, fuel is obviously a much more important component of U.S. imports from Canada than of exports to Canada.

Table 2

U.S. Imports from Canada in 2012, by Category of Goods (from COMTRADE BEC Data)

Category of Goods	Value in 2012 (US $ Millions)
Total Goods	$ 327,482,229,979
Not Classified (BEC 7)	$ 12,344,470,231
Fuel (BEC 3)	$ 104,085,590,509
Final Goods	$ 93,989,555,092
Non-fuel Intermediate Goods	$ 117,062,614,147

Table 3

U.S. Exports to Canada in 2012, by Category of Goods (from COMTRADE BEC Data)

Category of Goods	Value in 2012 (US $ Millions)
Total Goods	$ 291,674,879,742
Not Classified (BEC 7)	$ 13,321,206,373
Fuel (BEC 3)	$ 17,776,640,382
Final Goods	$ 125,586,333,208
Non-fuel Intermediate Goods	$ 134,990,699,779

None of the trade flow breakdowns reported in this study are adjusted for inflation. Price deflators are not available for individual SITC codes or BEC categories and, in any case, our analysis looks at ratios of current-dollar values rather than absolute dollar values themselves. Hence, when we examine the share of intermediate goods in total trade, those shares will reflect changes in the physical volumes of trade in the two categories of goods and changes in their relative prices.

By way of background, Figure 1 shows U.S. real imports from Canada, as well as real exports to Canada over the period 1990-2012.[14] Real imports increased quite consistently from 1990-2000. There was a sharp drop over the period 2001-2002 followed by a gradual increase beginning in 2003 and continuing through 2007. The sharp drop in real imports in 2008-2009 obviously reflects the severe recession in North America, while the increase in real im-

Figure 1
Real U.S. Goods Trade with Canada (millions of 2000 U.S. $)
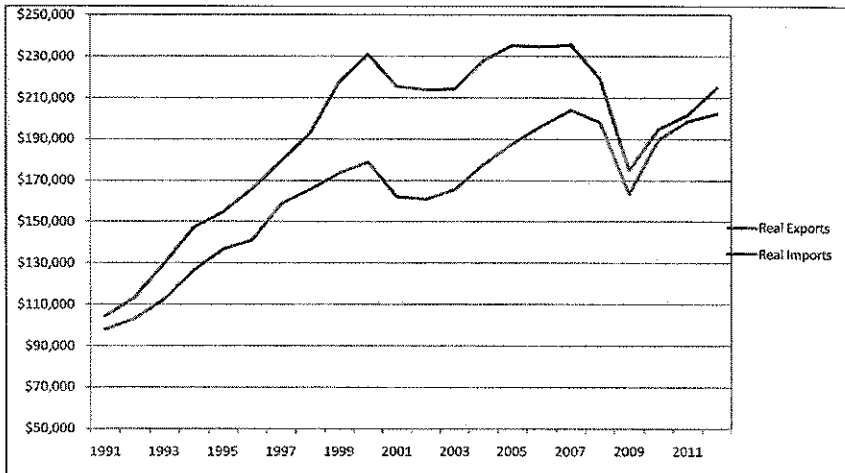
ports post-2009 likely reflects the economic recovery from the recession. Real exports also increased consistently between 1990 and 2000, followed by absolute decreases in 2001 and 2002. This decrease, as in the case of real imports, arguably is related to the border disruptions after the 9/11 terrorist attacks. Growth in real exports resumed from 2003-2007 and then declined sharply in the recent recession. The subsequent recovery post-2009 parallels the behavior of real imports.

It is clear from Figure 1 that the overall bilateral trade experience post-2001 differs from the prior experience. Specifically, real imports declined slightly at an average annual rate of approximately 0.02 percent from 2001 to 2012 compared to an average annual growth rate of about 7.5 percent from 1990 to 2001. Real exports grew at an average annual rate of slightly over 5 percent from

1990 to 2001 and increased approximately 2 percent per year from 2001 to 2012. In sum, the growth rate of bilateral trade, particularly U.S. imports from Canada, slowed significantly in the post-2001 period. Statistical studies cited earlier point to a thickening of the Canada-U.S. border and to security-related policies and procedures as contributing to the observed changes in the overall bilateral trade performance post-2001. The simple time series behavior of overall bilateral trade flows supports this assertion. It is therefore interesting to observe whether the time series behavior of intermediate goods trade as a share of total bilateral trade follows the pattern illustrated in Figure 1.

Figure 2 provides some evidence on this point. Specifically, it reports total U.S. intermediate goods imports from and exports to Canada as a percent of total imports plus exports, where both the numerator and denominator are net of the fuel category and expressed in billions of U.S. dollars. A striking feature of Figure 2 is the consistent decline in intermediate goods trade as a share of total bilateral trade over the period from around 1990 to 2003, with the exception of a single year's increase. While the decline in the ratio from 2001 to 2003 is consistent with a post-9/11 thickening of the border for intermediate goods relative to final goods, the consistency of the decline starting well before 9/11 suggests that other phenomena may also be relevant in the post-2001 period. We shall have more to say about this in a later section. What is relevant to highlight at this point is the difference between the pattern shown in Figure 2 and the findings of Goldfarb and Chu reported earlier. While the latter conclude that Canada's share of middle-stage goods trade with its North American partners was more or less unchanged comparing 1990 to 2006, our measure of intermediate goods' share of total bilateral trade in 2006 is somewhat below that of 1990.[15]

Figure 3 reports the share of intermediate goods imports as a percentage of total U.S. non-fuel imports from Canada, while Figure 4 reports the share of intermediate goods exports as a percentage of total U.S. non-fuel exports to Canada. Several observations might be made regarding the two series shown in Figures 3 and 4. First, while there is a fairly consistent decrease in the share of imported intermediate goods from 1990 to 2000, the share of intermediate goods exports is slightly higher in 2000 than it is in 1990. Second, the shares in total trade of both intermediate imports and exports decrease from 2001 to 2003. Third, while the share of intermediate

goods exports decreases from 2004 to 2009 before staging a modest increase, the share of intermediate goods imports increases fairly strongly from 2004 to 2009. In this context, our findings are consistent with results reported by Goldfarb and Chu. Since they look

