

June 2020



604-170 Laurier Ave. West
Ottawa, Ontario
K1P 5V5

613-233-8891
csls@csls.ca

CENTRE FOR
THE STUDY OF
LIVING
STANDARDS

The Price Effect of Trade: Evidence of
the China Shock and Canadian Consumer
Prices

Myeongwan Kim

Prepared for Global Affairs Canada

June 2020

CSLS Research Report 2020-02

The Price Effect of Trade: Evidence from the China Shock and Canadian Consumer Prices

Abstract

The explosive growth in Chinese imports to Canada over the last two decades has had both negative and positive effects. In this paper, we look at the impact of Chinese imports on the prices Canadians pay for household consumption goods. We find Canadians have benefited from lower prices on some goods and lower inflation overall. To quantify the importance of Chinese imports for individual consumer products and map them to consumer price data, we construct concordance between products in the consumer price index (CPI) and commodities in the Harmonized Commodity Description and Coding System. We estimate that over the 2001-2011 period, cumulative inflation would have been 1.17-percentage-points higher for the total CPI had there been no change in the Chinese share of total imports in Canada. This assumes other factors are held constant. The average annual inflation for the total CPI was 2.1 per cent over the 2001-2011 period, implying that annual inflation would have been about 0.12-percentage-points higher if there had not been a surge in imports from China.

The Price Effect of Trade: Evidence from the China Shock and Canadian Consumer Prices

Table of Contents

Abstract	I
List of Tables and Charts	III
Executive Summary	IV
I. Introduction	1
II. Data	5
1. Consumer Prices Data	6
2. Trade Data	7
3. Input-Output Data	7
4. Concordance	7
III. Descriptive Statistics: Trade and Consumer Prices Data	10
IV. Empirical Approach	14
1. Estimating Equation	14
2. Identification Strategy	15
3. Summary Statistics	17
V. Results	18
1. Baseline results	18
2. Contextualizing the Results	22
VI. Conclusion	25
References	26
Appendix A	29
Appendix B	32
Appendix C	35

The Price Effect of Trade: Evidence from the China Shock and Canadian Consumer Prices

List of Tables

Table 1: Domestically-produced and imported consumer goods, Canada, 2001-2017	10
Table 2: Average annual percentage-point change in the Chinese share in total imports and average annual inflation (per cent), 2001-2011	13
Table 3: Summary statistics, Stacked sub-periods, 1991-2011	17
Table 4: The effect of change in the Chinese share of total imports in Canada on consumer goods prices, Stacked differences: 1991-2001 and 2001-2017; 1991-2001 and 2001-2007; 1991-2001 and 2001-2011; 1996-2001 and 2001-2011.....	19
Table 5: The effect of Chinese imports on Canadian CPI for consumer goods, Robustness checks, 2001-2011, 2SLS estimates.....	21
Table 6: Trade-induced annual price changes, per cent, Selected CPI products, 2001-2011, Canada.....	23
Table 7: Implied effects of Chinese imports, Cumulative over 2001-2011.....	24
Table A1: Input-output linkages, Stacked differences: 1991-2001 and 2001-2011, Using import penetration ratio, 2SLS estimates	33
Table A2: The effect of Chinese imports on Canadian CPI for consumer goods, Using import penetration ratio, Stacked differences, 2SLS estimates	35

List of Charts

Chart 1: Chinese share in total imports by country, 1991-2017	2
Chart 2: Chinese share in total imports by CPI product category, per cent, Canada, 1991-2017 ...	3
Chart 3: Consumer Price Index by product category (Index=2001), Canada, 1991-2017	4
Chart 4: Chinese share in total imports by detailed product class in CPI, Canada, 1991-2017	11
Chart 5: Average annual change in the Chinese share in total imports (ΔVSH and $\Delta VSHE$), Consumer product classes in CPI, Canada and eight other advanced economies, percentage point, 2001-2011	17
Chart 6: Estimated marginal price effects of Chinese imports, by sub-period, 2SLS estimates, 90% confidence band.....	20
Chart A1: Chinese share in total imports by category, Canada, 2000-2011	34
Chart A2: Average annual inflation (per cent) and average annual change in the Chinese share in total imports (percentage point), by product class in CPI, Canada, 2001-2011	35

The Price Effect of Trade: Evidence from the China Shock and Canadian Consumer Prices

Executive Summary

Over the last 20 years Chinese-made goods have occupied more and more space in the shopping baskets of Canadians. This has costs and benefits. There is no shortage of research on the costs, which include job losses in manufacturing. This study is the first to take a detailed look at the benefits, which include lower prices for some products and lower inflation overall.

China became an exporting powerhouse after it joined the World Trade Organization (WTO) in 2001. Much of this export surge, commonly called the China Shock, stemmed from internal factors in China, such as urbanization, the rising competitiveness of Chinese manufacturing and the Chinese government's decision to abide by the rules of global trade. China wanted to sell its goods to the world and consumers in other countries were happy to buy them. The expansion of superstores like Wal-Mart, which focussed on high-volume, low-margin sales, boosted the spread of Chinese products.

We focus on goods in this paper. In 2000, consumer goods from China accounted for 5 per cent of all imported consumer goods in the basket of goods and services that Statistics Canada uses to calculate the consumer price index (CPI). A decade later they accounted for 14 per cent. The increase varied depending on the product category.

Canadians experienced particularly-rapid, trade-induced price declines in consumer products related to textiles, clothing, furniture, and electronics. It is worth noting that technological progress, which may be interrelated with rising Chinese imports, may also have depressed prices. Increasing imports from China could have induced domestic firms to adopt advanced technologies to become more competitive or because trade with China made those technologies more available.

We estimate that, on average, a 1-percentage-point increase in the Chinese share in total imports of a given product leads to a 0.221-percentage-point decrease per year in its consumer price. We also find that, over the 2001-2011 period, the cumulative inflation for all consumer goods in the consumer price index would have been higher by 2.41 percentage points had there been no change in the Chinese share of total imports in Canada. In other words, the cumulative inflation for all consumer goods over this period would have been 20.01 per cent instead of 17.60 per cent.

For the total consumer price index, which includes services as well as goods, cumulative inflation would have been higher by 1.17 percentage points in 2011 had the Chinese share in total imports in Canada remained at the 2001 level. The average annual inflation for the total CPI was 2.1 per cent over the 2001-2011 period, implying that the annual inflation would have been about 6 per cent higher (or 0.12 percentage-points) without the increase in imports from China.

How do these benefits stack up against the costs associated with the large increase in imported goods from China? A 2018 study by Myeongwan Kim estimated that the loss of 113,500 manufacturing jobs between 2001 and 2011 could be associated with the rise in imports of Chinese goods. The average annual wage for a manufacturing worker during the period was \$42,868 (in 2002 dollars).

This current study implies that lower inflation rates over this period translate into a cumulative gain of \$546 per Canadian worker or \$76,996 (in 2002 dollars) for every job lost. If this amount of money were given to the workers who lost their jobs it would be sufficient to compensate for lost earnings or training or other financial costs associated with finding a new job. It is worth noting that the costs of the China Shock are borne by a small group of workers and firms whereas the benefits are widely spread across Canada. Our findings provide support for compensation programs and other policies that redistribute the gains from trade

We suggest more research is needed to identify true trade shocks and to determine whether the benefits of lower prices are distributed equally among income groups.

The Technical Details

In this report, we estimate the overall price effect of increasing imports from China on consumer goods in Canada. To our knowledge, there is only one study (Morel, 2007) on this issue using Canadian data. There is no study analyzing the issue in Canada at a detailed product level, relying on econometrics. One potential reason is that the information researchers can use to map Canadian price data to trade data at a detailed product level is not readily available. There has been no attempt in the literature to map detailed product classes in official Canadian CPI data to commodities in the Harmonized Commodity Description and Coding System (HS).

To map import exposure measures to price data for a given consumer product, we construct concordance between basic product classes (the most detailed level available to the public) in the CPI published by Statistics Canada and HS commodities in the United Nations Comtrade database. We carry out concordance between an expenditure-based classification system (CPI) and an output-based system (HS) by using the Classification of Individual Consumption According to Purpose (COICOP) and the Central Product Classification (CPC) as bridges since the United Nations Statistics Division publishes official concordance tables for COICOP-CPC and CPC-HS codes. Note that COICOP is expenditure-based and CPC is output-based. After mapping CPI products to HS commodities, we construct a measure of Chinese import exposure for each CPI product.

An instrumental variable strategy is employed to identify trade shocks related to rising Chinese exporting capacity. We exploit the fact that growth in Chinese imports to developed economies like Canada since the early 2000s mostly stemmed from factors internal to China (urbanization, rising competitiveness in manufacturing, and accession to the WTO) rather than from positive demand shocks within developed economies. Thus, following Autor, Dorn, and Hanson (2013), we instrument for changes in the Chinese share of total imports in Canada using the changes in the Chinese share of total imports in eight high-income economies (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain and Switzerland).

The Price Effect of Trade: Evidence from the China Shock and Canadian Consumer Prices¹

I. Introduction

A growing literature on the China Shock focuses on the effect trade with China has on labour markets. There are a number of empirical studies relying on reduced-form methods that quantify the loss of manufacturing jobs due to China.² Some studies have explored the effect of trade on wages in different sectors.³

To promote a more balanced assessment of trade, researchers should also pay attention to all potential gains from trade. The impact of trade on consumer prices is likely to be an important gain. Canadians may have benefited if Chinese exports to Canada reduced domestic consumer prices. This is known as the Wal-Mart effect. It describes what happens when consumers substitute cheaper foreign goods for their normal purchases.⁴ But it can also occur when domestic producers lower their prices in response to competition from Chinese goods.⁵

Empirical evidence on the effect of trade on consumer prices is relatively limited and tends to focus on the United States.⁶ Previous studies that used scanner-level price data found that increasing Chinese import competition had a negative impact on consumer prices in the US.⁷ A study of Mexico that used micro data⁸ found that increasing trade driven by Mexico's accession to the North American Free Trade Agreement (NAFTA) reduced consumer prices.

¹ This report was written by Myeongwan Kim for Global Affairs Canada when he worked as an economist at the Centre for the Study of Living Standards (CSLS). The author thanks the United Nations Statistics Division for providing useful information on concordance tables. The author also thanks Andrew Sharpe at CSLS and Audrey Bélanger Baur, Hossein Rostami, and Colin Scarffe at Global Affairs Canada for helpful comments. The Centre for the Study of Living Standards would like to thank Global Affairs Canada for financial support for this research. This report was prepared for the Office of the Chief Economist at Global Affairs Canada. However, the opinions in this report are those of the author. An earlier version of the report was presented at the CSLS session on "The Impact of China on the Canadian Economy" at the annual meeting of the Canadian Economic Association held in Banff, Alberta, June 1st 2019. Email: myeongwan.kim@mail.utoronto.ca

² Some key examples are Autor, Dorn, Hanson (2013) and Acemoglu, Autor, Dorn, Hanson, and Price (2016) for the United States; Balsvik, Jensen, and Salvanes (2015) for Norway; and Murray (2017) and Kim (2018a, b) for Canada.

³ Examples are Cravino and Sotelo (2017) and Burstein and Vogel (2017)

⁴ As suggested by the trade models introduced in Arkolakis, Costinot, and Rodriguez-Clare (2012). Examples are Anderson (1979), Eaton and Kortum (2002), Krugman (1980), and Melitz (2003).

⁵ Jaravel and Sager (2018) find empirical evidence that a fall in prices in the United States is also stemmed from an endogenous response of domestic producers. Domestic producers could lower their markups or improve productivity due to the threat of Chinese competition.

⁶ Some examples are Broda and Romalis (2008), Bai and Stumpner (2017) and Jaravel and Sager (2018).

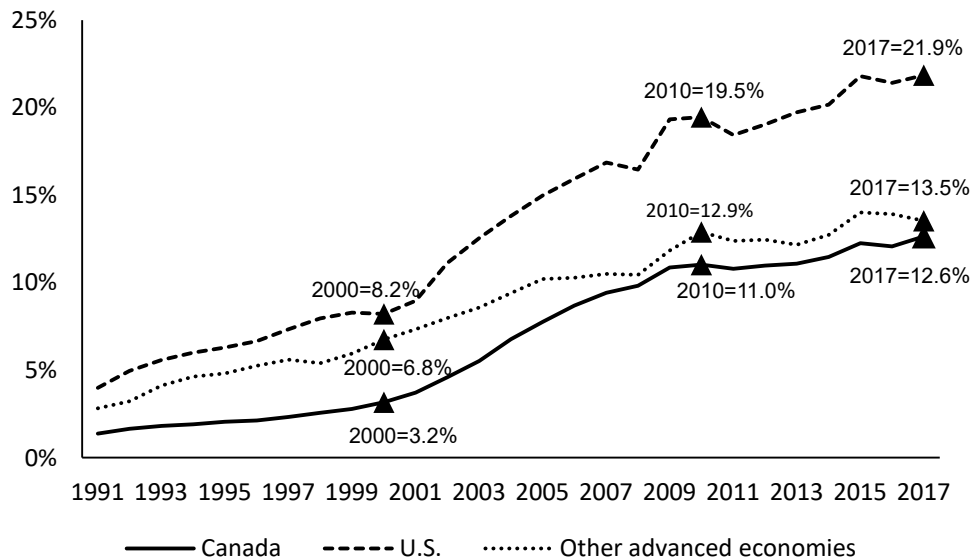
⁷ For example, Bai and Stumpner (2017) find that, over the 2004-2012 period, the cumulative inflation would have been 2.27 percentage points higher had there been no change in the Chinese import penetration for the United States.