Figure 2
Total Bilateral Intermediate Goods (net of fuel) as a Percentage of Total Bilateral Traded Goods (net of fuel)
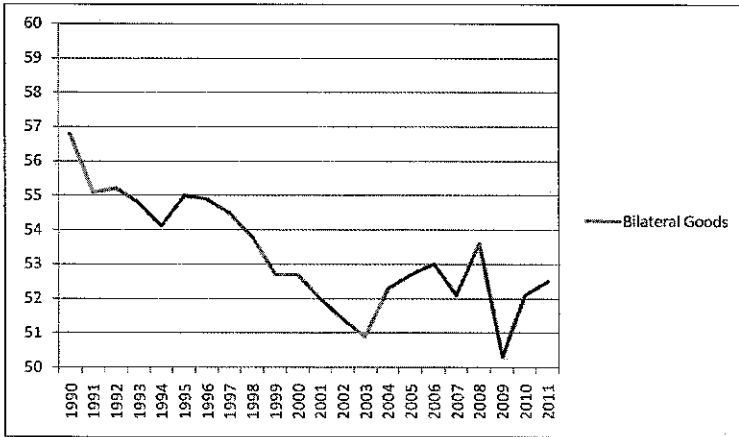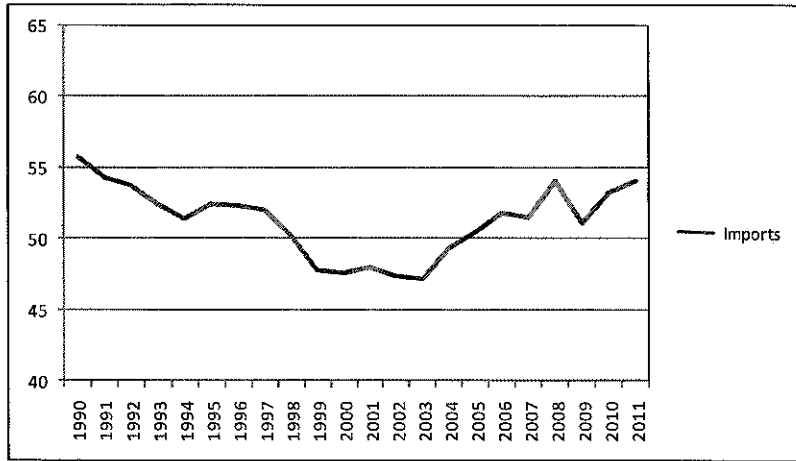
at exports and imports from Canada's perspective, their reported trade share series should be more or less mirror images of our series which define exports and imports from the U.S. perspective. Indeed, Goldfarb and Chu report that the share of middle-stage exports in total Canadian exports declined over the period between 1990 and 2000, while the share of middle-stage imports in total Canadian imports increased modestly over the same period. This is essentially the mirror image of what we find from the U.S. perspective.

In summary, we find that bilateral intermediate goods trade as a share of total bilateral trade (net of fuel) decreased in all but one year over the period 1990-2003. It then increased fairly consistently from 2003 to 2008 before plunging in late 2008-2009 and then recovering post-2009. The end period (2011) value for the ratio was about 2 percentage points higher than at its trough in 2009. However, the behavior of intermediate goods imports differs from that of intermediate goods exports. Specifically, while the intermediate goods share of total imports decreased consistently and substantially from 1990 to 2000, the intermediate goods export share was

slightly higher in 2000 than in 1990. Conversely, while the interme-
diate goods share of total imports was higher in 2011 than in 2000,
the opposite is true for intermediate goods exports as a percentage
of total exports.

An inference to be drawn from our findings reported to this
point is that the time series behavior of total intermediate goods
trade as a share of total trade obscures important differences in the
behavior of intermediate goods imports and exports. Specifically,
over our full sample time period, intermediate goods imports as a
percentage of total imports follow a mirror image time series pat-
tern to that of intermediate goods exports as a percentage of total
exports, with the exception of the immediate post-9/11 period when
both ratios decline. An implication of this observation is that factors
suggested as influencing both intermediate goods' import and ex-
port shares, such as tariff reductions, are unlikely to be important
explanations of intermediate goods trade shares in the bilateral con-
text. Rather, understanding the temporal behavior of intermediate
goods' share of total bilateral trade requires an understanding of
why the temporal patterns for intermediate imports and exports
differ. It is to this issue that we now turn.
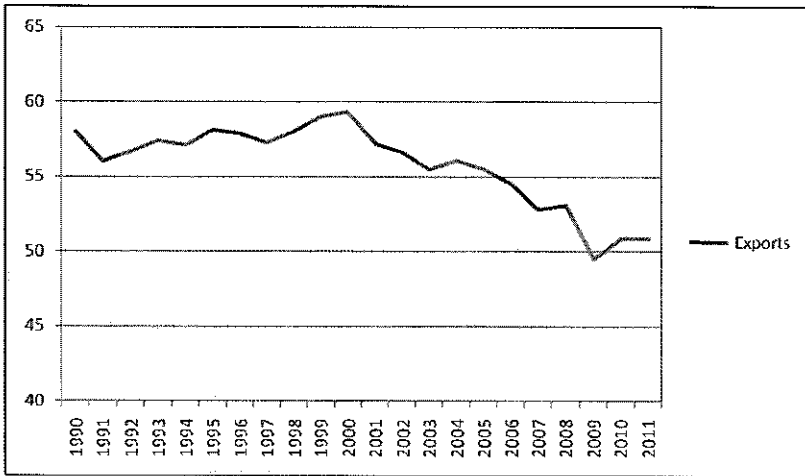
DIRECT AND INDIRECT CHANGES IN THE TRADE-SHARES OF INTERMEDIATE GOODS

Conceptually, for any definition of intermediate goods, the intermediate goods trade ratio for all industries is the sum of the products of the industry-level intermediate goods trade ratios multiplied by the shares of each industry in total trade. As a result, the ratios of imported or exported intermediate goods to total imported or exported goods will be influenced by changes in the industry mix of imports and exports (holding the share of intermediate goods in total trade for each industry constant), and by changes in the share of intermediate goods in total trade for each industry (holding industry constant). Separating the influences of these two broad phenomena could provide insight into the more specific factors that have affected the behavior of bilateral intermediate goods trade that was outlined in earlier sections of this study.

Tables 4 and 5 report data for U.S. imports by two-digit SITC industries for the years 1990, 2001 and 2011. Specifically, Table 4 reports an industry's share of total non-fuel U.S. imports from Canada for each sample year. Since the majority of all two-digit industries account for a very small share of total U.S. imports from Canada, we report results in Table 4 only for the "top ten" industries in

terms of shares of total imports averaged over all three years.[16] The ten industries for which data are reported in Table 4 account for approximately 60 percent of all non-fuel U.S. imports from Canada averaged over the three sample years.

As seen in Table 4, the share of total U.S. non-fuel imports accounted for by the ten most import-intensive industries decreased consistently over the three sample years. To the extent that these industries are characterized by above or below-average intermediate goods trade intensities, their declining importance in total non-fuel imports from Canada would contribute to a decrease (increase) in the intermediate goods intensity of non-fuel imports.

Table 5 reports the ratio of intermediate goods imports to total non-fuel imports for the ten industries listed in Table 4, as well as the ratio of intermediate goods imports to total imports for all two-digit SITC industries. Several observations might be highlighted. One is that the largest import sector (road vehicles) experienced a decrease in its share of total non-fuel imports over the period 1990 to 2001. It also experienced a decline in the share of imports accounted for by intermediate goods over that same period. While the second phenomenon directly contributes to a decrease in the overall ratio of intermediate goods imports to total imports, the first contributes to an indirect *increase* in the ratio. Hence, the contribution of road vehicles to intermediate goods trade intensity of imports as a whole is mixed for the first half of the sample period. Over the period 2001-2011, the share of total imports accounted for by road vehicles continued to decrease, although the ratio of intermediate goods imports to total imports remained constant. As a consequence, the contribution of road vehicles over the period 2001-2011 was to increase the ratio of intermediate goods imports to total imports for the full sample of industries.