⁸ Faber (2014)

To our knowledge, there is only one empirical study on this issue using Canadian data.⁹ It was written by Louis Morel for the Bank of Canada in 2007. The author calculates the overall weight of China in the Canadian total CPI, based on the share of imports in total Canadian demand and the Chinese share in total imported goods in Canada. He focusses on three broad product categories: clothing, furniture, and appliances and audiovisual. Using the Chinese weight in the total CPI and the Chinese export prices for those product categories (relative to Canada and other countries exporting to Canada), the author estimates that the impact of rising Chinese imports in Canada on the total CPI is -0.01 percentage point per year over the 2001-2006 period. Our study is different from the Morel paper in that we quantify the Chinese share in total imports in Canada at a detailed product level and rely on econometrics to estimate the effect of rising Chinese imports on the Canadian CPI over the 2001-2011 period.¹⁰

China provides researchers with a rare opportunity to study the causal impact of trade with developing countries on developed countries like Canada. Chinese exports have been increasing rapidly from the early 2000s. Such rapid increases in exports appear to be driven by positive supply shocks within China, such as rapid urbanization, rising competitiveness in manufacturing and the country’s accession to WTO in 2001, rather than by demand shocks experienced by some large economies. Researchers can rely on this exogenous increase in Chinese exports to estimate the impact of the country’s rising exporting capacity on a wide range of economic outcome variables in developed economies.¹¹

Chart 1: Chinese share in total imports by country, 1991-2017



Note: Other advanced economies include: Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain and Switzerland. Source: The author’s calculations based on the United Nations Comtrade database.

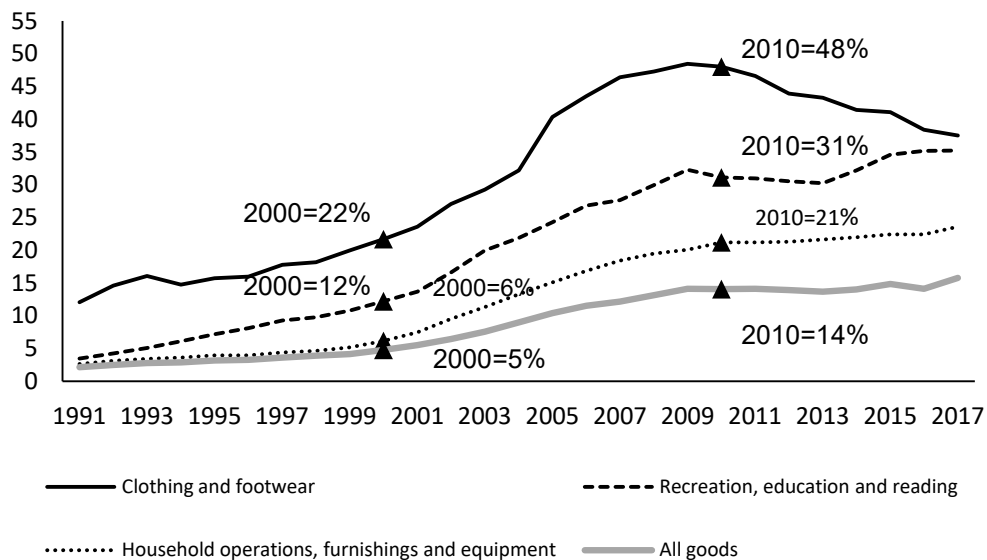
⁹ Morel (2007)

¹⁰ Despite the difference in the sample period and the empirical approach, their estimated effect of -0.10 percentage point per year is very close to our estimate of -0.12 percentage point per year (see footnote 64).

¹¹ One example is R&D spending. Motivated by a substantial decline in R&D intensity in Canadian manufacturing since the early 2000s, CSLS is also examining the impact of the China shock on R&D spending and TFP growth in Canadian manufacturing using firm-level data – Kim (forthcoming). Also see Autor, Dorn, and Hansen, 2016 for more details.

China's share in total imports increased in advanced economies around the world. Chart 1 presents time series for the Chinese share of total imports in various countries between 1991 and 2017. In 2000, China accounted for 3.2 per cent of total imports to Canada, less than its share of 8.2 per cent in the US or 6.8 per cent in eight selected advanced economies. By 2010, China accounted for 11.0 per cent of Canada's total imports, an increase of 7.9 percentage points from 2000.¹² That is larger than the increase observed in the selected advanced economies (6.1 percentage points) but smaller than the increase observed in the United States (10.2 percentage points).¹³ The Chinese share of total imports started to decline or stabilize in 2010 in all three series.

Chart 2: Chinese share in total imports by product category in CPI, Canada, per cent, 1991-2017



Source: Author's calculation based on the United Nations Comtrade database after mapping CPI products to HS commodities. Services are excluded from the calculations. All goods include the CPI products included in our sample. See section II for more details.

Within Canada, the increase in the Chinese share of total imports varied across product categories in the CPI. The share increase tended to be large for clothing and footwear, recreation and reading materials (which include toys, home entertainment equipment, and computers), and household operations, furnishing, and equipment (see Chart 2).¹⁴ The Chinese share in total imports for each of those three product categories remained relatively stable during the 1990s but

¹²In this overview of the trends, we choose 2000 as the starting point since it is the year from which the Chinese share in total imports started to grow at a notably faster rate. In our estimation, we choose 2001 as our starting point so that we can contextualize our results using the results from the previous CSLS research reports on the China Shock – their sample periods start from 2001 since they rely on census data. See Murray (2017) and Kim (2018a, b).

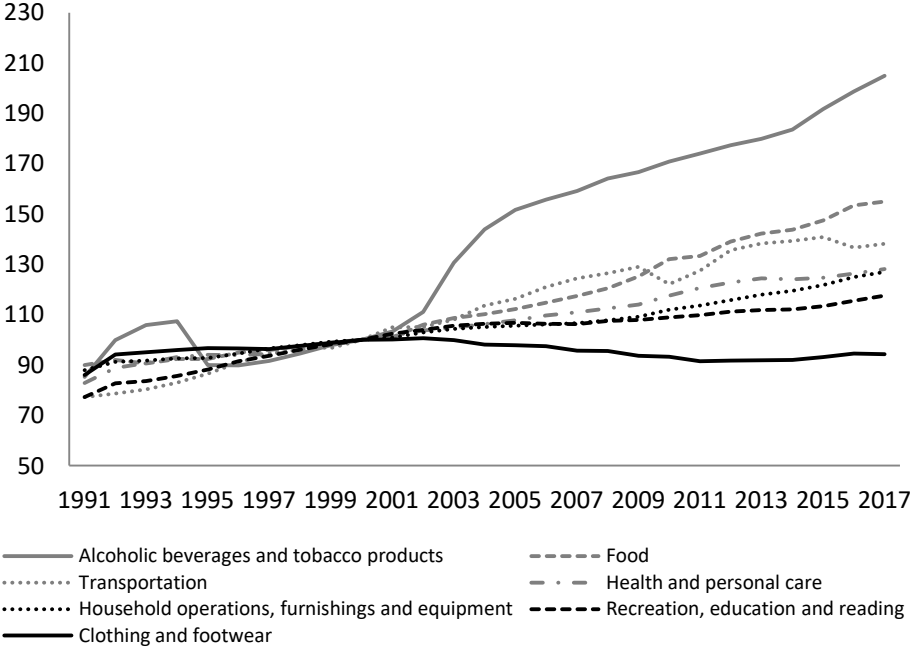
¹³It is interesting to note that the Chinese share in total imports in the United States is much higher than the share in Canada over the sample period. Moreover, the change in the share is also larger for the United States. It would be worthwhile to explore potential reasons for these observations.

¹⁴This is consistent with the findings in Morel (2007) – see Chart 5 in the paper.

started to increase substantially in the early 2000s. For example, in 2010, Chinese imports accounted for nearly half of the total imported clothing and footwear in Canada, compared to 22 per cent in 2000. The remaining product categories we examine are: alcoholic beverages and tobacco products, food, health and personal care, and transportation.¹⁵ These last four product categories are relatively less important in terms of an increasing Chinese presence. The Chinese share in each remained below 5% over the 1991-2017 period. Their time series are omitted from Chart 2.

Across product categories, we observe an important relationship between the Chinese share in each category and consumer price indices for these categories. Chart 3 presents the consumer price indices for the seven product categories discussed above. Over the 2000-2017 period, Canadian consumers experienced either relatively slow growth or even a decline in prices for the three product categories in which the Chinese import share increased the most. The consumer price for clothing and footwear fell by 5.7 per cent between 2000 and 2017. Prices for household operations, furnishing and equipment rose 27 per cent and those for recreation and reading materials rose 17.5 per cent in the same period. However, these increases are smaller than the average increase of 54.9 per cent for the remaining four categories.

Chart 3: Consumer Price Index by product category (2000=100), Canada, 1991-2017



Source: Statistics Canada Table 18-10-0005-01.

In this report, we estimate the overall price effect of increased trade with China on consumer goods in Canada after identifying exogenous trade shocks due to China. To our knowledge, no study has examined the issue in Canada at a detailed product level, relying on econometrics. This is presumably because of the lack of information for concordance between price and trade data. We construct concordance between basic product classes (the most detailed level available to the public) in the consumer price index data published by Statistics Canada and

¹⁵Shelter is omitted as the underlying products are mainly services.

commodities in the Harmonized Commodity Description and Coding System (HS) in trade data available from the United Nations Comtrade database. We then construct a measure of China import exposure for each CPI product. Exploiting across-product variations in Chinese import exposure and price change, we estimate the marginal effect of trade with China on consumer prices.

We find that increasing trade with China is associated with a fall in consumer prices in Canada. With a sample of 79 consumer goods covering 85 per cent of total household expenditure on goods, we estimate that, on average, a 1-percentage-point increase in the Chinese share in total imports of a given product leads to a 0.221-percentage-point decrease per year in its consumer price.¹⁶ A negative price response is found to be robust to different samples and model specifications and remains in the range of -0.2 and -0.3, which are consistent with the estimates found in the literature on quantitative trade models. We find evidence that the increasing Chinese presence in intermediates to produce final consumption goods also negatively affects consumer prices. That effect is estimated to be quite small. It is not included in our baseline estimate of -0.221 percentage point.

Over the 2001-2011 period, our estimates imply that the cumulative inflation for all consumer goods in the CPI would have been 2.41-percentage-points higher had there been no change in the Chinese share of total imports in Canada, assuming other factors are held constant. In other words, the cumulative inflation for consumer goods over this period would have been 20.01 per cent instead of 17.60 per cent had the Chinese share in total imports remained at the 2001 level. For the total CPI, we find that the cumulative inflation over the 2001-2011 period would have been 26.85 per cent instead of 25.68 per cent (1.17-percentage-points higher) had there been no change in the Chinese share of total imports in Canada.¹⁷ The average annual inflation for the total CPI was 2.1 per cent over the 2001-2011 period, implying that annual inflation would have been about 6 per cent higher (or 0.12 percentage-points) without the impact of China. This implies a cumulative gain of \$546 per worker or \$76,996 for each of the 113,500 jobs lost in manufacturing due to China over this period.¹⁸

In the following section, we describe our data and the concordance we construct to map CPI products to HS commodities and to input-output (I-O) commodities. In section III, we discuss key preliminary statistics to motivate our empirical analysis. Our empirical models and identification strategy are described in section IV which is followed by empirical results in section V. Section VI has our conclusions.

II. Data

Our main data sources are CPI data and input-output tables, both published by Statistics Canada, and trade data from the United Nations Comtrade database. We choose the period 1991-

¹⁶Our sample consists of consumer goods that have positive imports from China and exist in the consumption basket over the 1991-2011 period. The product level in our analysis is defined as the basic product class. Note that there are 118 basic product classes for goods in the CPI published by Statistics Canada.

¹⁷The effect on the total CPI is computed by scaling the effect on consumer goods by their expenditure share. See section V for more details.

¹⁸See Kim (2018a) for the estimate of trade-induced job loss in manufacturing over the 2001-2011 period.

2011 as our main sample period so that we can contextualize our results using those from Murray (2017) and Kim (2018a,b). Their sample period is 1991-2011, as they rely on census data. We also extend our sample period to 2017 to cover all data currently available to the public. We do not have complete price data for some product classes because they did not exist in the consumption basket in the past. If we start from 1996, we can construct a complete CPI series for most of the CPI products. Therefore, we also carry out analyses based on the 1996-2011 period. Estimation will also be carried out by sub-period as well: 1991-2001; 2001-2007 (to exclude the period after the financial crisis); 2001-2011; and 2001-2017.

1. Consumer Prices Data

The product classification in the CPI published by Statistics Canada is a hierarchy of roughly 695 elementary product classes. There are several intermediate aggregation stages that are relevant for different levels of analysis, such as the eight major aggregates (food; shelter; household operations and furnishing; clothing and footwear; transportation; health and personal care; recreation, education, reading; and alcoholic beverages and tobacco products). We rely on the most detailed data available to the public for our analysis.

The most detailed product level in the CPI is called the basic product class. Statistics Canada publishes price indices for 175 basic product classes (118 classes for goods and 57 for services) which are based on roughly 695 elementary aggregates, the lowest level to which expenditure weights are assigned.¹⁹ Elementary products under a basic product class either have a common end-use or are considered substitutes for each other. These elementary products are joined together to form a hierarchy. For example, toothpaste is an elementary aggregate that constitutes the basic product class, oral-hygiene, which is classified under the higher product level, personal care.

Among these basic product classes, we focus only on non-durable, semi-durable and durable goods and exclude services such as rent, childcare services and personal care services.²⁰ This leaves us with 118 basic product classes. We aggregate some of these product classes into a higher-level class for which Statistics Canada publishes price indices because it is not possible to map them to trade and I-O commodities at the basic product class level.²¹ We aggregate 23 basic product classes to 8 product classes at the next higher level. There are 10 basic product classes for which we could not carry out concordance with satisfactory quality. Hence, we dropped those 10 product classes.²² This procedure leaves us with the total of 93 product classes. (See the subsection on concordance for more details.)²³

¹⁹Note that expenditure weights are fixed for the basic classes for the duration of a basket while the elementary aggregates below a given basic class may have flexible weights over time.

²⁰In 2001, the expenditure weight for goods was 48.8 per cent. The average weight was 48.4 per cent over the 2001-2011 period.

²¹Relevant issues are discussed in detail in the following subsection on concordance.

²²They are: 'Pre-cooked frozen food preparations', 'All other food preparations', 'Other horticultural goods', 'Other household supplies', 'Other household furnishings and equipment', 'Purchase of digital media', 'Fuel, parts and accessories for recreational vehicles', 'School textbooks and supplies', 'Other reading materials' and 'Other alcoholic beverages purchased in stores'. They account for roughly 4.0 per cent of the total household expenditure.

²³Note that the expenditure weight for these 93 products was 44.8 per cent of the total CPI in 2001 or 91.8 per cent of the total expenditure on goods – the weight for total goods in CPI was 48.8 per cent in 2001 (see footnote 19).

The CPI is based on the fixed-basket concept. Changes in the index over time reflect only pure price change. They do not reflect any change in the consumption pattern of Canadian consumers. As a result, we do not capture the effect of the China Shock on the *overall* cost of living for consumers (*i.e.* the one includes the effect on consumption patterns).²⁴ Specifically, we measure the effect of China on the purchasing power of Canadians in maintaining a given basket of goods.

2. Trade Data

Trade data are required to construct a measure of Chinese import competition at a product level and its instruments. We use the United Nations Comtrade database. For Canada and the eight high-income countries we choose for our identification strategy, we extract data on nominal values of total imports from China at the 6-digit HS commodity level.²⁵ The trade data are then mapped to CPI data following the procedure we describe in the subsection for concordance.

3. Input-Output Data

We rely on the 1997 input-output table (aggregation level W) to construct the import penetration ratio as in equation (2) and the ratio reflecting I-O linkages as in equation (11a) and (11a') in Appendix B. There are two main reasons for choosing the 1997 I-O table. First, it predates the China Shock, reflecting I-O relationships that are likely to be exogenous to the subsequent trade shocks in Canada. Second, it is the earliest, publicly available I-O table at a very detailed industry level that allows us to match input-output industry codes (IOIC) to four-digit NAICS one-to-one.²⁶ If an I-O table prior to 1997 is used, we would have to aggregate 86 four-digit NAICS manufacturing industries to 42 I-O industries. We prefer not to aggregate industries because aggregation may lead to attenuation bias. Also, we lose efficiency in our estimation with a lower number of observations.

4. Concordance²⁷

There is no official concordance available for CPI-HS. Also, to our knowledge, there has been no attempt in the literature to map detailed product classes in official CPI data to trade data in HS. We implement our own concordance between the two classification systems, using the

Later, some of these 93 products are dropped in our regression sample since they do not have a complete CPI series or any positive imports from China, leaving us with 79 products for the 2001-2011 sample. In 2001, these 79 products were responsible for 41.5 per cent of the total household expenditure or 85.0 per cent of the total expenditure on goods.

²⁴When relative prices of consumption goods change due to rising import competition from China, Canadian consumers could also switch between products. The consumption basket is updated regularly (bi-annually since 2011) based on a new Survey of Household Spending and other data sources. When the basket is updated, however, indices based on different baskets are chained so that we can have a continuous time series for CPI without any break. Hence, a change in the chain-linked index from one period to another reflects only the change in prices. However, we think that changes in the consumption pattern are very small at the basic product class level.

²⁵The eight countries include: Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain and Switzerland.

²⁶One exception is IOIC 333X00 (Industrial, commercial and service industry machinery manufacturing) which is the aggregate of NAICS 3332 (Industrial industry machinery manufacturing) and 3333 (Commercial and service industry machinery manufacturing).

²⁷The concordance table for CPI-HS is available in the online Appendix of this paper.

Classification of Individual Consumption According to Purpose (COICOP) and the Central Product Classification (COP) as bridges.²⁸ We first map the basic product classes (excluding services) in CPI to the product classes in COICOP. The United Nations statistics division publishes official concordance tables for COICOP-CPC and CPC-HS codes. We subsequently carry out mappings between COICOP and CPC and then between CPC and HS codes.²⁹ Finally, we would have trade data available for each CPI product.

COICOP and CPC are useful tools to carry out mappings of CPI products to HS commodities. First, COICOP is constructed based on the classifications of consumer expenditures and is often used for consumer price indices, household budget surveys and international comparisons of consumer expenditures. COICOP consists of three product structures: consumption by households, non-profit institutions serving households, and general government, respectively. We focus on products for households. CPI and COICOP products are closely related, so in theory COICOP is appropriate to be mapped to any CPI classification system.³⁰

Second, the construction of CPC was motivated by initiatives in the early 1970s to harmonize international classifications. The classification system intends to cover all goods and services that are produced within or traded between economies. Hence, it is broad enough to be mapped to HS commodities. Also, the classification is based on industrial origins, the physical properties and the intrinsic nature of the products which are similar to the characteristics of HS. Moreover, efforts are made to define each subclass in the largest levels of aggregation in CPC as the equivalent of one heading or subheading or the aggregation of several headings or subheadings of the HS system. Therefore, the mapping between CPC and HS is relatively straightforward.

Nevertheless, the concordance for CPI-COICOP-CPC is not perfect. First, in the COICOP-CPC concordance, there are CPC subclasses assigned to each COICOP class. Some CPC subclasses have to be split when only some of the products covered by the subclass are to be assigned to a given COICOP class or when a CPC subclass comprises products that belong to more than one COICOP class. However, the split is not feasible since there is no further disaggregation of CPC subclasses.³¹ To improve the concordance, we identify these CPC subclasses in the CPC-HS concordance. HS commodities at the 6-digit level tend to be more disaggregated than the CPC subclasses in the COICOP-CPC concordance. We carry out the splits in the CPC-HS concordance when possible.

²⁸We adopt these bridge classification systems to minimize the role of subjective judgement in the concordance between CPI products and HS commodities. The United Nations statistics division has implemented systematic concordance between COICOP and COP and between COP and HS. So, we rely on them to establish mapping between CPI and HS.

²⁹We carry out one-to-one matching for some of the basic product classes but in most cases, the product classes in CPC and the HS classification system tend to be more disaggregated than the basic product classes in CPI. Therefore, we allocate a group of products to a given basic product class in CPI.

³⁰For example, the CPI classification developed by Korea Statistics (KOSTAT) follows COICOP (see Hwang, 2016). Also, OECD publishes Canadian CPI based on COICOP, which are directly provided by Statistics Canada (at a higher level of aggregation).

³¹This issue is noted in the official concordance developed by the United Nations Statistics Division but not resolved.

Second, there is no exact correspondence for some of the basic product classes in CPI. Instead of dropping them from our sample, we aggregate them to the next higher level for which Statistics Canada publishes a price index.³² We could not apply this solution to all problematic product classes. There are four basic product classes for which we could not carry out concordance with satisfactory quality, so we dropped them.³³

Third, there are some basic product classes whose descriptions include 'other', such as all other food preparation, other horticultural goods and other recreational equipment.³⁴ Because there is insufficient information on the exclusive list of elementary aggregates belonging to these product classes, we must rely on our subjective judgment in assigning subclasses in COICOP and CPC to those basic classes. Of these basic classes, we drop six classes because mappings cannot be done with acceptable quality.³⁵ The above procedures leave us with 93 product classes out of the 118 basic product classes, excluding services.

To ensure more precise matching between the basic product classes in CPI and the commodities in HS codes, we cross-checked with the Schedule B search engine available at the U.S. Census Bureau³⁶ and the Canadian Importers Database.³⁷ The search engines provide HS codes assigned to product names entered by the user. This is particularly useful since, unlike CPI, the product descriptions in HS are technical and specific about characteristics such as a product's component materials, its degree of technological complexity, its function, or its form. For example, for detergents and soaps (other than personal care), which is one of the consumer products belonging to the household cleaning product category in CPI, the corresponding HS commodity is described as "organic surface-active agents (other than soap); surface-active preparations, washing preparations (including auxiliary washing preparations) and cleaning preparations, whether or not containing soap". Using the search engine, we identify correct HS codes for consumer products to ensure precise mappings at a detailed level.

In our empirical analysis, we also estimate whether increasing Chinese imports for intermediates to produce final consumer goods has any effect on consumer prices. To incorporate input-output linkages in the measure of Chinese import competition, we need to map the commodities in an input-output table to CPI products. Unlike the concordance between CPI products and HS commodities, there is no bridge classification systems that could help us

³²For example, we had to aggregate 'Women's clothing', 'Men's clothing', and 'Children's clothing' into 'Clothing' for which Statistics Canada publishes a price index. Trade data do not have product classes that match exactly with those basic product classes. Clothing for children is not separately classified at the 6-digit level in the HS classification system. We aggregate 23 basic product classes into 8 CPI products at a higher level.

³³They are: 'Pre-cooked frozen food preparations', 'Purchase of digital media', 'Fuel, parts and accessories for recreational vehicles', and 'School textbooks and supplies'.

³⁴The components of a basic product class with 'other' are the items 'not elsewhere specified'. However, there is no information made available by Statistics Canada for us to identify these items. For some basic classes, such as 'Other fresh fruit' or 'Other processed meat', it is relatively straightforward for us to identify relevant items. However, it is quite problematic for others such as 'Other household supplies' or 'All other food preparations' as the scope of the product class is much wider.

³⁵The six product classes are: 'All other food preparations', 'Other horticultural goods', 'Other household supplies', 'Other household furnishings and equipment', 'Other reading materials', and 'Other alcoholic beverages purchased in stores'.

³⁶<https://uscensus.prod.3ceonline.com>

³⁷<https://www.ic.gc.ca/app/scr/ic/sbms/cid/searchProduct.html?lang=eng>.

construct a mapping between I-O commodities and CPI products. However, the mapping is relatively straightforward as the names of CPI products and I-O commodities are matched easily.³⁸ We are able to map 77 CPI products to I-O commodities with an acceptable level of quality. Since I-O commodities are not as detailed as HS commodities at the 6-digit level,³⁹ we have to aggregate some basic product classes to the next higher level for which Statistics Canada publishes CPI data.

III. Descriptive Statistics: Trade and Consumer Prices Data

Table 1: Domestically-produced and imported consumer goods, Canada, 2001-2017

Panel A: Domestically-produced and imported consumer goods, in millions of 2002 CAD			
	(1) Household expenditure on domestically-produced consumer goods	(2) Total imported consumer goods	(3) Imported consumer goods from China
2001	296,228	58,983	7,437
2006	344,956	69,331	14,078
2011	380,554	76,696	16,579
2017	445,843	93,191	17,588

Panel B: Shares, per cent			
	Share of imports in total consumer goods: (2) / (1) + (2)	Share of imports from China in total imported consumer goods: (3) / (2)	Share of imports from China in total consumer goods: (3) / (1) + (2)
2001	16.6	12.6	2.1
2006	16.7	20.3	3.4
2011	16.8	21.6	3.6
2017	17.3	18.9	3.3

Note: Nominal values are deflated by the CPI for household consumption goods. The import data follow the Broad Economic Categories (BEC). Consumer goods in BEC include: food and beverages (primary and processed for household consumption), transport equipment (non-industrial), and consumer goods not elsewhere specified. Note that the total imported consumer goods represent, on average, roughly 24 per cent of the total imports in Canada over the 2001-2017 period. The rest is accounted for by the imports of intermediates and capital goods.

Source: Statistics Canada Table 12-10-0090-01 and 36-10-0222-01.

We first note that the share of imported consumer goods from China in the household expenditure on total consumer goods increased while the share of total imports in the household expenditure on total consumer goods remained stable over time. Column 1 in Panel B of Table 1 shows that in 2001 total imported consumer goods accounted for 16.6 per cent of the household expenditure on total consumer goods. The share hardly changed over time, reaching 16.8 per cent in 2011, a 0.2 percentage-point increase. Meanwhile, imports of consumer goods from China increased both in absolute terms (Column 3 in Panel A) and as a share of total imported consumer goods (Column 2 in Panel B). Between 2001 and 2011 the share of imported consumer goods from China in total imported consumer goods increased from 12.6 per cent to 21.6 per cent.⁴⁰ As a result, the share of consumer goods imported from China in household expenditure

³⁸Note that we did not have to map most of the intermediate goods in an IO table to CPI products which are final consumption goods.