A second observation is that several other relatively prominent import sectors also had a "mixed" influence on the behavior of overall intermediate goods imports relative to total non-fuel imports. For example, over the period 1990 to 2001, the intermediate goods share of imports declined for power generating machinery; however, its share of import trade increased.[17] Miscellaneous manufacturing saw the intermediate goods share of imports increase, while its share of imports also increased. The former development contributes directly to an increase in the all-industry share of imports comprised of intermediate goods, while the latter develop-

Table 4
Industry Share of Non-Fuel U.S. Imports from Canada
(Selected Years)

		Import Share		
SITC 2	Industry	1990	2001	2011
78	Road Vehicles	32%	27.6%	22.7%
64	Paper and Paperboard	7.7%	5.4%	3.5%
93	Special Transactions (NEC)	4.6%	6.0%	4.0%
68	Non-Ferrous Metals	4.8%	3.4%	6.6%
71	Power Generating Machinery	3.4%	3.6%	3.1%
77	Electrical Machinery	4.1%	3.2%	2.4%
79	Other Transport Equipment	2.9%	3.8%	2.7%
74	General Industrial Machinery	2.1%	3.1%	3.5%
24	Cork and Wood	3.4%	3.5%	1.4%
89	Misc. Manufacturing	1.6%	2.8%	2.6%
	Sums of Shares	66.6%	58.4%	52.1%

Source: USITC Dataweb

Table 5
Intermediate Goods Imports/Total (Non-Fuel) Imports
(Selected Years)

		Ratio		
SITC 2	Industry	1990	2001	2011
78	Road Vehicles	22	18	18
64	Paper and Paperboard	99	94	87
93	Special Transactions (NEC)	0	0	0
68	Non-Ferrous Metals	100	100	100
71	Power Generating Machinery	94	92	91
77	Electrical Machinery	89	72	66
79	Other Transport Equipment	52	23	33
74	General Industrial Machinery	46	43	42
24	Cork and Wood	100	100	100
89	Misc. Manufacturing	28	35	39
	Average (all industries)	56	48	54

Source: USITC Dataweb

ment lowers that share. On the other hand, in the case of paper and paperboard, electrical machinery, other transportation equipment, and general industry machinery, changes in the two share ratios summarized in Tables 4 and 5 both contribute to a decrease in the overall ratio of intermediate goods imports to total imports.

A third broad observation is that changes in the ratio of inter-
mediate goods imports to total non-fuel imports are relatively mod-
est for most industries in Table 5 over the period 2001-2011. Hence,
changes in the overall ratio for all industries over this period are
likely to reflect changes primarily in the composition of industry
shares of imports over that period.

Figure 5
Intermediate Goods Share of Imports Fixing Industry-level Trade Shares
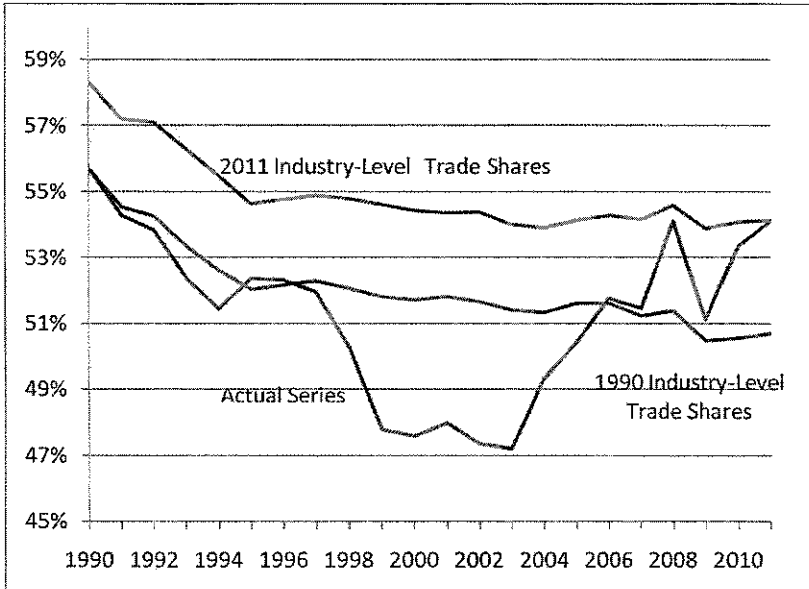
The broad inferences drawn from Tables 4 and 5 are under-
scored by Figures 5 and 6. Figure 5 shows the actual ratio of inter-
mediate goods imports to total imports over the period 1990-2011, as
well as two counterfactual ratios. One is the calculated ratio when
industry-level shares of total imports are held constant at their 1990
values. A second is the calculated ratio when industry-level shares
of imports are held constant at their 2011 values. The two counter-
factual time series control for the influence of changing industry
composition of imports using what are effectively Laspeyres and
Paasche index weights. To the extent that changing industry com-
position has no influence on the ratio of intermediate goods imports
to total imports, the two fixed-weight time series would not differ
very much from the actual time series.

Turning to Figure 5, we see that the two fixed industry trade-share time series decline over the period 1990-2001, as does the actual time series of intermediate goods imports as a share of total imports. However, the slope of the actual series is steeper than the slopes of the fixed weight time series. This is consistent with our earlier assessment that the behavior of the intermediate goods share for total imports reflects changes in industry shares of imports, as well as changes in the intermediate goods import intensities of individual industries. On the other hand, the two fixed weight time series are relatively constant from 2001 to 2011, whereas the actual time series increases sharply over that period. Hence, changing industry shares of imports appear to have a substantial influence on the intermediate goods share of total imports over that latter time period.

Figure 6
Intermediate Goods Share of Imports Fixing Industry-level Intermediate Goods Shares
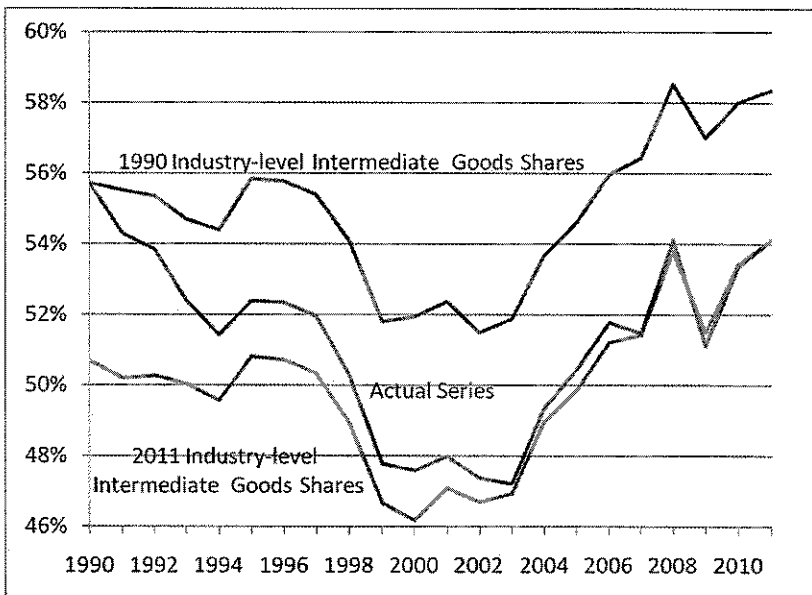
The two counterfactual series in Figure 6 complement those in Figure 5 by holding industry-level intermediate goods shares constant over time. Figure 6 shows that changes in intermediate goods' share of total imports are partly influenced by changes in the trade shares of leading import industries from 1990 to around

2001. Thereafter, changes in intermediate goods' share of imports are almost entirely explained by changes in the shares of individual industries in total imports.