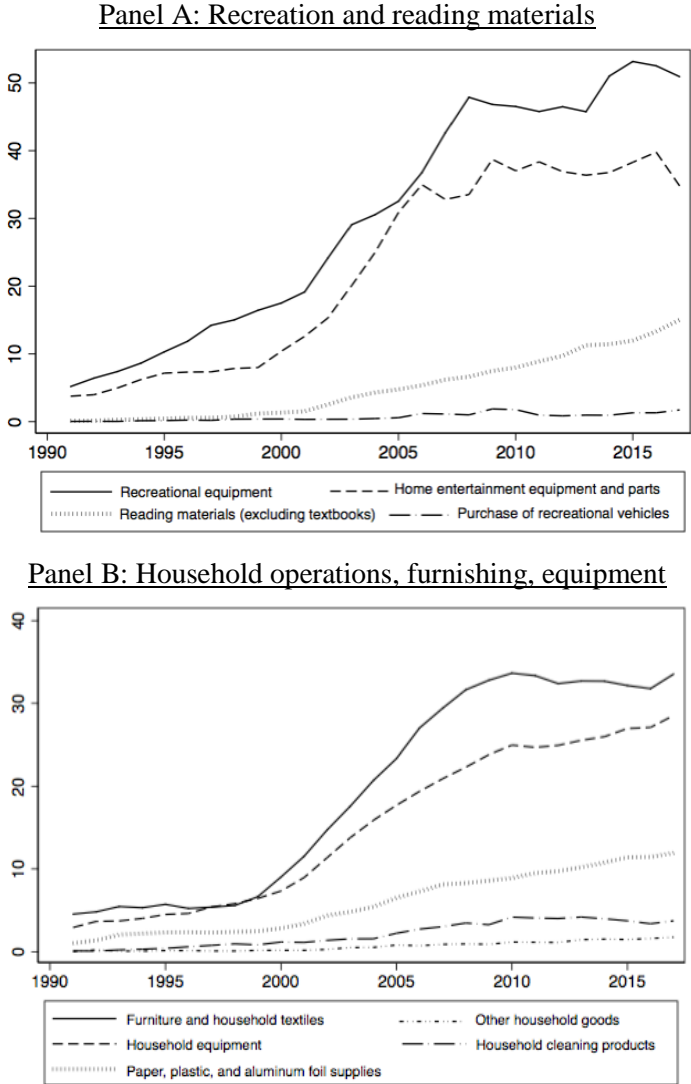
³⁹There are 701 I-O commodities in the 1997 I-O table at the aggregate level W, compared to roughly 5,300 commodities in HS at the 6-digit level.

⁴⁰Note that most of the increase in the Chinese share occurred between 2001 and 2006. See Chart 7 for a complete time series for the Chinese share in total imported consumer goods in Canada for the 2000-2011 period.

on total consumer goods increased from 2.1 per cent to 3.6 per cent between 2001 and 2011, a 1.5 percentage-point increase. This implies that the importance of imported goods from the rest of the world in household expenditure on total consumer goods declined over time.

Chart 4 presents time series for the Chinese share of total imports in a given product category in CPI. There was a particularly large increase in the Chinese share in three product categories: recreation and reading materials; household operations, furnishings, and equipment; and clothing and footwear.

Chart 4: Chinese share in total imports by product category in CPI, Canada, 1991-2017



Source: Author's calculation based on the United Nations Comtrade database after mapping CPI products to HS commodities. Services are excluded from the calculations.

A further breakdown reveals that the large increase in the Chinese share of imports in the recreation and reading materials category was driven by electronics used for recreational purposes, such as digital computing equipment and devices, and home entertainment equipment

and parts, such as audio and video equipment. (See Panel A in Chart 4.) These two product classes had the highest share of Chinese imports in the recreation and reading materials product category between 1991 and 2017.

In the household operations, furnishing and equipment category, the increase in the Chinese share of imports was driven by furniture and household textiles, and by household equipment, such as appliances. (See Panel B in Chart 4.) The increases in the Chinese share over the sample period are much larger than those observed in other product categories. Among product categories, household operations, furnishing and equipment had the highest share of Chinese imports over the 1991-2017 period.

A breakdown of clothing and footwear, a category that also includes accessories, jewelry, clothing materials and notions, reveals that clothing and footwear exhibit the largest increases. The Chinese share in total imports of other products in this category remained relatively stable and low over the 1991-2017 period.

Our data indicate that rising Chinese imports tend to concentrate in product categories related to electronics, textiles and clothing. This observation is consistent with the data presented in Murray (2017), who showed that three, 4-digit NAICS industries had the most rapid increase in Chinese import penetration over the 2001-2011 period: computer and peripheral equipment manufacturing; audio and video equipment manufacturing; and clothing knitting mills.

Increasing competition from China may have induced labour-intensive and low-labour productivity industries, such as those producing textile products and clothing or assembling electronics, to move abroad or exit domestic product markets. Domestic electronics producers may have shut down assembly lines and expanded non-manufacturing activities, such as intellectual services, in the domestic economy.⁴¹ That would result in products that are developed in Canada, but assembled in China and imported back to Canada. Some firms might provide professional services related to products but would not own an assembly line abroad. IBM is an American example. It provides data solution services rather than manufacturing personal computers.⁴² Another well-known example is Apple, which offshores assembly but designs its products and produce related services in the United States.

To motivate an empirical analysis, we establish a relationship between growth in Chinese imports and change in consumer prices at the detailed product level we adopt as our unit of analysis. Table 2 shows the ten largest and ten smallest product classes in the CPI (out of 79 product classes in our sample) in terms of the absolute, percentage-point change in Chinese import exposure, measured as the Chinese share in total imports (ΔVSH). Even at a more detailed product level, we observe a negative relationship between import exposure and price.

⁴¹For example, Fort, Pierce, and Schott (2018) find that within manufacturing firms in the United States, employment had shifted from manufacturing plants to non-manufacturing plants (*e.g.* professional services and retail) over the past couple of decades – see Figure 7 in their paper.

⁴²In 2005, IBM's personal computer business (and its ThinkPad brand) was purchased by a Chinese multinational technology firm, Lenovo. ThinkPad computers are now produced in manufacturing facilities in China (*e.g.* Guandong, Schenzen, Shanghai, and Beijing).

Table 2: Average annual percentage-point change in the Chinese share in total imports and average annual inflation (per cent), 2001-2011

<u>Ten largest</u>	Δ VSH	Δ Price
Digital computing equipment and devices	3.87	-14.98
Bedding and other household textiles	3.32	-0.55
Upholstered furniture	3.18	-0.83
Video equipment	2.88	-8.62
Non-electric kitchen utensils, tableware and cookware	2.74	-1.80
Window coverings	2.69	2.37
Clothing	2.54	-1.71
Audio equipment	2.37	-4.83
Other personal care supplies and equipment	2.11	0.53
Footwear	2.08	-0.77
<u>Ten Smallest</u>	Δ VSH	Δ Price
Medicinal and pharmaceutical products	-0.29	3.24
Beer purchased from stores	-0.27	7.47
Other fresh fruit	-0.18	1.30
Ham and bacon	-0.16	2.51
Cigarettes	-0.05	5.68
Gasoline	-0.01	7.21
Nuts	-0.01	1.09
Oranges	-0.004	0.31
Fuel oil and other fuels	-0.004	1.51
Sugar and syrup	-0.002	0.51

Note: Author's calculations based on the United Nations Comtrade database and Statistics Canada Table 18-10-0005-01 after mapping CPI products to HS commodities. Δ VSH represents a change in the Chinese value share (*i.e.* the share of imports from China in total Canada imports of a given product class).

The ten largest product classes in terms of Δ VSH are consistent with our observations from Charts 2 and 4, which showed the Chinese share in total imports by product category. Digital computing equipment and devices (which is classified under recreational equipment in Panel A in Chart 4) had the fastest growth in Chinese import exposure and the fastest decline in its consumer price over the 2001-2011 period.⁴³ Other product classes included in the ten largest list are related to clothing, furniture, textiles and electronics. All ten products, except for other personal care supplies and equipment, belong to the three upper-level product categories – recreation and reading materials; household operations, furnishings and equipment; and clothing and footwear– for which the Chinese import share increased the most over the 2001-2017 period (see Chart 2). Most of the CPI products in the top quartile in terms of Δ VSH belong to these

⁴³The decline in the price is exceptionally large relative to other product classes in the list. Falling prices could also be driven by innovations in the use of information technology, which were commonly observed in most of the advanced economies around the world. Due to these common shocks, product classes related to ICT such as computers may be a source of endogeneity, potentially contaminating our estimates, even with the identification strategy we adopt. Kim (2018a) shows that this is indeed the case. See footnote 22 in the paper. Later, we present a robustness check for this issue.

three categories. Some examples are home appliances (refrigerators and freezers and laundry and dishwashing appliances), toys, area rugs and wooden furniture.

The product classes in the ten smallest list tend to be food products in which the Chinese share in total imports remained very low over the sample period (See Chart 1). For all the product classes, ΔVSH is negative.⁴⁴ Importantly, inflation for these product classes tends to be higher than for the products in the ten largest list.

A negative relationship is not limited to the 20 product classes reported in Table 2 but observed across most of the product classes we include in our sample. This is illustrated in Chart A2 in Appendix C, which shows a scatter plot and the best-fit line between the two variables of our interest.

IV. Empirical Approach

In this section, we introduce our econometrics model and identification strategy. We first introduce our estimating equation that assesses the effect of rising Chinese imports in Canada on Canadian consumer prices. Theoretical motivation and the associated reduced-form equation are presented in Appendix A. Next, we discuss our identification strategy to capture exogenous changes in the Chinese share of total imports in Canada. Lastly, we briefly discuss the summary statistics of the key variables used in our estimation.

1. Estimating equation

We mainly rely on across-products variations in prices and exposure to Chinese imports to identify the parameters of our interest. Motivated by a multi-sector version of the basic trade model and its reduced-form equation introduced in Appendix A, we estimate the marginal effect of an increase in Chinese import exposure on the rate of price change as follows:

$$(1) \pi_{k,\tau} = \beta \Delta IP_{k,\tau} + \gamma X_{k,\tau} + \alpha_\tau + \mu_{k,\tau}$$

where τ denotes time period during which a variable's change is measured and $X_{k,\tau}$ is a vector of controls. α_τ represents period fixed effects. β corresponds to $1/(1 - \sigma_k)$ in equation (10a) in Appendix A.⁴⁵

$\Delta IP_{k,\tau}$ denotes changes in Chinese import penetration ratio:

$$(2) \Delta IP_{k,\tau} \equiv \frac{\Delta M_{k,\tau}^{China}}{Y_{k,\tau_0} + M_{k,\tau_0} - E_{k,\tau_0}}$$

⁴⁴Not all food products in CPI had a decrease in VSH. For example, canned vegetables and other vegetable preparations is ranked 11th in terms of ΔVSH . This is consistent with the data in Broda and Romalies (2008). They show that the Chinese import share in the United States and in the total world increased very rapidly for canned foods.

⁴⁵Notice that Equation (1) is based on a multi-sector model. When we estimate the equation in practice, we use the square root of final consumption spending weights for k so that we recover the average expenditure-weighted $1/(1 - \sigma_k)$ given that the specification is correct.

where the numerator $\Delta M_{k,\tau}^{China}$ denotes the change in imports of product k from China over period τ . The denominator $(Y_{k,\tau_0} + M_{k,\tau_0} - E_{k,\tau_0})$ represents the domestic absorption for product k in the initial period τ_0 .

However, information on domestic absorption at a detailed product level is not readily available. Due to limited data availability, we adopt the value of imports from China as a share of total imports in Canada at a product level as our main measure, following the value share approach proposed in Bernard, Jensen, and Schott (2002).⁴⁶ The value share measure is defined as follows:

$$(3) \Delta VSH_{k,\tau} \equiv \Delta \frac{M_{k,\tau}^{China}}{M_{k,\tau}^{Total}}$$

which would replace $\Delta IP_{k,\tau}$ in equation (1) when we estimate the variable's effect on consumer prices.

We also construct ΔIP as in equation (2) at a product level by mapping CPI products to commodities in an input-output table to obtain estimates of domestic absorption. Although the mapping is relatively straightforward, there is no official information available on which we can objectively validate our concordance. Therefore, we prefer our estimates based on the value share approach. The results based on ΔIP at a product level are reported in Table A2 in Appendix C.⁴⁷

Equations (2) and (3) capture two possible channels through which an increase in Chinese import exposure affects consumer prices. First, an increase in Chinese imports for product k implies that Canadian consumers can now substitute cheaper Chinese imports, reducing the observed consumer price for that product. Some existing domestic (or imported) products may exit the market as new Chinese products replace them. Second, an increase in the share of Chinese imports in the total imports of product k or the domestic market for product k can be a proxy for an increase in Chinese competition in the product market for k . Domestic producers (and other foreign importers) may change their prices in response to increased competition from China, lowering markups or improving productivity.

2. Identification strategy

To identify shocks exogenously driven by rising Chinese exporting capacity, we exploit the fact that growth in Chinese exports to developed economies like Canada since the early 2000s mostly stemmed from factors internal to China, such as urbanization, opening to foreign investment, rising competitiveness in manufacturing, and China's accession to the World Trade Organization in 2001, rather than from positive demand shocks within developed economies.

⁴⁶Bloom, Draca, and Van Reenen (2016) also adopt the value share approach as their main measure of trade exposure to China as they work with commodity-level trade data.

⁴⁷As in the case with the value share approach, we observe a negative effect of increasing Chinese trade exposure on consumer prices. However, the effect tends to be larger in magnitude than that based on the value share approach.