Table 6 reports the industry shares of non-fuel U.S. exports to Canada for the ten two-digit industries enjoying the largest export shares. There is clearly overlap with the leading import industries, with road vehicles dominating both import and export trade. Table 7 reports intermediate goods' share of exports for the same ten industries as in Table 6 for the three selected years. As SITC 78 is the largest export sector, it might be expected to have a prominent impact on the behavior of overall intermediate goods exports to total exports. Since the share of exports of road vehicles attributed to intermediate goods was virtually unchanged over the period 1990-2001, the decreased share of exports accounted for by road vehicles, in conjunction with the slightly below-average intermediate goods trade intensity of that export sector, contributes to the modest increase in the overall ratio of intermediate goods exports to total exports from 1990 to 2001 as identified in Figure 4.

A similar impact could be expected from the declines in the export shares of miscellaneous manufacturing, specialized machinery, and office machines. By analogous reasoning, the increased export shares of power generating machinery would also contribute to an increase in the ratio of intermediate goods exports to total exports. In short, changes in industry export shares arguably influenced the behavior of intermediate goods exports as a share of total exports in the first half of our sample period.

Changes in the ratios of intermediate goods exports to total exports for individual industries are also clearly relevant to understanding the behavior of the overall ratio of intermediate goods exports to total exports between 1990 and 2001. While Table 7 shows very modest changes for the majority of the industries, there were substantial decreases in the ratios for general industrial machinery, electrical machinery and other transport equipment. In short, changes in the overall intermediate goods ratio for exports reflect both changes in industry export shares and changes in intermediate goods trade intensities for individual industries over the period 1990-2001.

A somewhat different picture emerges for the period 2001 to 2011. While the industry-level export shares of the largest export sectors differ when comparing 2001 to 2011, the differences are

Table 6
Industry Share of Non-Fuel U.S. Exports to Canada
(Selected Years)

SITC 2	Industry	Export Share		
		1990	2001	2011
78	Road Vehicles	23%	20.4%	19.4%
74	General Industrial Machinery	6.1%	6.5%	6.4%
77	Electrical Machinery	8.4%	6.7%	5.0%
89	Misc. Manufacturing	5.0%	4.7%	4.8%
72	Specialized Machinery	4.1%	2.8%	4.0%
71	Power Generating Machinery	5.2%	6.6%	3.4%
69	Manufactures of Metal n.e.s.	2.9%	4.1%	3.6%
75	Office Machines	4.5%	3.7%	3.2%
79	Other Transport Equipment	2.3%	2.5%	2.9%
87	Scientific Instruments	2.5%	3.0%	2.4%
	Sum of Shares			

Source: USITC Dataweb

Table 7
Intermediate Goods Exports/Total (Non-Fuel) Exports
(Selected Years)

SITC 2	Industry	1990	2001	2011
78	Road Vehicles	51.3%	51.5%	35.9%
74	General Industrial Machinery	54.5%	48.9%	46.7%
77	Electrical Machinery	83.2%	77.2%	73.5%
89	Miscellaneous Manufacturing	15.9%	21.6%	26.0%
72	Specialized Machinery	35.8%	35.2%	28.6%
71	Power Generating Machinery	84.0%	85.0%	74.4%
69	Manufacturers of Metal n.e.s.	82.4%	84.0%	79.3%
75	Office Machines	32.4%	31.1%	25.4%
79	Other Transport Equipment	54.3%	43.0%	6.4%
87	Scientific Instruments	15.1%	12.5%	10.2%
	Average (all industries)	58.0%	57.2%	50.9%

Source: USITC Dataweb

fairly small for the most part. On the other hand, several indus-try-level changes in the ratio of intermediate goods exports to total exports are quite substantial. This phenomenon is quite noticeably the case for road vehicles, specialized machinery, power generat-ing machinery and other transport equipment, where the relevant ratio decreased. The inference one might draw is that changes in the overall ratio of intermediate goods exports to total exports reflect, to a significant extent, changes in the intermediate goods ratios for individual industries over the full sample period, and particularly over the second half of the sample period.

Figure 7
Intermediate Goods Share of Exports Fixing Industry-level Trade Shares
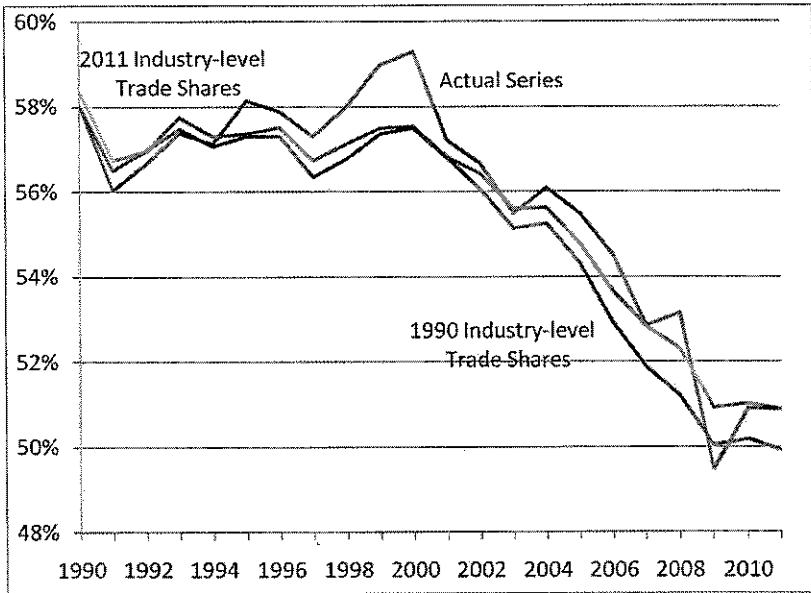
Figures 7 and 8 support this interpretation of the time series reported in Figure 4. Specifically, Figure 7 shows that for the period 1990-2001, the ratio of intermediate goods exports to total exports decreases, even if industry-level trade weights are held constant, while Figure 8 shows that the ratio actually increases if only industry shares of total exports are allowed to change over that same period. For the period 2001-2011, Figure 7 documents that the decrease in the ratio has virtually nothing to do with changing industry shares

of exports. This is seen by the fact that the two counterfactual series holding constant industry-level shares of total exports virtually overlap the actual ratio of intermediate goods exports to total exports. Similar information is provided by Figure 8 which shows that if one holds industry-level intermediate goods share constant at either their initial or end period values, there would have been little change over time in the overall intermediate goods ratio. Equivalently, changes in the industry level composition of total exports had little impact on changes in the overall intermediate goods ratio for exports from 2001 to 2011.