We capture the common within-product (or industry) factors of rising Chinese exporting capacity, which stemmed from rising Chinese comparative advantage in manufacturing and lower trade costs due to factors internal to China. Thus, following Autor, Dorn, and Hanson (2013), we instrument for changes in the Chinese share of total imports in Canada using the changes in the Chinese share of total imports in the following eight advanced economies: Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain and Switzerland.⁴⁸

The first-stage regression is given by the following:

$$(4) \Delta VSH_{k,\tau} = \delta \Delta VSHE_{k,\tau} + \tilde{\gamma} X_{k,\tau} + \tilde{\alpha}_\tau + \tilde{\eta}_k + \mu_{k,\tau}$$

where $\Delta VSHE_{k,\tau}$ represents changes in the Chinese share in total exports to the eight comparison countries.

The above strategy has the following key identifying assumptions: 1. product-specific shocks are uncorrelated across Canada and the eight countries; and 2. there are no strong increasing returns to scale in Chinese manufacturing such that Canadian shocks increase efficiency within the Chinese manufacturing industries and lead them to export more to the eight other economies. The former may be a concern in our analysis. We are particularly concerned with the possibility of correlated shocks related to the innovation in the use of ICT technologies, which were observed in most of the advanced economies around the world, increasing demand for ICT-related goods from China.⁴⁹ However, the latter is not a serious concern since Canada is a small, open economy. Shocks within products in Canada are not likely to have a substantial impact on the overall efficiency within relevant Chinese industries.

It appears that the change in trade exposure to China in the eight countries has significant predictive power for the change in Canada (See Chart 5). Approximately 70 per cent of the variation in the value share in Canada is presumably driven by exogenous supply shocks for the 2001-2011 period.⁵⁰ A strong predictive power is also observed in terms of import penetration ratio (ΔIP). The partial R-squared is 0.93. (Chart not reported.)

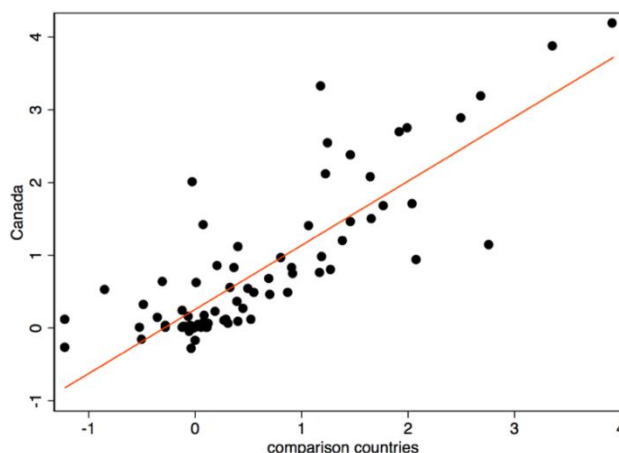
⁴⁸We exclude the United States because its economy is highly integrated with Canada and is likely to have experienced similar demand shocks.

⁴⁹Related to this issue is that in this IV setting, there could be a small number of products driving a large share of the identifying variations in our sample (see Goldsmith-Pinkham *et al.*, 2018). We carry out a simple robustness check but find that the impact of ICT-related products is potentially not substantial. See section V.

⁴⁹See Autor *et al.* (2013) for further discussion.

⁵⁰The R-squared is 0.564 for the 1991-2011 stacked differenced sample.

Chart 5: Average annual change in the Chinese share in total imports (ΔVSH and $\Delta VSHE$), Consumer product classes in CPI, Canada and eight other advanced economies, 2001-2011, percentage point



Note: Services are excluded from the calculations. The comparison countries include: Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain and Switzerland. Source: Author's calculation based on the United Nations Comtrade database after mapping CPI products to HS commodities.

3. Summary statistics

Table 3: Summary statistics, Stacked sub-periods, 1991-2011

	Mean	Median	Std. Dev.
ΔVSH	0.065	0.016	0.098
$\Delta VSHE$	0.073	0.033	0.096
$\Delta Price$	0.011	0.014	0.029

Note: CPI products that are included in our regression sample are used. The square-root of household consumption expenditure shares in the initial year are used as weights. The number of observations is 137. We should have 186 observations (93x2). (See subsection 3 in Section II for more detail.) However, some CPI products are excluded from our estimation samples since they have missing information for CPI or ΔVSH or $\Delta VSHE$ or household expenditure shares or some combination of the four. For example, the CPI data for telephone equipment starts from 2012. Some CPI products related to fresh or frozen meat and dairy products do not have any imports from China (e.g. beef, pork, and chicken; milk, butter, and cheese). Telephone equipment, eye-care goods, and other recreational equipment do not have information on household expenditure shares in 1991, 1996, and 2001.

Table 3 shows the summary statistics for the variables in our regression, based on the stacked difference sample for the 1991-2011 period.⁵¹ The mean increase in VSH is 6.5 percentage points (or 0.65 percentage points per year on average) but features large variations across products. Its standard deviation amounts to 9.8 percentage points. Our instrument ($\Delta VSHE$) exhibits a similar mean and standard deviation but the median is twice as large as that of ΔVSH . The mean annual inflation ($\Delta Price$) is 1.1 per cent with a standard deviation of 2.9 percentage points. These variations in ΔVSH and $\Delta Price$ across products would provide us with valuable information to estimate the parameter of our interest (*i.e.* the marginal effect of ΔVSH on $\Delta Price$).

⁵¹We also run regressions based on samples covering other periods such as 1991-2017, 1991-2007, and 1996-2011 but we do not report the summary statistics for these periods. The summary statistics are very similar to the ones reported in Table 3 except that the standard deviations for the variables based on the 1991-2007 period tend to be slightly smaller as we exclude the period after the financial crisis in 2007.

V. Results

1. Regression results

Table 4 reports our estimation results based on stacked differenced data (stacked cross-sections of two sub-periods). We present four sets of results: 1991-2017; 1991-2007; 1991-2011; and 1996-2011.⁵² In all sample periods, the effect based on OLS tends to be less negative than that based on 2SLS. This observation supports our expectation that OLS estimates are likely to be biased upwardly as unobserved domestic demand shocks would be positively correlated with both Chinese imports and inflation.⁵³ Therefore, the coefficient would be closer to zero or some positive number if we fail to account for those unobserved factors.

In all sample periods, our 2SLS estimates show that a 1-percentage-point increase in the Chinese share in total imports of a given consumer good is associated with a decline ranging from 0.2 to 0.3 percentage points in its average annual inflation. Such effect is not negligible given that the average annual inflation for consumer goods in Canada was 1.4 per cent over the 1991-2017 period.⁵⁴

Chart 6 summarizes 2SLS estimates based on selected sub-periods. As suggested by Charts 1 and 3, the effect of trade with China on consumer prices is found to be smaller during the earlier period (1991-2001), compared to the estimates based on the later periods. This indicates that the results reported in Table 4 are mainly driven by developments that occurred after 2000. Also, note that the price effect remains negative and statistically significant when we exclude the period covering the recession after the financial crisis in 2007.⁵⁵

⁵²We report the results based on 1996-2011 since the period maximizes the number of observations in our sample. Some CPI products do not have price information prior to 1996.

⁵³We would like to note that, ex-ante, the correlation between unobserved shocks and the change in the Chinese share in total imports in Canada is not always positive. For example, it is possible that some positive demand shock may lead to an acceleration of the change in imports from both China and other countries such that there is no change in ΔVSH . However, this would not be the case for ΔIP where the change in Chinese imports is normalized by the initial domestic market size.

⁵⁴The average annual inflation was 1.7 per cent and 1.6 per cent over the 1991-2007 and the 1991-2011 period, respectively.

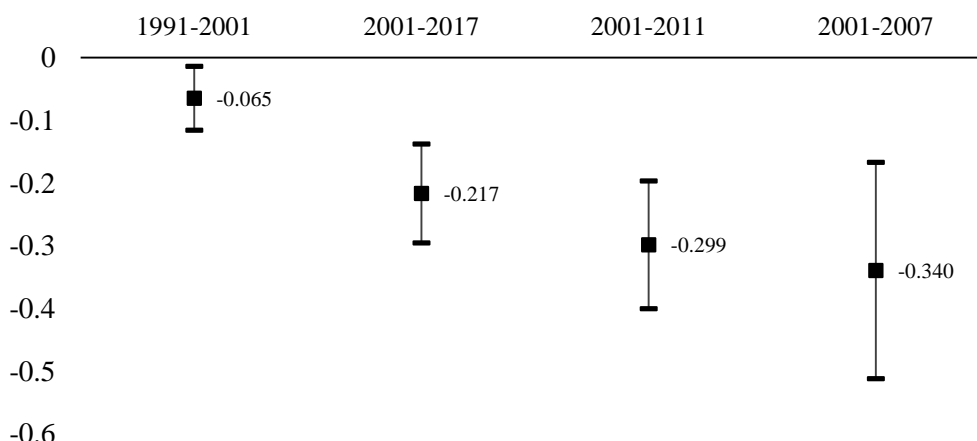
⁵⁵It is worth noting that the share of Chinese imported goods in total imported consumer goods in Canada declined between 2011 and 2017 (see Table 1) and that the share of Chinese imports in total imports in Canada stabilized after 2011 (see Chart 1 and Chart 2). The impact of an increasing share of Chinese imports becomes negligible for the post-2011 period. When the equation is estimated on the sample period of 2011-2017, the coefficient on ΔVSH is not statistically different from zero based on both OLS and 2SLS.

Table 4: The effect of change in the Chinese share of total imports in Canada on consumer goods prices
Stacked differences: 1991-2001 and 2001-2017; 1991-2001 and 2001-2007; 1991-2001 and 2001-2011; 1996-2001 and 2001-2011

	Dependent variable: Average annual inflation							
	1991-2017		1991-2007		1991-2011		1996-2011	
	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) OLS	(8) 2SLS
Δ VSH	-0.131*** (0.043)	-0.161*** (0.042)	-0.151*** (0.058)	-0.221*** (0.076)	-0.163*** (0.053)	-0.221*** (0.056)	-0.229*** (0.062)	-0.295*** (0.064)
Obs.	137	136	138	136	138	137	150	150
First-stage F Statistics	-	36.9	-	30.3	-	44.8	-	62.0

Note: In all columns, period fixed effects are included but not reported. Standard errors are clustered by products. The square-root of household consumption expenditure shares in the initial year are used as weights. Expenditure shares are obtained from Statistics Canada Table 18-10-0007-0. For each column, we should have 186 observations (93x2). (See subsection 3 in Section II for more detail.) However, some CPI products are excluded from our estimation samples since they have missing information for CPI or Δ VSH or Δ VSHE or household expenditure shares or some combination of the four. For example, the CPI data for telephone equipment starts from 2012. Some CPI products related to fresh or frozen meat and dairy products do not have any imports from China (*e.g.* beef, pork, and chicken; milk, butter, and cheese). Telephone equipment, eye-care goods, and other recreational equipment do not have information on household expenditure shares in 1991, 1996, and 2001. The remaining products in our sample still account for nearly 90 per cent of the consumption basket of total goods (excluding services). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Chart 6: Estimated marginal price effects, by sub-period, 2SLS estimates, 90% confidence band



Note: Standard errors are clustered by products. The square-root of household consumption expenditure shares in the initial year are used as weights. Expenditure shares are obtained from Statistics Canada Table 18-10-0007-0.

Some products may have particularly large increases in Chinese import share over time but they may also have different trends in inflation. For example, electronics such as computers are subject to a high degree of innovation in related technologies and very low inflation over time (even before the 2000s), potentially resulting in downward bias in our estimates. Hence, we report some robustness checks in Table 5, focusing on the 2001-2011 period. The results from the third column in Chart 6 are reproduced in Column 1 for comparison.

First, we estimate the equation excluding the top five products in terms of ΔVSH (see Table 2 for the top five products). Note that these top five products include digital computing equipment and devices, which exhibit an exceptionally large decline in their price over the 2001-2011 period while exhibiting the fastest growth in VSH among the CPI products in our sample. As shown in Column (2), the size of the coefficient decreases but remains negative and statistically significant.⁵⁶ Second, Column (3) controls for prior inflation and indicates that the Chinese impact tends to be smaller for products with higher average inflation prior to the period of a substantial increase in Chinese import shares.⁵⁷ The average price response to China is 10.8-per-cent lower ($1 - \frac{-0.249+0.027}{-0.249}$) if the prior inflation for a given product is one standard deviation higher. Lastly, we exclude the bottom five products in terms of inflation (or top five in terms of deflation) to examine whether our estimate is largely affected by products with a particularly large fall in prices.⁵⁸ Column (4) shows that the coefficient decreases but remains negative and statistically significant.

⁵⁶As discussed earlier, ICT-related products, such as computers, may be a source of endogeneity in our identification strategy as ICT innovations appear to be correlated across Canada and the eight advanced economies we have chosen. When we exclude only computer products from the sample, the coefficient becomes -0.238*** which indicates that failing to account for the common ICT shock potentially leads to a downward bias. As a further check, we estimate an equation where ΔVSH and its instrument are interacted with a dummy indicating ICT-related products. We find that the marginal price effect for ICT-related products is twice as large as that for non-ICT-related products (-0.433*** vs. -0.208***). The difference is statistically significant.

⁵⁷Prior inflation is defined as the average inflation over the 1991-2001 period, standardized by its standard deviation.

⁵⁸Note that only two products overlap with the top five products in terms of ΔVSH .

We conclude from these checks that our estimate is fairly robust. That is, the marginal price response to a one-percentage-point-increase in the Chinese import share is negative and remains between -0.2 and -0.3 percentage points.

It is reassuring to find that our estimate is consistent with the estimates from the literature on quantitative trade models. Although there are some variations in the estimate of trade elasticity (*i.e.* σ in equation 1a in Appendix A), the consensus in the literature appears to be $\sigma \approx 4$ or $\frac{1}{1-\sigma} \approx -0.3$ which is similar in magnitude to our estimate of -0.299 in the third column of Chart 6.⁵⁹ Our finding deviates largely from Jaravel and Sager (2018) in which the authors estimate $\frac{1}{1-\sigma} \approx -3$. The authors reconcile their large estimate by suggesting that their estimate is based on very disaggregated data and hence, is likely to be larger than the estimate based on more aggregated sectors in quantitative trade models (attenuation bias). Note that our estimate is based on much more aggregated product level data than Jaravel and Sager (2018) in which very detailed-level micro data are exploited.

Table 5: The effect of Chinese imports on Canadian CPI for consumer goods, Robustness checks, 2001-2011, 2SLS estimates

	Dependent variable: Average annual inflation			
	(1) Full sample	(2) Top 5 Δ VSH	(3) Prior inflation	(4) Bottom5 Δ P
Δ VSH	-0.299*** (0.062)	-0.257*** (0.054)	-0.249*** (0.047)	-0.204*** (0.043)
Δ VSH x Prior Inflation	-	-	0.027** (0.013)	-
Prior Inflation	-	-	-0.003 (0.005)	-
Constant	0.032*** (0.006)	0.031*** (0.006)	0.032*** (0.007)	0.030*** (0.005)
Obs.	79	74	79	74
First-stage F Statistics	117.2	37.0	376.1	76.1

Note: Standard errors are clustered by products. The square-root of household consumption expenditure shares in the initial year are used as weights. Expenditure shares are obtained from Statistics Canada Table 18-10-0007-0. For each column, we should have 93 observations. However, some CPI products are excluded from our estimation samples since they have missing information for CPI or Δ VSH or Δ VSHE or household expenditure shares or some combination of the four. Top five products in Δ VSH include digital computing equipment and devices, bedding and other household textiles, upholstered furniture, video equipment, and non-electric kitchen utensils, tableware and cookware. Bottom five in Δ P (or Top five in deflation) products in deflation are digital computing equipment and devices, video equipment, photographic equipment and supplies, audio equipment, and other recreational equipment. Prior inflation is defined as the average inflation over the 1991-2001 period, standardized by its standard deviation. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

A non-negligible portion of trade with China is in intermediate goods and such trade flows can, in theory, be another channel through which trade can affect consumer prices. Note that the share of intermediate goods in total Chinese exports to Canada increased from 26.9 per cent to 33.8 percent between 2000 and 2017.⁶⁰ We examine this issue in Appendix B.

⁵⁹In general, our estimated coefficients range from -0.2 to -0.3.

⁶⁰Source: Statistics Canada Table 12-10-0090-01.

2. Contextualizing the results

We compute the implied change in annual inflation for household consumption goods by multiplying the estimated coefficient from Column (6) in Table 4 by the median increase in $VSH(0.022)$ for the 2001-2011 period.⁶¹ This quantity is then discounted by the R-squared from the first-stage regression to capture the portion explained by exogenous trade shocks related to China. We estimate that the annual inflation for household consumption goods included in our sample would have been higher by 0.280 percentage points (or 0.238 percentage points for all goods in the CPI or 0.116 percentage points for the total CPI) had there been no change in the Chinese share of total imports in Canada over the 2001-2011 period.⁶² The average annual inflation for the total CPI was 2.1 per cent over the 2001-2011 period, implying that the annual inflation would have been about 6 per cent higher (or 0.12 percentage-points) with no increase in Chinese import shares.⁶³

Our estimate of the implied effect is aligned with the findings in the literature. Jaravel and Sager (2018) estimate the effect of rising Chinese import penetration on the U.S. consumer prices to be -0.281 percentage points per year on average.⁶⁴ Following a slightly different specification for the estimating equation and using a different subset of the micro data used by Jaravel and Sager (2018), Bai and Stumpner (2017) estimate that the effect on the U.S. consumer prices to be -0.284 percentage points per year on average.⁶⁵

Table 6 reports implied price effects of China, focusing on selected individual CPI products in our sample. Trade-induced price declines are large for products in clothing, textiles, electronics and furniture. Also, note that the household expenditure share for those products is non-negligible. In 2001, Canadian households spent 17.6 per cent of their total expenditure related to goods on the ten product classes reported in Table 6. For example, on average, the consumer price for clothing would have increased by 1.46 per cent annually over the 2001-2011 period instead of falling by 1.71 per cent had there been no increase in imports from China. In 2001, Canadian households devoted 9.1 per cent of their expenditure related to goods on clothing.

⁶¹We choose to use median instead of mean as the distribution of ΔVSH is highly skewed. We also tried using the weighted mean of $\Delta VSH(0.0296)$ with weights being the expenditure shares. With the weighted mean, the implied effect on $\Delta Price$ for the consumer goods in our sample is estimated to be -0.368 percentage points per year or -0.313 percentage points per year for all consumer goods in the CPI – -0.368 multiplied by 0.85 which is the expenditure share for the goods included in our sample. A very similar implied effect is found when we aggregate the product-specific actual changes in VSH based on expenditure weights.

⁶²To get the implied effect on all consumer goods in the CPI, we multiply -0.280 by the household expenditure share for the goods included in our sample. We use the initial expenditure share (the share in 2001) which is 85.0 per cent (See footnote 22). Hence, we have the following: $-0.280 * 0.85 = -0.238$. For the total CPI, the initial expenditure share is 0.415 and hence, we have $-0.116 (-0.280 * 0.415)$.

⁶³Note that the implied effect is calculated without factoring in general equilibrium effects such as monetary policy responses or changes in the consumption patterns. In response to changing prices, the policy rate would have been set to achieve the target inflation of 2 per cent in Canada (starting in 1991). Also, Canadian households could have changed their spending patterns as more Chinese imports become available. Hence, we expect to see some changes in quantity weights in the CPI.

⁶⁴Using their estimate, we have that $\frac{-1.97 \text{ \%pt. over } 2000-2007}{2007-2000} = -0.281$. Their estimated coefficient is much larger than ours but the actual increase of their measure of Chinese import penetration is much smaller than the increase observed in our data, resulting in a similar implied effect on average annual inflation.

⁶⁵We annualize their implied effect as follows: $\frac{-2.27 \text{ \%pt. over } 2004-2012}{2012-2004} = -0.284$.

The Chinese import share increased the most in digital computing equipment and devices between 2001 and 2011. However, the relative importance of China in explaining its actual price decline is the smallest among the ten product categories in Table 2. On average, about 32 per cent of the actual annual price fall for digital computing equipment and devices was due to increasing Chinese imports in Canada over the 2001-2011 period. A similar pattern is observed for other electronics products such as audio and video equipment. The relative importance of Chinese imports in Δ Price for them tends to be smaller than other products. One potential explanation is that a significant portion of the price fall in electronics products may be explained by a high degree of innovation in ICT related to them over the 2001-2011 period.

Table 6: Trade-induced annual price changes, per cent, Selected CPI products, 2001-2011, Canada

Top ten product categories in Table 2	Trade-induced	Actual	Counterfactual	Expenditure share
Digital computing equipment and devices	-4.82	-14.98	-10.16	1.90
Bedding and other household textiles	-4.13	-0.55	3.58	0.50
Upholstered furniture	-3.95	-0.83	3.12	1.20
Video equipment	-3.58	-8.62	-5.04	1.09
Non-electric kitchen utensils, tableware and cookware	-3.40	-1.80	1.60	0.36
Window coverings	-3.34	2.37	5.72	0.29
Clothing	-3.16	-1.71	1.46	9.09
Audio equipment	-2.95	-4.83	-1.89	0.52
Other personal care supplies and equipment	-2.62	0.53	3.15	0.57
Footwear	-2.58	-0.77	1.81	2.13

Note: Author's calculations based on the estimates in Table 4 and CPI data published by Statistics Canada (Table 18-10-0005-01). Trade-induced price change is computed by multiplying the actual change in *VSH* by the estimated coefficient, scaled by the *R* squared in the first-stage regression. Actual is the average annual price change based on CPI data published by Statistics Canada. Counterfactual price change is computed as actual minus trade-induced change. Expenditure share is defined as the share in total household expenditure on goods (excluding services) in 2001.

We now turn to implied effects at the aggregate level and relate them to the aggregate job loss in manufacturing due to increasing Chinese import competition. Table 7 reports the actual cumulative inflation for all consumer goods in the CPI over the 2001-2011 period and the counterfactual inflation implied by the estimates based on our baseline specification (Column 6 in Table 4). The cumulative inflation for all consumer goods in the CPI over the 2001-2011 period was 17.60 per cent and it would have been 2.41 percentage point higher (20.01 per cent) had the Chinese share in total imports in Canada remained at the 2001 level. For the total CPI, we find that the cumulative inflation would have been 26.85 per cent instead of 25.68 per cent (higher by 1.17 percentage point) had there been no change in the Chinese share of total imports in Canada.⁶⁶

⁶⁶This is calculated by multiplying the implied effect on annual inflation for the goods included in our sample (-0.280 percentage point) by their expenditure share in the total CPI (0.415), which is -0.116 percentage point per year – see footnote 22. Then, using this quantity, we compute the counterfactual cumulative inflation for the total CPI over the 2001-2011 period.

To assess the gain in terms of dollars, we compute the counterfactual expenditure on final household consumption goods by multiplying annual expenditure by $(1 + \hat{\pi})$ where $\hat{\pi}$ represents the difference between the counterfactual and actual annual inflation for the consumer goods in the CPI. We define the annual gain as the difference between counterfactual and actual expenditure, which represents the additional money Canadian households would have had to spend on goods due to higher prices.⁶⁷

Table 7: Implied effects of Chinese imports, Cumulative over 2001-2011

Panel A: Cumulative inflation on all consumer goods in CPI	
Actual cumulative inflation	17.60%
Counterfactual cumulative inflation	20.01%
Counterfactual - Actual	2.41% pt.
Panel B: Implied gain from trade with China, in 2002 CAD	
Total gain	\$8.74 billion CAD
# of manufacturing job loss due to China	113,500
Gain per job loss	\$76,996

Note: Author's calculations based on the baseline estimates and Statistics Canada Table 36-10-0222-01 and 18-10-0005-01.

Over the 2001-2011 period, the cumulative gain amounts to \$8.74 billion CAD. To contextualize this quantity, we note that the total employment in Canada was roughly 16 million on average over the 2001-2011 period, implying the total direct welfare gain of \$546 CAD per worker (or \$55 CAD per worker per year) over this period.

We also examine the gain relative to the number of jobs lost in manufacturing due to China. Kim (2018a) estimates that 113,500 jobs were lost between 2001 and 2011 due to increasing import competition from China. This implies a gain of \$76,996 CAD per job loss in manufacturing ($\frac{\$8.74 \text{ billion CAD}}{113,500}$). Given that the average annual earning for workers in manufacturing was \$42,868 CAD (in 2002 dollars) over the 2001-2011 period⁶⁸, this appears to be sufficient to compensate an average manufacturing worker that loses his or her job for lost earnings and/or for training and other financial costs associated with re-employment.

The expected complete duration of unemployment in Canadian manufacturing ranges from 11.3 weeks to 12.0 weeks (adjusted for age and gender) in 2000, 2004 and 2008 (see Bernard, 2009). As an *illustrative* example, if we assume that each of the 113,500 unemployed workers in manufacturing remained unemployed for 12 weeks until they were re-employed in jobs with the same salary as before, then the cumulative lost earnings are \$42,868 CAD * (12/52) = \$9,893 CAD per displaced manufacturing worker or \$1.12 billion CAD for all 113,500 displaced manufacturing workers over the 2001-2011 period.

To obtain a rough benchmark for the cost of training, we look at the Canada-Ontario Job Grant (COJG), an Ontario government funding program that offers grants to employers for

⁶⁷The gain is converted to constant 2002 dollars using CPI for household consumption goods.

⁶⁸Data are based on gross payroll before source deductions (*i.e.* CPP, EI, and federal/provincial or territory income tax). Source: Statistics Canada Data Table 14-10-0204-01.

training their workers. Eligible training expenses vary by firm size, ranging from \$10,000 to \$15,000 per trainee. Although the program is for those who are currently employed, the numbers provide us with a benchmark for how much the government is currently spending per worker to support job training in Ontario.⁶⁹ Second Career, a provincial government program that provides financial support for unemployed workers in Ontario who need new skills for re-employment, provides up to \$28,000 to cover the costs of tuition, books, manuals, transportation, basic living allowance and childcare.

Our analysis indicates that the cumulative gain is likely to outweigh the cumulative loss from trade with China, implying that trade with China can, in theory, lead to a Pareto improvement (making at least one person better off without making any other person worse off through redistribution). It is important to note that the losses are concentrated in a subset of the Canadian population (manufacturing workers) while the gains are widely dispersed across consumers in the form of higher purchasing power. This observation provides support for compensation programs and other policies that redistribute the gains from trade.