In sum, the behavior of two-way Canada-U.S. intermediate goods trade over the period 1990-2001 reflects the combined impacts of changes in the importance of individual exporting and importing industries, as well as changes in the intermediate goods intensities of exports and imports. Over the period 2001-2011, changes in industry-level intermediate goods intensities do not seem relevant to explaining changes in the behavior of bilateral intermediate goods imports as a share of total imports. Rather, only changes in the industrial mix of imports seem relevant. Conversely, changes in in-

dustrial mix are seemingly relatively unimportant as an explanation of changes in the behavior of U.S. intermediate goods exports as a share of total exports to Canada. For the latter phenomenon, the relevant influence seems to be changes in the intermediate goods intensities of individual export industries, particularly over the period 2001-2011.[18]

This mixed and varying pattern of influences on the overall ratio of intermediate goods trade to total non-fuel trade for imports versus exports suggests that there is unlikely to be a single explanation of the overall ratio for two-way trade. Indeed, it is unlikely that there is a single explanation of the ratio of intermediate goods trade to total trade for imports and exports taken separately. The next section of this paper considers possible explanations in more detail.

Table 8
Intermediate Goods Shares for U.S. Trade with the World

Year	Exports	Imports	Exports + Imports
1995	62%	47%	54%
1998	59%	45%	51%
1999	60%	44%	51%
2000	62%	44%	51%
2001	60%	42%	50%
2002	61%	41%	49%
2003	62%	41%	49%
2004	61%	43%	50%
2005	61%	43%	50%
2006	60%	44%	50%
2007	60%	43%	50%
2008	60%	44%	51%
2009	60%	41%	49%
2010	61%	42%	50%
2011	61%	44%	51%
2012	60%	44%	51%

Source: COMTRADE Data, November 30, 2013.

EXPLAINING THE PATTERN OF BILATERAL INTERMEDIATE GOODS TRADE

Some insight into the factors influencing the pattern of bilateral intermediate goods trade might be obtained by considering how U.S. intermediate goods trade with countries other than Canada varied over our sample time period. Table 8 reports our calculations

of intermediate goods share of total U.S. trade with the world for selected years. It shows a pattern that is similar to that of Canada-U.S. bilateral trade. Specifically, two-way intermediate goods trade as a share of total U.S. trade with the world decreases from 1995 to 2002 and then increases slightly through 2005. Furthermore, the ratio at the end of 2010 is about equal to the ratio in 2005. Thus, the behavior of U.S. intermediate goods trade with the world is similar to its pattern of overall intermediate goods trade with Canada over the period 1990-2011; however, there are slight differences when considering imports and exports separately. As shown in Figure 3, in the case of Canada-U.S. trade, intermediate goods imports as a share of total imports decreased from 1990 through approximately 2003 and then essentially increased for the rest of the time period. In the case of U.S. trade with the world, intermediate goods imports

Figure 9

Influence of Changing Industry Shares versus Changing Intermediate Gods Intensities

	Changing Industry Shares		Changing Intermediate Goods Intensity	
	1990-2001	2001-2011	1990-2001	2001-2011
Imports	Relevant	Relevant	Relevant	Irrelevant
Exports	Relevant	Irrelevant	Relevant	Relevant

as a share of total imports also decreased noticeably from 1995 to 2002;[19] however, the subsequent increase in the share is somewhat more modest than in the case of Canada-U.S. trade. For exports, the intermediate goods share of U.S. trade with the world is essentially unchanged over the period 1995-2010, whereas Figure 4 shows a modest increase from 1990 to 2001 for U.S share of exports to Canada and then a fairly pronounced decrease through 2009.

In short, the pronounced decrease in U.S. intermediate goods exports to Canada as a share of total non-fuel exports in the post-2001 period stands out as a distinctive feature of U.S. international trade. This suggests that factors generally influencing U.S. trade relations with its other trading partners are unlikely explanations for the distinctive feature of Canada-U.S. trade in intermediate goods; namely the marked decrease in U.S. exports of intermediate goods to Canada as a share of total U.S. exports to Canada. As discussed

earlier, this decrease is almost entirely due to a decrease in the ratio of intermediate goods exports to total exports at the industry level. As seen in Table 7, the industry-level decrease is especially prominent in two SITC categories when comparing 2011 to 2001: road vehicles (SITC 78) and other transport equipment (SITC 79).[20] Hence, an understanding of why the ratio declined in these two export industries would help explain the behavior of the overall ratio of intermediate goods exports to total exports.

One explanation for the decline in the ratio observed for "other transportation equipment" is the fact that the U.S. government swept all data on aircraft exports into a single category which the BEC correspondence table classifies as a final good. Hence, beginning in 2009, exports of aircraft parts are identified as final goods exports rather than as intermediate goods exports. The decline in intermediate goods share of exports from 2001 to 2011 reported in Table 7 is, therefore, overstated. As well, the slight recovery in intermediate goods exports as a share of total exports over the period 2009-2011 is likely understated. However, the bias owing to reclassification is arguably relatively small. Specifically, intermediate goods exports as a share of total exports averaged 50.4% over the period 2009-2011 when SITC 79 is included in the series and 51.8% when it is excluded.

The change in the ratio of intermediate goods exports to total exports in the transportation equipment sector might also be explained by a changing pattern of geographical specialization for road vehicles (SITC 78). Specifically, U.S.-based manufacturers may have chosen to assemble more cars in their Mexican affiliates than in their Canadian affiliates. As a consequence, U.S. parts suppliers may have exported more parts to Mexico than to Canada. This speculation is certainly supported by the information summarized in Figure 10 which shows the behavior of intermediate goods exports (automotive parts and assemblies) as a share of total automotive goods exports to Mexico and Canada, respectively.[21] Figure 10 shows a dramatic divergence in the series for the two countries. Whereas U.S. exports to Mexico are increasingly intermediate goods-intensive post-2005, the share of intermediate goods in total automotive goods exports to Canada decreases post-2004.

The increase in U.S. exports of vehicle parts to Mexico is consistent with Mexico's growing North American share of light vehicle (car and light truck) production. This share grew from 6%
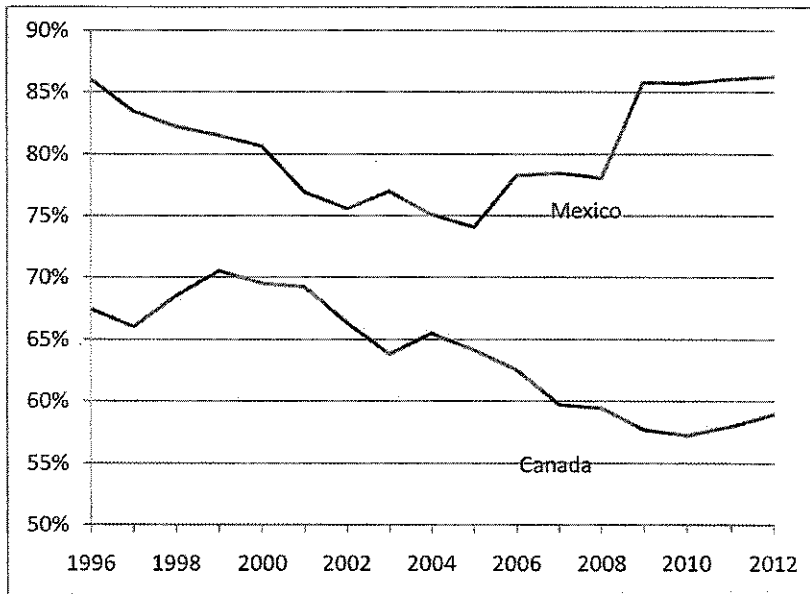
in 1990 to 11% in 2000 and then to 19% in 2012. In 2008, Mexico surpassed Canada for the first time as the second-largest producer of light vehicles in North America, after the United States. Indeed, Mexico's production gap with Canada increased every year from 2008 to 2012.[22] Klier and Rubenstein (2013) credit Mexico's expansion in auto production capacity to its low auto industry wage rate compared to the U.S. and Canada. Also, a shift in the mix of vehicle production toward small vehicles favored vehicle production in Mexico, as its plants were primarily designed to produce small vehicles. Finally, Mexico's vehicle exports outside North America increased substantially post-2001 given the proliferation of free trade agreements that Mexico signed with the European Union and various countries in Asia. The rapid growth of vehicle sales undoubtedly increased Mexican demand for vehicle parts.