It is worth emphasizing that this assessment is intended to serve as a benchmark. It is based on the assumption that all displaced workers are able to quickly find jobs offering the same salary. In reality, this is unlikely to be true for all unemployed workers.

VI. Conclusion

Canadian consumers purchased an increasing amount of Chinese goods over the past two decades. This has had both negative and positive consequences in Canada. The rapid rise in Chinese imports seems to have negatively affected employment in Canadian manufacturing. But it has also led to lower prices for some consumer goods, especially textiles, clothing, furniture and electronics. Consumers devote a significant share of their total spending on these items.

We estimate that a 1-percentage-point increase in the Chinese share in total imports of a given consumer product leads to a 0.221 percentage-point decline in its price annually, on average. This means that cumulative inflation between 2001 and 2011 for all consumer goods in the CPI would have been 2.41 percentage points higher (roughly 14 per cent of the actual cumulative inflation) had there been no change in the Chinese share in total imports in Canada.

We based our estimates on a sample of 79 CPI products covering 85 per cent of total household expenditure on goods. Some of the price decline for final consumption goods is driven by increasing imports of intermediates from China. However, this impact is potentially small and we have not included it in our overall estimate.

⁶⁹In 2001, Ontario accounted for 51.3 per cent of total manufacturing employment in Canada (see Table 18-1 in Kim, 2018a).

We conclude the report by suggesting some directions for future research. First, our report focuses on the overall effect of imported China goods on consumer prices in Canada. However, these price effects may have distributional implications if the spending pattern of consumers differs significantly by income group. That is, the group that spends proportionally more on final goods in which the Chinese import share increased rapidly or on final goods that rely heavily on imported intermediate inputs may reap greater purchasing-power benefits from trade.

The implication for distributional effects is mixed in the literature. Recent work shows that high- and low-income households in the United States have similar spending shares for imports, both in total and from China specifically (*e.g.* Borusyak and Jaravel, 2017; Hottman and Monarch, 2018). This suggests that the expenditure channel of trade could be neutral in terms of distribution. Using barcode-level data, Bai and Stumpner (2017) find no statistical evidence for differential price effects across income groups in the United States. However, using similar data for the United States, Broda and Romalis (2008) found that in response to an increase in Chinese imports, low-income households experienced a larger decline in prices for non-durable goods than high-income households. In contrast, Jaravel and Sagel (2018) find that, in the United States, the price response was greater in product categories that cater more to highly-educated households, suggesting high-income groups benefit more from trade. Similarly, Faber (2014) finds that high-income households benefited more from increasing trade than low-income households after Mexico joined Canada and the United States in the North American Free Trade Agreement.

More work is needed to identify true trade shocks. A price drop for a given product may be caused by increasing imports from China. But it could also be caused by technological progress or some combination of technology and increasing imports. The two appear to be interrelated. It is possible that increasing trade with China induces domestic manufacturers to adopt advanced technologies, such as computers and robots. The manufacturers may be driven by competition or because cheaper intermediates for those technologies become available with imports from China. Indeed, the share of U.S. firms that purchase computers or use electronic networks to control shipments started to increase rapidly from the early 2000s (see Figure 2 in Fort, Pierce, and Schott, 2018). Also, Bloom, Draca, and Van Reenen (2013) find that European firms spent more resources on R&D and on adopting advanced technologies in response to increasing Chinese import competition. Hence, identifying true trade shocks appears to be quite tricky. A better empirical strategy should be explored.

References

- Acemoglu, Daron, David H. Autor, David Dorn, Gordon H. Hanson, and Brendan Price (2016) "Import Competition and the Great US Employment Sag of the 2000s," *Journal of Labor Economics*, Vol. 34, No. S1, Part 2, pp. S141-S198
- Anderson, James E. (1979), "A Theoretical Foundation for the Gravity Equation." *American Economic Review*. Vol. 69, No.1, pp.106–16.
- Autor, David H., David Dorn and Gordon H. Hanson (2013) "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," *American Economic Review*, Vol. 103, No. 6, pp. 2121-2168
- Autor, David H., David Dorn and Gordon H. Hanson (2016) "The China Shock: Learning from Labor-Market Adjustment to Large Changes in Trade," *Annual Review of Economics*, Vol. 8, No. 1, pp. 205-240
- Arkolakis, Costas, Arnaud Costinot, and Andres Rodriguez-Clare (2012), "New trade models, same old gains?" *American Economic Review*, Vol.102, No.1, pp.94-130.
- Armington, Paul. S. (1969): "A Theory of Demand for Products Distinguished by Place of Production," *International Monetary Fund Staff Papers*, No.16, pp.159–178.
- Bai, Liang and Sebastian Stumpner (2017), "Estimating the Price Effects of Globalization: The Case of US Imports from China," mimeo
- Balsvik, Ragnhild, Sissel Jensen, and Kjell G. Salvanes (2015) "Made in China, Sold in Norway: Local Labour Market Effects of an Import Shock," *Journal of Public Economics*, Vol. 127, pp. 137-144
- Bernard, Andrew, Bradford Jensen, and Peter Schott (2002), "Survival of the Best Fit: Competition from Low Wage Countries and the (Uneven) Growth of U.S. Manufacturing Plants," *NBER Working Paper*, September, No.9170
- Bernard, Andre (2009), "Job Stability and Unemployment Duration in Manufacturing," *Statistics Canada*, Catalogue No.75-001-X.
- Bloom, Nicholas, Mirko Draca, and John Van Reenen (2016), "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity," *Review of Economic Studies*, Vol. 83, pp. 87-117
- Borusyak, Kirill and Xavier Jaravel (2017), "The Distributional Effects of Trade: Theory and Evidence from the United States," mimeo
- Broda, Christian and John Romalis (2008), "Inequality and Prices: Does China Benefit the Poor in America?" mimeo, University of Chicago.

- Burstein, Ariel and Jonathan Vogel (2017), "International Trade, Technology, and the Skill Premium," *Journal of Political Economy*, Vol.125, No.5, pp.1356-1412.
- Cravino, Javier and Sebastian Sotelo (2017), "Trade Induced Structural Change and the Skill Premium," *NBER Working Paper*, June, No. 23503
- Eaton, Jonathan and Samuel Kortum (2002), "Technology, geography, and trade," *Econometrica*, Vol.70, No.5, pp.1741-1779.
- Faber, Benjamin (2014), "Trade Liberalization, The Price of Quality, and Inequality: Evidence from Mexican Store Prices," mimeo, UC Berkeley.
- Fort, Teresa, Justin Pierce, and Peter Schott (2018), "New Perspectives on the Decline of U.S. Manufacturing Employment," *Journal of Economic Perspectives*, Vol. 32, No.2, pp.47-72.
- Goldsmith-Pinkham, Paul, Isaac Sorkin, and Henry Swift (2018), "Bartik Instruments: What, When, and How," National Bureau of Economic Research, Working Paper 24408, March 2018
- Hottman, Colin and Ryan Monarch (2018), "Estimating Unequal Gains across U.S. Consumers with Supplier Trade Data," *Board of Governors of the Federal Reserve System, International Finance Discussion Papers*, No. 1220.
- Hwang, Kyung-In (2016), "Tariffs, Intermediaries and Consumer Prices," mimeo, University of Nottingham.
- Jaravel, Xavier and Erick Sager (2018), "What are the Price Effects of Trade? Evidence from the U.S. and Implications for Quantitative Trade Models," mimeo
- Kim, Myeongwan (2018a) "Rising Import Competition in Canada and its Employment Effect by Skill Group: Evidence from the 'China shock'," CSLS Research Report 2018-02, August.
<http://www.csls.ca/reports/csls2018-02.pdf>.
- (2018b) "Rising Import Competition in Canada and its Employment Effect by Gender: Evidence from the 'China shock'," CSLS Research Report 2018-03, August.
<http://www.csls.ca/reports/csls2018-03.pdf>.
- (forthcoming) "Trade-induced Innovation: Measuring the impact of Chinese import competition on innovation in Canadian manufacturing using firm-level data," forthcoming as a CSLS Research Report
- Krugman, Paul. (1980). "Scale Economies, Product Differentiation, and the Pattern of Trade." *American Economic Review*, Vol.70, No.5, pp.950–959.
- Melitz, Marc J. (2003). "The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity," *Econometrica*, Vol.71. No.6, pp.1695–1725.

Morel, Louis. (2007). "The Direct Effect of China on Canadian Consumer Prices: An Empirical Assessment." Bank of Canada, Staff Discussion Paper 2007-10, September 2007
<https://www.bankofcanada.ca/2007/09/discussion-paper-2007-10/>

Murray, Alexander (2017) "The Effect of Import Competition on Employment in Canada: Evidence from the 'China Shock'," CSLS Research Report 2017-03, July.

Appendix A

1. Theoretical motivation

The welfare prediction of a dominant class of trade model in the literature depends on two sufficient statistics: 1. the share of expenditure on domestic goods; 2. an elasticity of imports with respect to variable trade costs, often referred to as the trade elasticity. The change in real income ($\widehat{W} \equiv \Delta W/W$) driven by any foreign shock can be related to the change in the share of expenditure on domestically produced goods ($\hat{\lambda} \equiv \Delta \lambda/\lambda$):

$$(1a) \quad \widehat{W} = \hat{\lambda}^{1/(1-\sigma)}$$

where $(1 - \sigma) < 0$ is the trade elasticity.

We rely on a very simple trade model to illustrate the derivation of Equation (1a) – the Armington model (Armington, 1969).⁷⁰ Assume each country i produces a differentiated good one-to-one from their labour (L_i) which is inelastically supplied. Also, assume that a representative household in each country maximizes the following Dixit-Stiglitz utility function:

$$(2a) \quad U_j = \left[\sum_{i=1}^n q_{ij}^{(\sigma-1)/\sigma} \right]^{\sigma/(\sigma-1)}$$

where q_{ij} is the quantity of country i 's goods consumed by country j and $\sigma > 1$ is the elasticity of substitution between goods.

The price index in country j is expressed as follows:

$$(3a) \quad P_j = \left[\sum_{i=1}^n (w_i c_{ij})^{1-\sigma} \right]^{1/(1-\sigma)}$$

where w_i is the wage in country i and $c_{ij} \geq 1$ is the variable trade costs between country i and country j .

Total expenditure of country j on imports from country i is given by:

$$(4a) \quad X_{ij} = \left(\frac{w_i c_{ij}}{P_j} \right)^{1-\sigma} Y_j$$

⁷⁰We rely on the most basic trade model as it is convenient for us show important implications we would like to draw for our analysis. Arkolakis *et al.* (2012) introduce a large class of trade models such as Anderson (1979), Eaton and Kortum (2002), Krugman (1980), and Melitz (2003). These models tend to show the same implication for the relationship described in equation (1a) and hence, our reduced-form equation. That is, the welfare effect of a foreign shock can be summarized by the change in the share of expenditure on domestically-produced goods.

where $Y_j = \sum_{i=1}^n X_{ij}$ is total expenditure in country j and $1 - \sigma < 0$ is the partial elasticity of the expenditure on imports relative to that on domestically-produced goods (*i.e.* relative imports) with respect to variable trade costs. That is, $1 - \sigma = \partial \ln \left(\frac{X_{ij}}{X_{jj}} \right) / \partial \ln (c_{ij})$.

With trade balance, we have $Y_j = w_j L_j$. Now, if there is an external shock for country j affecting labour endowments and trade costs in all other countries except for its own, the change in real income, $W_j \equiv Y_j / P_j$ can be derived as follows. First, taking wage in country j as numeraire and noting that trade balance implies $Y_j = w_j L_j$, we have $d \ln(Y_j) = 0$. Then, changes in real income are given by:

$$(5a) \quad d \ln(W_j) = - \sum_{i=1}^n \lambda_{ij} (d \ln(w_i) + d \ln(c_{ij}))$$

where $\lambda_{ij} = X_{ij} / Y_j$.

Now, with Equation (4a), changes in relative imports are given by:

$$(6a) \quad d \ln(\lambda_{ij}) - d \ln(\lambda_{jj}) = (1 - \sigma)(d \ln(w_i) - d \ln(c_{ij}))$$

Equation (5a) and Equation (6a) imply the following relationship:

$$(7a) \quad d \ln(W_j) = \sum_{i=1}^n \lambda_{ij} (d \ln(\lambda_{jj}) - d \ln(\lambda_{ij})) / (1 - \sigma) = d \ln(\lambda_{jj}) / (1 - \sigma)$$

where the second equality is obtained by noting that $\sum_{i=1}^n \lambda_{ij} = 1$.

Combined with the initial equilibrium and the new equilibrium after the shock, we obtain:

$$(8a) \quad \widehat{W}_j = \widehat{\lambda}_{jj}^{1/(1-\sigma)}$$

where the hat denotes the change in the corresponding variable between the initial and the new equilibrium.

2. Reduced-form equation

In our empirical analysis, we derive an equivalent expression for Equation (8a) from a multi-sector model since we run regressions across sectors (or products). From a multi-sector version of Equation (1a), we derive a reduced-form equation for econometrics estimation. We denote product classes by subscript k . By taking the domestic wage as numeraire, welfare (or real income) in the class of trade model discussed above is the inverse of the domestic price index. That is, welfare increases as the domestic price index decreases in response to a lower share of expenditure on domestically produced goods due to a trade shock:

$$(9a) \quad \Delta \ln (P_k) = - \frac{1}{1-\sigma_k} \Delta \ln (\lambda_k)$$

Introducing inflation shocks – both common and product-specific:

$$(9a') \Delta \ln (P_k) = \alpha - \frac{1}{1-\sigma_k} \Delta \ln(\lambda_k) + \mu_k$$

where P is the domestic price index.