In a similar manner, the growth of the vehicle assembly sector in Mexico can help explain the marked decline in the share of U.S. imports from Canada accounted for by SITC 78 (road vehicles) over the period 2001-2011. Specifically, the U.S. may have increased imports of road vehicles from Mexico in preference to importing ve-

hicles from Canada. This phenomenon contributes to the growth in intermediate goods imports as a percentage of total imports over the period 2003-2011 as shown in Figure 3. This is because intermediate goods imports as a share of total imports for road vehicles are well below the average for all SITC industries. Hence, a declining import share for road vehicles would contribute to a higher average ratio of intermediate goods imports to total imports. Support for this interpretation is provided in Figure 11 which shows the shares of U.S. imports of cars and light trucks from Canada and Mexico. Canada's share in 2011 is significantly below its value in 2004, whereas the reverse is true for Mexico.

Other explanations for the post-2001 observed decreases in the ratio of intermediate goods exports to total exports shown in Figure 4 are less obvious. For example, it seems likely that border delays owing to post-9/11 security procedures contributed to the

Figure 11
Shares of U.S. Imports of Passenger Vehicles from Canada and Mexico
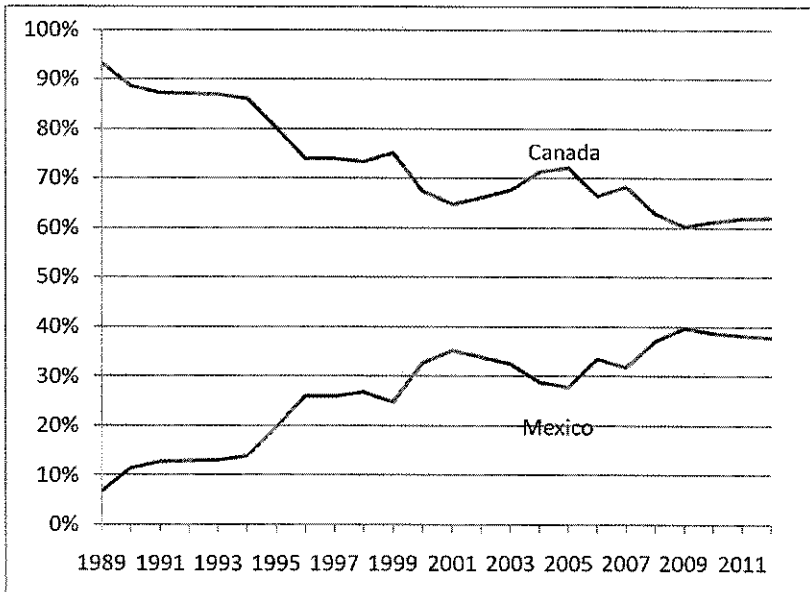
observed decreases in both imports and exports of intermediate goods as a share of total imports and exports, respectively, in the 2001-2002 time period. However, it seems unlikely that tightened border security impacts persisted beyond 2003, primarily because the pattern identified for intermediate goods' share of imports is the mirror image of the pattern identified for intermediate goods' share of exports. There is no reason to believe that border delays adversely impacted U.S. exports of intermediate goods to Canada while promoting U.S. imports of intermediate goods from Canada, especially since North American executives, as well as statistical evidence, consider post-9/11 border disruptions as more severe for goods entering the U.S. than for goods entering Canada.[23]

Similar reasoning militates against increased product regulations applied by customs officials as a robust explanation of the patterns of trade illustrated in Figures 3 and 4. It is implausible that regulatory changes in Canada affecting cross-border trade could be so different from regulatory changes in the U.S., such that the export share of intermediate goods would behave so differently from the import share of intermediate goods over the period 2001-2011.

The severe recession of 2008-2009 does appear to have contributed to a relatively short-run decrease in the ratio of intermediate goods trade to total trade for both imports and exports. As discussed earlier, this result likely reflects the fact that intermediate goods trade is more sensitive to business cycle conditions than trade in final goods.

There is also some support for the argument that trade in intermediate goods is less sensitive to changes in exchange rates compared to trade in final goods. Over the period 2003-2011, the Canadian dollar generally increased in value relative to the U.S. dollar. One would expect this development to discourage increased U.S. imports from Canada while encouraging U.S. exports to Canada. If intermediate goods experience weaker exchange rate "pass through" than final goods, the ratio of intermediate goods imports to total imports could be expected to generally increase over the period 2003-2011. This is because intermediate goods imports would decline more slowly than total imports. In fact, this appears to be the case over the time period 2003-2011. As well, intermediate goods exports could be expected to increase at a slower pace than total exports given a decline in the U.S. dollar over the period 2003-2011. The information in Figure 4 supports this expectation. As a

practical matter, we cannot assess the importance of the growth of Mexico's auto assembly sector relative to changes in the Canada-U.S. exchange rate as determinants of observed patterns of bilateral trade intensity. These trends basically occurred over the same time period. However, it is plausible that the appreciation of the Canadian dollar over the past decade contributed, at the margin, to increased production of motor vehicles in Mexico.

It is also possible that other industries besides autos help to explain the post-2001 decline in intermediate goods exports as a share of total U.S. exports to Canada. When measured by looking at the change in the product of industry-level intermediate goods shares multiplied by the industry's share of exports (in either 1990 or 2011), about half of the decline in the overall intermediate goods share of exports is attributable to road vehicles. In addition to the "Other Transportation" industry where changes in industry-level intermediate goods shares may be largely the outcome of the statistical reclassification described above, a number of other industries

Figure 12
Intermediate Goods as a Share of U.S. Electrical Machinery Exports
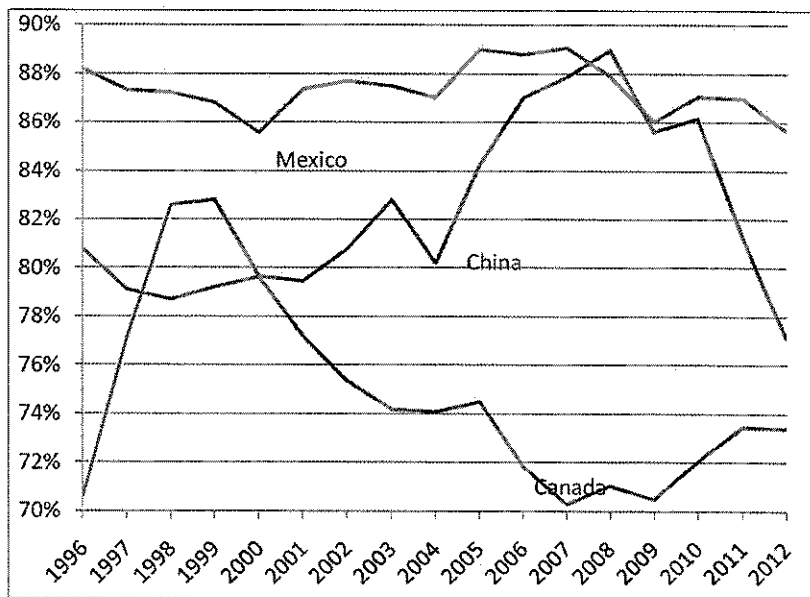
might account for a modest, but non-trivial, portion of the decline as a consequence of increased U.S. outsourcing. Among the most likely candidates are the following SITC codes: 71, 72, 76, and 77.[24] All four of these industries are in the machinery and equipment section of the SITC classification, and they account for between roughly three and seven percent of the total drop in the intermediate goods share for U.S. exports. Of these four industry codes, we select SITC 77, "Electrical Equipment", for greater scrutiny given the important role that outsourcing has played in this industry in recent years.

The intermediate goods share for SITC 77 is shown in Figure 12 for U.S. exports to Canada, China, and Mexico. The graph shows a fairly constant intermediate goods share for Mexico, while the series for Canada and China have been much more variable since 1996. Beginning around 2000, there is a noticeable negative relationship between the two series for Canada and China. Specifically, from 2000 through 2007, the intermediate goods share rose for China and fell for Canada. This pattern is consistent with China displacing Canada as a location for the use of U.S. intermediate goods in the assembly of electrical machinery. After 2009, however, the intermediate goods share rebounds somewhat for Canada and declines significantly for China. Interestingly, this post-2009 reversal for Canada and China coincides with a rebound of the intermediate goods intensity of all U.S. exports to Canada. As a result of the reversal of the 2000-2007 pattern, SITC 77 accounts for a smaller portion of the change in the overall intermediate goods share of exports between 2001 and 2011 than it does between 2001 and 2007. Nevertheless, on balance, post-2000 shifts of production to China reduced the intermediate goods intensity of U.S. exports of electrical machinery and, likely, of other machinery and equipment industries.

CONCLUSIONS AND POLICY IMPLICATIONS
This paper identifies a number of important changes over time in the intermediate goods intensity of Canada-U.S. trade. An important finding is that the time series of Canada-U.S. intermediate goods trade intensities have mirror-image shapes for U.S. imports and exports. The mirror-image time series pattern is reflected in Figure 13 which shows the intermediate goods' share for U.S. exports to Canada minus the corresponding value for U.S. imports. Broadly speaking, the figure shows that from 1990 to around 2001, intermediate goods exports as a share of total exports increased faster than intermediate goods imports as a share of total imports. The reverse

Figure 13
Intermediate Goods Share for U.S. Exports to Canada
Minus Share for U.S. Imports from Canada
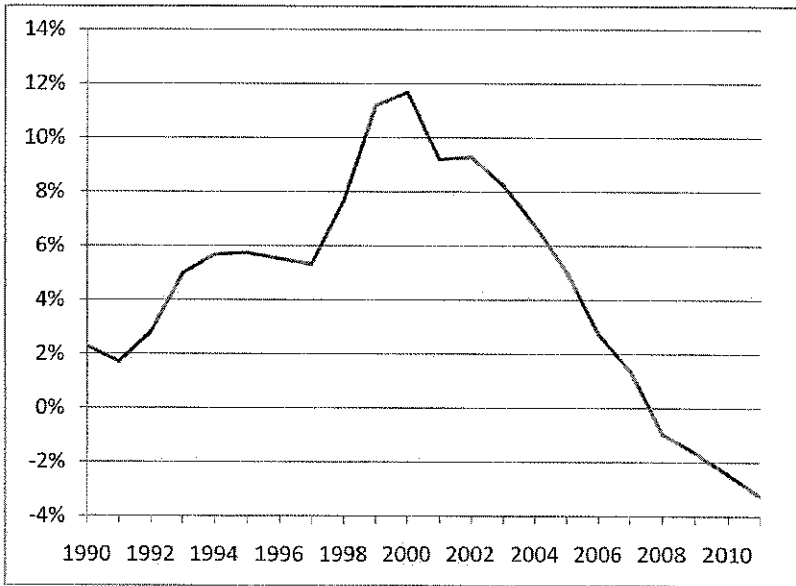
was true from 2001 through 2011. Furthermore, the determinants of the pattern summarized in Figure 13 arguably differ as they apply to imports and exports. Specifically, changing industry-level shares of trade seem to matter much more for imports than for exports, while changes to industry-level intermediate goods share are the driving force for exports.

Given that our ultimate goal is to guide policy makers with an interest in Canada-U.S. trade, we focus on identifying patterns in intermediate goods intensity that are specific to bilateral trade. Patterns that are found in U.S. trade with the world in general will not require a Canada-specific policy response. The pattern we identify that is of greatest relevance for Canada-U.S. trade policy is the decrease in the intermediate goods share of U.S. exports to Canada from roughly 2001 through 2009. We find some evidence that the industry-level declines in intermediate goods intensity for U.S. exports to Canada are associated with shifts of assembly operations

to low-wage locations such as Mexico in the case of the automotive industry and, to a lesser extent, to China in the case of electrical machinery.

The appropriate policy response to these observed patterns is unclear. The fact that declining intermediate goods intensity is greatest for SITC codes in the "equipment" section of the industrial classification might be cause for concern, since it could lead to Canada losing access to intermediate inputs for high valued-added sectors such as the automotive industry. At the same time, it might also be true that assembly activities in China and perhaps also Mexico could involve relatively low value and, as a result, this changing trade pattern might be of little concern to Canada. The link between intermediate goods trade and global value chains means that policy makers must be aware of changing patterns of intermediate goods intensity. This paper has provided important contributions toward describing and explaining these patterns, as well as determining their significance. Perhaps the simple message for Canadian policymakers is that North American firms are increasingly integrated into global value chains, and that the economic importance of North American production integration is tied to closer trade and investment relationships with other parts of the world.

Our analysis also suggests that initiatives to expedite commercial shipments of intermediate goods (such as FAST) offset border-thickening related to post-9/11 border security developments. Additional initiatives to lower border costs could therefore further promote intermediate goods trade. While our analysis does not clearly identify increasing regulatory cost burdens as a factor discouraging trade in intermediate goods particularly, the harmonization and streamlining of border regulations is still undoubtedly a worthwhile policy to pursue.

REFERENCES

Anderson, James and Eric Van Wincoop (2004)."Trade Costs."*Journal of Economic Literature*, Vol. XLII, pp. 691-751.

Bergstrand, Jeffrey and Peter Egger (2008)."The Growth of FDI Relative to Trade: Measurement, Determinants and Consequences of International Trade Flows in Intermediates." University of Notre Dame, mimeo, http://www.jhubc.it/FULLEVENTCAL/UPLOADFILE2/Bergstrand%20Paper.pdf

Blank, Stephen (2009)."The North American Free Trade Agreement and North America." Portal for North America, The Centre for International Governance Innovation, available at: http://www.portalfornorthamerica.org/es/teaching-resources/north-american-free-trade-agreement-and-north-America.