Note that λ is one minus the import penetration ratio (IP). Therefore, Equation (9a') can be re-written as:

$$(10a) \Delta \ln (P_k) = \alpha - \frac{1}{1-\sigma_k} \Delta \ln (1 - IP_k) + \mu_k$$

$$\approx \alpha + \frac{1}{1 - \sigma_k} \Delta IP_k + \mu_k$$

where $\Delta \ln(1 - IP_k) \approx -\Delta IP_k$.⁷¹

The above reduced-form equation motivates our estimating equation as in equation (1) in the main text. Note that $1/(1 - \sigma_k)$ from the multi-sector version is analogous to $1/(1 - \sigma)$ in Equation (8a). $1/(1 - \sigma_k)$ from the multi-sector model represents varying σ_k across sectors (or products) whereas $1/(1 - \sigma)$ from the one-sector model represents the entire economy. We weight each product by its expenditure share. Hence, $1/(1 - \sigma_k)$ estimated by our regression equation would be an average expenditure-weighted $1/(1 - \sigma_k)$ across products.

⁷¹The approximation is better if the value of IP is small in the initial period.

Appendix B

As cheaper Chinese intermediate goods become available, the cost of producing product k across Canadian industries could decline or increase less rapidly, affecting the consumer price of product k .⁷² Therefore, we explicitly quantify the degree of import penetration for intermediate goods relevant for product k and include it in Equation (1) as a control variable.

For the empirical analysis on this issue, we rely on import penetration ratios as described in section IV instead of the value share approach.⁷³ We exploit input-output relationships available in a detailed-level input-output table published by Statistics Canada. After computing a symmetrical industry-by-industry requirement table, we first construct a measure of import penetration in intermediates defined at the 4-digit NAICS industry level as follows:

$$(11a) \Delta IPII_{m,\tau} \equiv \sum_{n=1}^N \frac{b_{m,n,\tau_0}}{b_{m\tau_0}} \Delta IP_{n,\tau}$$

where $b_{m\tau_0}$ is the gross output of 4-digit NAICS industry m and b_{m,n,τ_0} is the value of industry n 's gross output purchased as input by industry m at the start of period τ . $\Delta IP_{n,\tau}$ is the change in Chinese import penetration in industry n over τ .⁷⁴ Therefore, $\Delta IPII_{m,\tau}$ is a weighted average in import exposure changes experienced by industry m 's suppliers.⁷⁵

Next, we define $\Delta IPII$ at the product level as follows:

$$(11a') \Delta IPII_{k,\tau} \equiv \sum_{m=1}^M \frac{y_{m,k,\tau_0}}{y_{k,\tau_0}} \Delta IPII_{m,\tau}$$

where y_{m,k,τ_0} is the output value of product k produced by industry m and y_{k,τ_0} is the total output of product k .⁷⁶ Thus, $\Delta IPII_{k,\tau}$ is a weighted average in import exposure changes experienced by the suppliers of the industries that produce product k .

⁷²Industries could either substitute domestically-produced intermediates with cheaper Chinese intermediates or obtain access to cheaper domestically-produced intermediates as domestic intermediate producers reduce markups in response to increasing Chinese import competition.

⁷³The reason is that we need to map I-O commodities not only to CPI products but also to HS commodities in order to construct $\Delta IPII$ based on ΔVSH as in equation (11a) and (11a'). Since there is very limited information for us to construct such mappings, we did not pursue this approach.

⁷⁴We normalize the change in Chinese imports to Canada by dividing it by the 1997 domestic absorption. We choose 1997 for normalization since we rely on the 1997 I-O table to establish initial I-O linkages. See section II-3 for more detail.

⁷⁵It is also possible to directly construct a commodity-by-commodity requirement table but this would make it necessary to construct concordance between I-O commodities (all commodities including intermediates) and the HS commodities in trade data. Since there is no official concordance available or reliable source of information for us to construct the concordance between the two classification systems, we did not pursue this approach.

⁷⁶We compute the weights by constructing an industry-by-commodity market share table after mapping I-O commodities to product classes in CPI following the concordance we construct.

$\Delta IPII_{k,\tau}$ is used to assess the first-order effect on prices stemming from increasing trade exposure relevant for the intermediates to produce product k . It does not reflect further spillovers from increasing trade exposure faced by lower-level intermediates (*i.e.* intermediates used to produce the intermediates for product k). To account for the full chain of input-output linkages, we construct the following measure based on the Leontief inverse of the matrix of first-order linkages:

$$(12a) \Delta IPII_{m,\tau}^{full} \equiv (I - B)^{-1} \Delta IP_{n,\tau}$$

$$(12a') \Delta IPII_{k,\tau}^{full} \equiv \sum_{m=1}^M \frac{y_{m,k,\tau_0}}{y_{k,\tau_0}} \Delta IPII_{m,\tau}^{full}$$

where B is the matrix that contains $\frac{b_{m,n,\tau_0}}{b_{m\tau_0}}$ and I is the identity matrix.

Table A1 shows the results from including $\Delta IPII$ in our regressions equation, based on the stacked differences of two sub-periods: 1991-2001 and 2001-2011. For comparison, Column (1) reproduces the results from Column (3) in Table A2 in Appendix C. In all columns, we report 2SLS estimates, using as instruments the change in IP and $IPII$ in the eight other countries.

Table A1: Input-output linkage, Stacked differences, 1991-2011, Using import penetration ratio, 2SLS estimates

	Dependent variable: Average annual inflation		
	(1) Direct effect	(2) First-order linkage	(3) Full linkage
ΔIP	-0.453*** (0.209)	-0.265*** (0.103)	-0.094 (0.113)
$\Delta IPII$	-	-0.012*** (0.004)	-0.002*** (0.0003)
Obs.	139	139	139
First-stage F Statistics	114.3	86.7; 246.4	71.3; 68.4

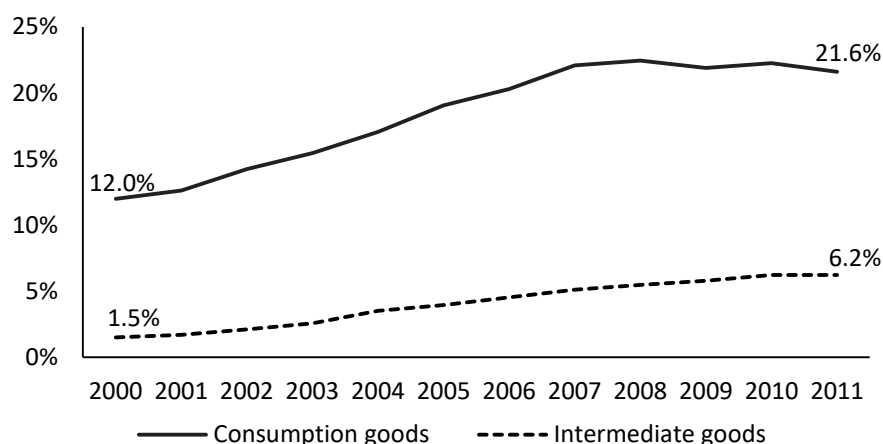
Note: In all columns, period-fixed effects are included but not reported. Standard errors are clustered by products. The square-root of household consumption expenditure shares in the initial year are used as weights. Expenditure shares are obtained from Statistics Canada Table 18-10-0007-0. For each column, we should have 154 observations (77x2) (See subsection 3 in Section II for more detail.) However, some CPI products are excluded from our estimation samples since they have missing information for CPI or ΔVSH or $\Delta VSHE$ or household expenditure shares or some combination of the four. All nominal are converted from U.S. dollars to Canadian dollars, using annual PPPs for PCE available from OECD. Then, they are deflated to chained 2007 Canadian dollars using the Canadian PCE deflator. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

We find evidence that trade exposure based on input-output linkages ($\Delta IPII$) plays a role in explaining annual changes in prices across consumer products in Canada. But the magnitude appears to be very small. Our result for the first-order effect (Column 2) indicates that a one-percentage-point increase in trade exposure of the intermediates to produce a given consumer product is associated with a 0.01-percentage-point decrease in the average annual inflation for that final product. When we include $\Delta IPII$, the coefficient for the direct effect becomes smaller than that reported in Column (1) but remains highly statistically significant. A small price effect

of ΔPII is also observed when we include the measure of full input-output linkage but the magnitude is much smaller and the direct effect loses its statistical significance.⁷⁷

Our results in Table A1 indicate that spillovers from intermediates do explain falling consumer prices but their magnitude is potentially minimal. This is consistent with the findings in Bai and Stumpner (2017). They find no evidence of the I-O linkage effect on consumer prices for the United States. The spillover effects stemmed from I-O linkages are potentially small on other outcome variables in Canada. For example, Murray (2017) finds no strong evidence that the I-O linkage effect is important in explaining employment growth in Canadian manufacturing.

Chart A1: The Chinese share in total imports by category, Canada, 2000-2011



Note: The data follow the Broad Economic Categories (BEC). Consumption goods in BEC include food and beverages (primary and processed for household consumption), transport equipment (non-industrial), and consumer goods not elsewhere specified. Intermediate goods include food and beverages (primary and processed for industry), industrial supplies not elsewhere specified (primary and processed), fuel and lubricants (primary and processed), parts and accessories of capital goods, and parts and accessories of transport equipment. Source: Statistics Canada Table 12-10-0090-01.

One potential explanation for the small spillover effect through I-O linkages (relative to the direct effect of trade exposure for final consumption goods) is that China is less important in the total imports of intermediate goods to Canada than in the total imports of final consumption goods. Chart A1 shows the Chinese share in total imports of intermediates and consumption goods in Canada. First, the Chinese share in total intermediate imports to Canada remained much lower than the country's share in total consumption goods imported (*e.g.* 1.5 per cent vs. 12.0 per cent in 2000). Moreover, the change in the Chinese share was smaller for intermediate goods. Between 2000 and 2011, the increase in the Chinese share of total intermediate imports stood at 4.7 percentage points while the increase in the share of imported consumption goods amounted to 9.6 percentage points.

⁷⁷As discussed in Acemoglu, Autor, Dorn, Hanson, and Price (2016) and Murray (2017), ΔP and ΔPII are highly correlated, resulting in a smaller or insignificant direct effect. As a solution, following Acemoglu *et al.* (2016), we include the sum of the direct and I-O linkage effect in the equation by imposing a restriction that the direct impact is the same as the I-O linkage effect. However, the coefficient on the combined effect remains negative and statistically significant but much smaller for both first-order and full linkage – not reported.

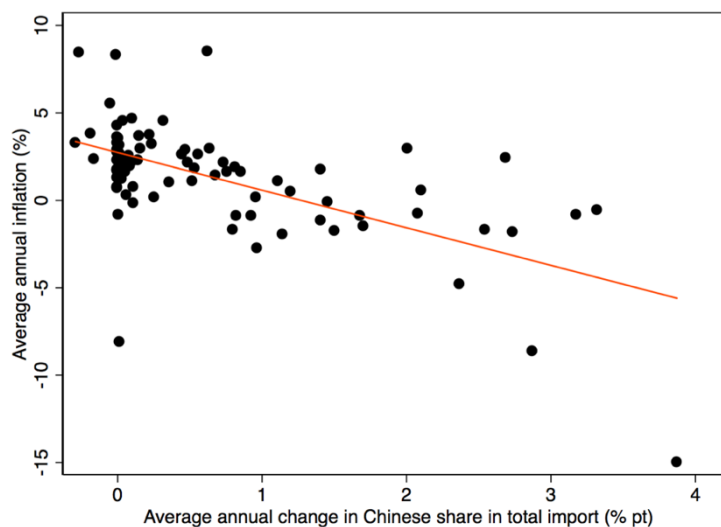
Appendix C

Table A2: The effect of Chinese imports on Canadian CPI for consumer goods, Using Import penetration ratio, Stacked differences, 2SLS estimates

	Dependent variable: Average annual inflation		
	(1) 1991-2017	(2) 1991-2007	(3) 1991-2011
ΔIP	-0.283*** (0.140)	-0.639*** (0.244)	-0.453*** (0.209)
Obs.	139	139	139
First-stage F Statistics	95.5	165.3	114.3

Note: In all columns, period-fixed effects are included but not reported. Standard errors are clustered by products. The square-root of household consumption expenditure shares in the initial year are used as weights. Expenditure shares are obtained from Statistics Canada Table 18-10-0007-0. For each column, we should have 154 observations (77x2) (See subsection 3 in Section II for more detail.) However, some CPI products are excluded from our estimation samples since they have missing information for CPI or ΔVSH or $\Delta VSHE$ or household expenditure shares or some combination of the four. All nominal are converted from U.S. dollars to Canadian dollars using annual PPPs for PCE available from OECD. Then, they are deflated to chained 2007 Canadian dollars using the Canadian PCE deflator. The instrument is the average annual change in imports from China in the eight advanced economies divided by the total Canadian market volume (*i.e.* domestic absorption) in that industry in 1997, scaled by 9.36 which is the ratio of the eight countries' combined GDP to Canadian GDP in 1997 at PPP. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Chart A2: Average annual inflation (per cent) and Average annual change in the Chinese share in total imports (percentage point), by product class in CPI, Canada, 2001-2011



Source: Author's calculation based on the United Nations Comtrade database after mapping CPI products to HS commodities.