Blank, Stephen (2013). "Getting to North American Governance: Practice, Practice, Practice." Ottawa: Centre on Governance, Conference Summary Report, No. 1.

Bridgman, Benjamin (2010)."International Supply Chains and the Volatility of Trade." Bureau of Economic Analysis, Working Paper No. 0067.

Burt, Michael (2009)."Tighter Border Security and Its Effect on Canadian Exports."*Canadian Public Policy*, XXXV (2), pp. 149-169.

Chen, Pu (2010)."Trade Volatility and Intermediate Goods."University of Minnesota, mimeo.

Chen, Hogan, Matthew Kondratowicz and Kei-Mu Yi (2005). "Vertical Specialization and Three Facts about International Trade." *North American Journal of Economics and Finance*, Vol. 16, pp. 35-59.

Feenstra, Robert (1998)."Integration of Trade and Disintegration of Production in the Global Economy." *Journal of Economic Perspectives*, 12 (4), pp. 31-50.

Feenstra, Robert and Gordon Hanson (1999). "The Impact of Outsourcing and High Technology Capital on Wages: Estimates for the U.S., 1979-1990."*Quarterly Journal of Economics*, Vol. 114, pp. 907-940.

Georgopoulos, George (2008). "The J-Curve Revisited: An Empirical Analysis for Canada."*Atlantic Economic Journal*, 36 (3), 315-332.

Globerman, Steven and Paul Storer (2008). *The Impacts of 9/11 on Canada-US Trade*. Toronto: University of Toronto Press.

Globerman, Steven and Paul Storer (2009). "Border Security and Canadian Exports to the United States: Evidence and Policy Implications."*Canadian Public Policy*, XXXV (2), pp. 172-186.

Globerman, Steven and Paul Storer (2011)."Regional and Temporal Variations in Transportation Costs for U.S. Imports from Canada."*The Journal of Regional Analysis & Policy*, 41 (1), pp. 38-55.

Goldfarb, Danielle (2007). "Reaching a Tipping Point? Effects of Post-9/11 Border Security on Canada's Trade and Investment." Ottawa: The Conference Board of Canada.

Goldfarb, Danielle and Doris Chu (2008). "Stuck in Neutral: Canada's Engagement in Regional and Global Supply Chains." Ottawa: The Conference Board of Canada.

Grady, Paul (2008), "How Much Were Canadian Exports Curtailed by Post 9/11 Thickening of the U.S. Border?" Unpublished manuscript. Accessed 25 May 2009 at http://www.global-economics.ca/border_post911.pdf

Hart, Michael (2010). *A Matter of Trust: Expanding the Preclearance of Commerce between Canada and the United States*. Toronto: C.D. Howe Institute, mimeo.

Hodgson, Glen (2008). "Making Integrative Trade Real: Creating a Value Chain Trade Policy for North America." Ottawa: The Conference Board of Canada.

Klier, Thomas and James Rubenstein (2013). "Mexico Growing Importance in North American Auto Production." Chicago: Federal Reserve Bank of Chicago Fed Letter.

Miroudot, Sebastien, Rainer Lanz and Alexandros Ragoussis (2009). "Trade in Intermediate Goods and Service." OECD Trade Policy Working Paper No. 93, Paris: OECD.

Oguro, Yoko, Kyoji Fukao and Yougesh Katu (2008). "Trade Sensitivity to Exchange Rates in the Context of Intra-Industry Trade." Washington, D.C.: IMF Working Paper, wp/08/134.

Sturgeon, Timothy and Olga Memodovic (2011). "Mapping Global Value Chains: Intermediate Goods Trade and Structured Change in the World Economy." Vienna: United Nations Industrial Development Organization.

ENDNOTES

[1] See Blank (2009) for a discussion of the distinction and its relevance to policymakers.

[2] The results for Canada's total trade are similar to those for trade with its North American partners.

[3] Hodgson (2008).

[4] The share of entry-stage exports was the same in 2006 as in 1990, while end-stage exports' share was correspondingly higher in 2006 than in 1990. The share of entry-stage imports was lower in 2006 than in 1990, while the reverse was true for end-stage imports. The changes were relatively small in all cases.

[5] Goldfarb and Chu report that Canada's top twenty-five exports and imports accounted for approximately 85% of its total goods trade with the world in 2006.

[6] Feenstra (1998) reports that agriculture and raw materials accounted for a major decline in the share of U.S. trade over the period 1950-1995.

[7] Customized intermediate products are those they deemed likely to be used in specific final products, or at least in relatively narrow classes of products. Generic intermediates are products likely to be used in a wide range of final products, as well as products made in large, standardized batches.

[8] Blank (2009) argues that much of the relevant bilateral production integration took place prior to CUSTA.

[9] Oguro, Fukao and Katu (2008) show that intra-industry trade is less sensitive to exchange rate changes than inter-industry trade.

[10] See Miroudot, Lanz and Ragoussis (2009).

[11] See Bergstrand and Egger (2008) for an illustration of this methodology.

[12] We used the downloadable BEC – SITC Rev. 3 correspondence file available from the United Nations Statistics Division at http://un-stats.un.org/unsd/cr/registry/regdnld.asp?Lg=1.

[13] In 1990, bilateral trade through the northern border U.S. customs districts accounted for around 85 percent of total bilateral trade. In 2011, the share was around 77 percent.

[14] Real imports are deflated by the U.S. Import Price Index for Canada, while real exports are deflated by the U.S. Producer Price Index (PPI) for manufacturing. Georgopoulos (2008) recommends using the PPI for manufacturing, since around 90% of Canada's imports from the U.S. are manufactured goods.

[15] Our findings do support Goldfarb and Chu's observation that trade in middle-stage goods as a share of total trade decreased from 2000 to 2003 and then increased through 2006. We also note that our measure of intermediate goods includes primary goods that are likely excluded from Goldfarb and Chu's measure.

[16] Import shares in each year for every two-digit industry are available from the authors upon request.

[17] Since power generating machinery is characterized by an above average ratio of intermediate goods imports to total imports, the former phenomena will lower the all-industry share of imports consisting of intermediate goods, while the latter will increase the share.

[18] A summary of these various impacts is provided in Figure 9.

[19] See Table 8.

[20] For these two industries, intermediate goods are likely to be vertical specialized or middle-staged as defined in an earlier section.

[21] Figure 10 is based on lists of HTS codes for passenger vehicles and light trucks (final goods) and automotive parts and assemblies (intermediate goods) that were created by the U.S. Department of

Commerce. These lists are accessible through the USITC Dataweb Web site. These HTS-based decompositions into intermediate and final goods will include some intermediate goods that are not included in SITC 78.

[22] See Klier and Rubenstein (2013).

[23] For a full discussion of this asymmetry in border thickening, see Globerman and Storer (2008).

[24] The descriptions of these four industries are: SITC 71, Power Generating Machinery and Equipment; SITC 72, Specialized Machinery; SITC 76, Telecommunications and Sound Recording Apparatus; and SITC 77, Electrical Machinery, Equipment, and Apparatus.

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